

Ministry of Higher
Education and
Scientific Research



University of Babylon
College of Engineering
Civil Department

***RAPID ENVIRONMENTAL IMPACT
ASSESSMENT OF SOME INDUSTRIES IN
THE MIDDLE OF EUPHRATES REGION***

A Thesis

Submitted to The College of Engineering
of The University of Babylon in Partial
Fulfillment of The Requirements
for The Degree of Master
of Science in Civil
Engineering

By

HUDA MOHAMMAD SELMAN
B.Sc.2005

Supervised by

Asst. Prof. Dr. MOHAMMAD A.MUSLEM
Asst. Prof. Dr. JABAR HOMOD

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Shwal, 1429

تقييم سريع للأثر البيئي لبعض الصناعات في منطقة الفرات الأوسط

رسالة

مقدمة إلى كلية الهندسة في جامعة بابل

كجزء من متطلبات تخرج الماجستير في علوم

الهندسة المدنية

من قبل

هدى محمد سلمان الشمري

إشراف

د. محمد عبد مسلم الطفيلي

د. جبار حمود البيضاني

تشرين الأول 2008

شوال 1429

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

وَسَأَلُونَهُ عَنِ الرُّوحِ قُلِ الرُّوحُ
مِنْ أَمْرِ رَبِّي وَمَا أُوتِيتُمْ مِنَ الْعِلْمِ
إِلَّا قَلِيلًا

صَدَقَ اللَّهُ الْعَظِيمُ

سورة الإسراء / الآية (85)

الخلاصة

تم إنشاء وتطبيق قاعدة معلومات بيئية للأنشطة الصناعية في منطقة الفرات الأوسط (بابل – النجف – كربلاء). إنشاء نظام خبير لتقييم أحمال التلوث الصناعي على البيئة باستعمال طريقة تقييم الأثر البيئي السريع. النتائج البيئية قورنت مع محددات الصحة العالمية والمحددات العراقية لاقتراح الحلول المناسبة. ثم استعملت مصفوفة ليبولد لتقييم الأثر بواسطة تطبيق إجراء تقييم الأثر البيئي.

إن أعداد وأنواع الأنشطة الصناعية التي اختيرت في هذا البحث هي: (9) معامل النسيج, (1) معمل الصناعات الكيماوية, (4) معامل الطحين, (10) معامل الطابوق, (4) معامل السمنت, (1) معمل النورة, (3) معامل المشروبات الغازية, (1) محطة توليد الطاقة الكهربائية, (1) معمل المنتجات المطاطية, (7) معامل منتجات الألبان و(4) معامل الإسفلت.

أحمال تلوث الهواء والماء لتلك الأنشطة الصناعية حسبت بواسطة تقنية التقييم السريع, منظمة الصحة العالمية, 1993, تركيز ملوثات الهواء (الجزينات العالقة الكلية, ثنائي اوكسيد الكبريت, اكاسيد النيتروجين, المركبات العضوية المتطايرة, أحادي اوكسيد الكربون, الكلور, كلوريد الهيدروجين, ثالث اوكسيد الكبريت والفلور) وملوثات الماء (المتطلب البايوكيميائي للأوكسجين, المواد العالقة الكلية, النيتروجين, الفسفور, الزيوت, الكروم, النحاس, النيكل, الخارصين والزنبق) في الحالة التصميمية والحالية حسبت أيضا, ثم قورنت هذه التراكم مع محددات الصحة العالمية والمحددات العراقية. كل هذه الحسابات والمقارنات تم الحصول عليها بواسطة برنامج نظام خبير كتب بلغة فيجيوال بيسك 6.

أظهرت النتائج وجود نقص في أجهزة السيطرة على تلوث الهواء في كل المعامل التي شملتها هذه الدراسة. يوفر النظام الخبير للمستخدم كافة المعلومات المطلوبة لكل معمل (من معلومات عامة ومعلومات بيئية) والتي تساعد هذا المستخدم في عمليات تقدير الأثر البيئي. كل معامل الطابوق والأسمنت التي تقع في منطقة الفرات الأوسط تبعث كمية كبيرة من الملوثات مثل الجزينات العالقة, اكاسيد النيتروجين, المواد المتطايرة, ثنائي اوكسيد الكربون, اوكسيد الكبريت والفلور. اكبر نسبة للجزينات العالقة الكلية في منطقة الفرات الأوسط 50% تنبعث من صناعة الاسمنت في محافظة النجف. مصدر تلوث الهواء في صناعة الاسمنت هو غبار الفرن وطحن المواد الأولية. اكبر نسبة لثنائي اوكسيد الكبريت في منطقة الفرات الأوسط 63% تنبعث من صناعة الطابوق في محافظة بابل. يعود ذلك إلى عدة أسباب منها استعمال أساليب قديمة في الصناعة (كإضافة الوقود يدويا) والتي تزيد من كميات الملوثات المنبعثة واستعمال

النفط الأسود كوقود والذي يمتاز بنسبة عالية من الكبريت . اكبر نسبة للمتطلب البايوكيميائي للأوكسجين 99% تنتج من صناعة النسيج في محافظة بابل. المخلفات الناتجة من عملية التنظيف تساهم بالحصّة الأكبر من المتطلب البايوكيميائي للأوكسجين أثناء عمليات التحضير. اكبر نسبة للمواد العالقة الكلية في منطقة الفرات الأوسط 81% تنبعث من محطة الكهرباء في محافظة بابل والتي تنتج من تنظيف المدخنة وأجهزة المحطة. الشركة العامة للصناعات الكيماوية في مدينة السدة تطرح الزئبق بكمية غير قليلة (36 ملغم/ لتر) وتلوث المنطقة المحيطة.

Abstract

An environmental database for industrial activities in the middle Euphrates region at: Babylon, Al-Najaf and Kerbela governorates was constructed and applied. An expert system was constructed to evaluate the industrial pollution loads on the environment using Rapid Environmental Impact Assessment tool. The results were compared with the WHO and Iraqi standards to determine pollution extend and suggest suitable solutions. Then Leopold matrix method was used to assess impact by applying EIA procedure.

The numbers and types of industrial activities that selected in this research were: (9) textile factories, (1) chemical industries factory, (4) grain mill factories, (10) bricks factories, (4) cement factories, (1) lime factory, (3) soft drink factories, (1) power station, (1) rubber products factory, (7) dairy products factories and (4) asphalt factories.

The loads of air and liquid pollution of these industrial activities were calculated by applying Rapid Assessment Inventory Techniques which dependent by WHO, 1993. The concentration of air pollutants like (TSP, SO₂, NO_x, VOC, CO, Cl₂, HCL, SO₃ and F₂) and liquid pollutants like (BOD₅, TSS, Tot N, Tot P, Oil, Cr, Cu, Ni, Zn and Hg) in design and working state were calculated too. Comparison was made with these concentrations of WHO and Iraqi limits. All these calculations and comparisons were obtained by expert system program written by visual basic 6.0 language.

The results of this study indicate that there is a lack of air pollution control equipment in the middle of Euphrates region. The expert system gives the users all necessary information for each factory which help in the process EIA system . All bricks and cement factories which are located in the study area are emitting high quantity of pollutants TSP, NO_x, VOC, CO, SO₂, and F₂.

The Maximum percent of TSP load in the middle Euphrates region was 50% emitted from cement factory in Al-Najaf governorate. The sources of air emission in the cement industry are the kiln dusts and raw material grinding. The Maximum percent of SO₂ load in the middle Euphrates region was 63% emitted from bricks industry in Babylon governorate. This is due to different reasons such as the use of old technique in the manufacturing process which increases the quantity of pollutants, and the use of fuel oil as a fuel type which contains high percentage of sulfide. The maximum percent of BOD₅ load in the middle Euphrates region was 98% results from textile industry in Babylon governorate scouring wastes contribute a large portion of biological oxygen demand (BOD₅) loads from preparation processes. The maximum percent of TSS in the middle Euphrates region was 81% results from power plant station in Babylon governorate which results from cleaning stack gases and power plant equipments. General company for chemical industries in Al Sadda city release mercury (Hg) in amount which considered to be not small of (36 mg/l) that makes pollution of the surrounding area.

CERTIFICATION

We certify that the preparation of this thesis entitled “***Rapid Environmental Impact Assessment of Some Industries in the Middle of Euphrates Region***” was prepared by “***Huda Mohammad Selman***” under our supervision at Babylon University, College of Engineering in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering / Environmental Engineering.

Signature

Name : Asst. Prof. Dr. Mohammad A.M. Al-Tufaily (Supervisor)

Date : / / 2008

Signature

Name : Asst. Prof. Dr. Jabbar H. Al-Baidhani (Supervisor)

Date : / / 2008

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Signature

Name :

Asst. Prof. Dr. Alaa H. Wadi Al-Fatlawi
(Member)

Date : / / 2008

Signature

Name :

Asst. Prof. Dr. Muhannad J. Al-Kazwini
(Chairman)

Date : / / 2008

Signature

Name :

Asst. Prof. Dr. Mohammad A.M. Al-Tufaily
(Supervisor)

Date : / / 2008

Approval of the Civil Engineering Department.
Head of the Civil Engineering Department.

Signature

Name : Asst. Prof. Dr. Ammar Y. Ali

Date : / / 2008

Approval of the Deanery of the College of Engineering.
Dean of the College of Engineering.

Signature

Name : Prof. Dr. Salah Tawfeeq Al-Bazzaz
University of Babylon

Date : / / 2008

Signature

Name :

Asst. Prof. Dr. Jawad K. Al-Rifai
(Member)

Date : / / 2008

Signature

Name :

Asst. Prof. Dr. Jabbar H. Al-Baidhani
(Supervisor)

Date : / / 2008

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Huda Mohammad Selman
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CHAPTER ONE

1

INTRODUCTION

1.1 General

Rapid Environmental Impact Assessment (REIA) is a way to investigate complicated situations in which issues are not yet well defined and where there is not sufficient time or other resources for long-term, traditional qualitative research. REIA uses intensive team interaction in both the collection and analysis of data instead of prolonged fieldwork and iterative data analysis and additional data collection to quickly develop a preliminary understanding of a situation from the insider's perspective. ^[1]

Any industrial activity in general is expected to cause impacts on surrounding environment at the industry site during its implementation and operation phases, which can be either positive or negative. The nature and intensity of impacts on different components of environment depends on the type of industry activities and geographical conditions of the study area. The impacts of the industrial activities on environmental components can be quantified through Rapid Environmental Impact Assessment (REIA) Studies within the impact zone of the industrial activities. ^[2]

The rapid assessment process was initially designed for research purpose. It provides a strategic first step in urban environmental planning and management by helping to clarify issues, involve key actors, identify priorities, and build political commitment in a setting where some or all of these elements are lacking. The methodology consists of a three-step process: ^[1]

1. completion of a questionnaire on environmental data,
2. preparation of an environmental profile, using data from the questionnaire and research assistance from local investigations; and
3. discussion of the results through a series of consultations, culminating in a priority-focused public workshop.

Industrial activities are divided mainly into *extractive Industries* (oil and gas, metals cruds such as lead, arsenic, phosphate rocks, etc.) and *manufacturing Industries* (foods, textile, chemicals, equipments and tools, etc.). This research dealt with manufacturing Industries.

Pollution means making the environment in which man lives dirty and unclean. It refers to the ways in which our surrounding is harmed by cars, sewage, industrial waste, and noise. It also refers to the effects of all this on our health, weather and future resources.

The industrial activities are considered as the major contributor to world's pollution loads. Pollutants either waste water pollutants (oil and grease, total suspended particles, pathogen, heavy metals...etc.) or emitted from industries (sulfur oxides, nitrogen oxides, carbon oxides, hydrocarbons, etc.) the composition and quantities of these pollutants vary from industry to another and depends on several factors such as:

1. Type and size of industry.
2. Technologies used for production.
3. Type of fuel used.
4. Maintenance of equipments.
5. Pollution control measures and their effectiveness, etc.

The problem of environmental pollution due to industrial activities in developing countries comes from different reasons: ^[3]

1. Most industries have been located in or around urban centers. They become centers of attraction that lead to increased rural-urban migration and to marked increase in population densities around them. Most of these settlements are poor settlements, lacking of essential services, and they are threaten from the industrial problems and accidents.
2. There are a large number of small industries using old technique in the manufacturing process with the absence of treatment units or air pollution control equipments.
3. Lack of adequate environmental management system, which helps in the selection of industrial site process, pollutants reduction and controlling units and equipments.

For doing REIA should be data available and information that be collected completely and uniformly that is called Data Base according to the Iraqi environmental law (law number (2) in 1997) which limited each industrial activity that produced environmental pollutions to do as follows:

1. Equipments for measuring and monitoring pollution must available.
2. Treatment units and air pollution control equipments.
3. Construction of data base related to environmental protection and pollutants concentration.

Generally, when collecting new data there are two appropriate approaches: ^[4]

1. Rapid assessment methods :

The rapid assessment methods are less time-consuming and less expensive, and while they still require methodological considerations and understanding, they are more likely to be used as complementary approaches to provide a more nuanced understanding of constraints and facilitating factors (i.e., lessons learned) as a part of a comprehensive evaluation.

Advantages:

- Low cost.
- Can be conducted quickly.
- Provides flexibility to explore new ideas.

Disadvantages:

- Findings usually relate to specific communities or localities—thus difficult to generalize from findings.
- Less valid, reliable, and credible than formal surveys.

2. Not-so-rapid assessment methods:

More time-consuming and thus more expensive include quantitative behavioral surveys, biological surveillance, and facility assessments.

The commonly used of Rapid Assessment Methods are:^[4]

1. *Key informant interviews.* Involves interviews with 15 to 35 individuals selected for their knowledge and to reflect diverse views. Interviews are qualitative, in-depth and semi structured. Interview guides listing topics are used, but questions are framed during the interviews, using subtle

probing techniques REIA of the middle Euphrates region in the present work depends on this approach.

2. *Focus groups*. Several homogeneous groups of 8 to 12 participants each discuss issues and experiences among themselves. A moderator introduces the topic, stimulates and focuses the discussion, and prevents domination of discussion by a few.
3. *Community interviews*. These take place at public meetings open to all community members. Interaction is between the participants and the interviewer, who presides over the meeting and asks questions following a carefully prepared interview guide.
4. *Direct observation*. Teams of observers record what they see and hear at a program site, using a detailed observation form. Observation may be of physical surroundings or of on going activities, processes or discussions.
5. *Minisurveys*. Involves interviews with 25 to 50 individuals, usually selected using no probability sampling techniques. Structured questionnaires are used that focus on a limited number of closed-ended questions. Generates quantitative data that can often be collected and analyzed quickly.

1-2 Objectives of the Research

The main objectives of the research are:

1. Construction an the environmental database for industrial activities in the middle Euphrates region at: Babylon, Al-Najaf and Kerbela governorates. These activities include textile, chemical, grain mill, bricks, cement, lime, soft drink, power station, rubber products, dairy products and asphalt industry.

2. Construction and application of an expert system to evaluate and assess the local, sectoral, and regional environmental industrial load using Rapid Environmental Impact Assessment (REIA) tool.
3. Assessing the Environmental Impacts using Leopold matrix method by applying (EIA) procedure.

1- 3 Thesis Outlines

To meet the above mentioned objectives, the present research is divided into the following tasks:

1. Chapter one provides a general introduction.
2. A theoretical concept and review of literatures concerning the subjects involved is presented in chapter two.
3. Chapter three includes description of the study area and all- important information about the industries included in the study area (process manufacturing and environmental pollution)
4. Chapter four includes computer program. .
5. Chapter five includes analysis of results and their discussion
6. Conclusions abstracted from the research and recommendations suggested for further work are included in chapter six

CHAPTER TWO

2

THEORETICAL CONCEPT AND LITERATURE REVIEW

2.1 General

Environmental Management could be defined as a process of an allocating natural and artificial resource so as to make optimum use of the environment in satisfying the basic human needs, if possible for an indefinite period and with minimum adverse impact. It could be established through the following procedures: complex problems were decoupled into series of much simpler ones, inventory and control models, as well as ambient quality modules, capable of providing solutions in an effective and practical manner were carefully selected or developed, most important control measures were classified into categories and existing relevant data and information about their cost, effectiveness and implementation aspects were documented, and finally, a coherent approach for the collection of the required information from the study area, the analysis and the evaluation of the existing problems and the synthesis, of truly effective management strategies was formulated field tested and described.^[5]

Sustainable development, is the development that meets the needs of the present without affecting the ability of future generations to meet their own

needs. Its assume the conservation of the natural assets for future growth and development. ^[6]

2.2 Environmental Management Tools

To undertake any task one needs appropriate tools. This section describes a range of environmental management tools - tools that any company can use to effectively manage its environmental affairs. The environmental management tools are:

1) The Environmental Impact Assessment(EIA):

The exact definition and using of the environmental impact assessment (first tool of the environmental management) did not start before the late 1960. In February 1970, the first true Environmental Impact Assessment (EIA) appeared to have been commissioned into copper mining in Puertorico ^[31]. Through these years NEPA adopted the EIA in the USA. EIA will illustrate in section (2.2)

2) Rapid Environmental Assessment (REA):

It is effective way of assessing air, water, and solid wastes generated by any source within the study area. As illustrated in section (2.3.3)

3) Hazard Assessment:

It is another tool of Environmental Management, run parallel with and overlap EIA. Many scientist regard hazard assessment as an essential component of EIA. ^[8]

4) Environmental Policy:

An environmental policy is a document which clearly sets out the overall aims and intentions of a firm with respect to the environment. Developing an environmental policy is often the first step taken by firms who wish to undertake environmental management. An environmental policy signals a commitment to environmental management and can prepare the way for further environmental management activities. There are a number of reasons for producing an environmental policy:

- Producing a policy is an important first step towards achieving effective environmental management
- It provides important information to your external stakeholders on your aims and intentions with respect to the environment^[6].

5) Environmental Management Systems (EMS):

An environmental management system (EMS) enables a firm to manage its environmental affairs in a planned and systematic way and thus identify those ways of improving its environmental performance that most benefit its business performance.^[6]

6) Environmental Auditing:

Environmental auditing is a tool for checking whether a firm is doing what it should be doing. For instance a legislative compliance audit checks that those activities of the firm covered by environmental legislation (i.e. what it is doing) actually comply with that legislation (i.e. what it should be doing). An environmental audit will tell a firm whether its waste management practices

(i.e. what it is doing) conform with the industry sector best practice guidelines, it has committed itself to following (i.e. what it should be doing).^[6]

7) Environmental Indicators:

Environmental indicators allow a firm to measure both its environmental performance and its efforts to improve its performance. Indicators can be used within an environmental management system to check that a firm has met the targets, it is required to set for itself, but can equally well be used in firms that have not developed an EMS.^[6]

Environmental performance can be defined as: the results of an organization's management of its environmental aspects , *Environmental performance evaluation* is the process to facilitate management decisions regarding an organization's environmental performance by selecting indicators, collecting and analyzing data, assessing information against environmental performance criteria, reporting and communicating and periodic review and improvement of this process. Examples of indicators include:

- Tones of SO₂ released per year
- Tones of CO₂ released per unit of production
- Liters of water used per year
- Kilogram's of hazardous waste produced per year
- Number of legislative breaches per year
- Number of environmental improvement suggestions from employees and number taken up by management.^[6]

8) Ecobalance:

A company ecobalance records the various raw materials, energy, resources, products and wastes entering, held within and leaving a company over a specified period of time. In other words, it provides a record of a company's physical inputs, stock and outputs. Once a company knows exactly what is coming in and going out, it can begin to assess the particular environmental impacts of those inputs and outputs.^[6]

9) Life Cycle Assessment (LCA):

Life cycle assessment (LCA) is a tool for identifying and assessing the various environmental impacts associated with a particular product. LCA takes a “cradle to grave” approach looking at the impacts of the product throughout its life cycle - i.e. from the raw materials acquisition (the “cradle”) through its production and use to its final disposal (the “grave”).

LCA allows manufacturers to find ways of cost-effectively reducing the environmental impact of a product over its life-cycle and to support their claims about the environmental impact of their products.^[6]

10) Environmental Labelling:

Environmental labelling schemes award an environmental label to those products that are judged to be less harmful to the environment than others within the same product group. Firms that wish for their products to be considered for a label must apply to the scheme organizer. To be awarded a label, a product has to meet a set of environmental criteria drawn up for its product group by the labelling scheme organizer.^[6]

11) Environmental Reporting:

Having undertaken various environmental management initiatives to improve its environmental performance, a firm may wish to communicate the results of these initiatives to the outside world. One way of doing or publishing an environmental report. Issuing an environmental report can improve a firm's public image and lead to improved relationships with stakeholders. To date, it is mainly large companies that have issued such reports but small and medium enterprise may also find environmental reporting a useful tool. ^[6]

12) Environmental Charters:

There are a number of environmental charters and guidelines to which a firm can subscribe in order to demonstrate its commitment to responsible environmental management. ^[6]

13) Environmental Risk Assessment:

Risk assessment is another tool of Environmental Management and could be defined as the process of assessing magnitudes and probabilities of the adverse effect of human activities (including technical innovation) or natural catastrophes. Both hazard and risk assessment firstly appears in 1940s. The risk assessment processes are:

1. *Hazard identification* (the chemicals present at the site or facility and their characteristics; i.e., source analysis).
2. *Exposure assessment* (potential transport of the chemicals to receptors and level of intake; i.e., path way analysis).
3. *Toxicity assessment* including the determination of numerical indices of toxicity (i.e., receptors analysis).

4. *Risk characteristics* involving the determination of number that express risk such as one in one hundred (0.01) or one in one million (1×10^{-6}).

An environmental risk assessment may be a necessary part of the EIA if there is considerable uncertainty about the likelihood or the magnitude of environmental impacts. The data collected during basic EIA studies provides much of the information needed for explicitly dealing with the uncertainties relating to environment impacts. There are two major categories of risk: 1) those to human health, and 2) those to ecosystem integrity.^[8]

The primary goal of environmental risk assessment is to evaluate risks, their monetary costs, the costs of emergency response and/or avoidance of risk.^[9]

14) Economic Analysis:

Economic analysis of environmental impacts provides one means of quantifying the severity of the impacts. The net environmental benefit or loss provided by a project can be evaluated if monetary values may be assigned to environmental and social components. Project options may be compared by their net economic impact^[10].

15) Strategic Environmental Assessment:

Strategic environmental assessment is the formalized, systematic and comprehensive process of identifying and evaluating the environmental consequences of proposed policies, plans or programmes to ensure that they are fully included and appropriately addressed at the earliest possible stage of decision making on a par with economic and social considerations.

Strategic environmental assessment provides a structured process of analyzing the economic, social and ecological impacts of programmes, plans

and policies and of identifying alternative economic incentives for conserving and wisely or sustainably using ecosystems.^[11]

16) Expert System:

Expert systems are computer programs that perform difficult, specialized tasks at the level of a human expert.

The degree to which expert systems will be used depends on whether or not practitioners in developing countries can acquire the necessary skills to effectively use the systems^[10]. The expert system written in this research by using visual basic (version 6.0).It can be used in the directorates of environment for large field and given the results quickly and less time consuming.

2.3 Environmental Impact Assessment

Environmental impact assessment (EIA) is a process that requires consideration of the environment and public participation in the decision-making process of project development .an environmental impact statement (EIS) is a review document prepared for assessment in the EIA process. In some countries, EIA is direct legal requirement, while in others it is enforced indirectly under general planning, health or pollution control powers.

The National environmental Policy Act (NEPA) was introduced in the U.S in 1969 and required environmental statements to be prepared for federally funded or supported projects that were likely to have impacts on the environment. In 1973, the U.S Council of Environmental Quality (CEQ) has developed and published standard procedures for environmental statement.

In 1978, the CEQ published regulations under the Act which were directed towards streamlining the process, making the output more useful to planners and decision makers, encouraging public involvement and ensuring that the agencies follow up on their responsibilities after the approval of the EIS. In 2000, the Environmental impact assessment Act was issued as a legal regulation.^[12]

In 1972, environmental assessment was accepted in principle at the United Nations Conference on the Human Environment at Stockholm when the framework of modern environmental international and national policy was laid down.

(Lohani: 1997), in his description of the prediction and assessment of impacts on the environment, provides specific guidance on and examples of how to assess significance for: 1) air; 2) surface water; 3) soil and groundwater; 4) noise; 5) biological environment; 6) cultural (architectural, historical and archaeological) environment; 7) visual environment; and 8) socioeconomic environment.^[10]

The Rijeka - Zagreb Motorway Project involves completion of the 148.45 km Motorway between Zagreb and Rijeka. Two separate EIA were commissioned by the Croatian Road Authority and prepared by the Croatian Civil Engineering Institute, as follows:

- 1- Preliminary Study on the Environmental Impact.
- 2- Environmental Protection Study; and by this study the construction of the project has already begun.^[13]

(Faisal Aslam; 2006) This study evaluates environmental system in Pakistan and environmental impact assessment laws and their effectiveness in comparison to European Union rules and regulations. The study explains the social and political system in brief to understand the EIA system at the national level. The Study concludes that although the system is good to some extent, but poor implementation and non-existence of standardized monitoring system are the major setbacks.^[14]

The EIA consists mainly of four stages^[4]. The stages include the following:

1. *Screening*, to decide which project should be subjected to environmental assessment. Criteria used include threshold, size of project and sensitivity of the environment.
2. *Scoping* is the process, which defines the key issues that should be included in the environmental assessment. Many Early EIAs were criticized because they were encyclopedic and included irrelevant information.
3. *EIS preparation* is the scientific and objective analysis of the scale, significant and importance of impacts identified. Various methods have been developed to assist this task.
4. *Review*, As environmental assessments are normally produced by the project proponent, it is usual for a review to be undertaken by a government agency or an independent review panel. The review panel guides the study and then advises the decision-makers.

In order to quantify the *impact* through sensible values or numbers, three approaches were mainly selected these are: ^[15].

- Leopold matrix
- Overlays
- Battelle environmental evaluation

Although, the last method seems powerful in obtaining reasonable ranking for the projects been assessed, the first method (Leopold matrix) will be applied in this research due to the following reasons:

1. The method is applied extensively in the reports issued by the UNEP. So that, using this method will coincide with the structural view of the national reports.
2. This method is simple to follow up, and a comparison among different projects can be clarified easily.
3. The method is comprehensive in covering physical, biological and socio-economic environment.
4. The method can be modified to (Battelle) method, when there is enough skilled data to count the environmental quality index, by applying the weights for each environmental characteristic. Thus obtaining a sum that reflects the overall assessment of the impact.

The constructions for using Leopold matrix are as follow: ^[15].

1. Identify all actions (located across the top of the matrix) that are part of the proposed project.

- 0 = no impact, 3 = moderate impact,
1 = minimal impact, 4 = significant impact
2 = small impact, 5 = severe impact.

4. The text, which accompanies the matrix, should be a discussion of the significant impact, those columns and rows with large numbers of boxes marked and individual boxes with the larger numbers. Fig. (2.1) shows the Leopold Matrix.

[illegible]

- a- Importance (0-5),
- b- Magnitude (calculating),
- c- Impact = a * b
- d- Percent of parameter from total = c / e
- e- Total

Fig. (2.1): Shape of the Leopold Matrix

2.4 Rapid Inventory Techniques

The essential process in each tool of Environmental management is the inventory of the environmental pollution for each activity or project and "Rapid Inventory Techniques" is a process used to get this aim. It's considered a good method of EIA

This technique was firstly adopted by WHO (World Health Organization) in 1982 and updated over the past years. In 1991 WHO initiated the Global Environmental Technology Network (GETNET), which include the technology of environmental pollution controlling to increase the efficiency of the environmental management.

(Barnard and Olivetti; 1990) ^[16] introduced the using of rapid assessment technique in assessment and evaluation of pollution loads for

industries in Spain and Italy. The assessment was based on the number of employments and they build a computer program to calculate the environmental pollution.

(Economopoulos; 1993) ^[5] updated the rapid pollution assessment factors and introduces air, water and solid waste inventory and control model. He describes how to initiate a study, including how to organize study team, how to collect, cross-check, organize and process field data so as to generate air, water and solid waste inventories. The necessary models and data for conducting air, water and solid waste inventories, for assessing the pollution load reduction effectiveness of the latter are provided in his study.

(Mohammed; 1995) ^[17] used rapid assessment techniques to calculate the pollution loads for the industrial activity in Iraq. He constructed an expert system to apply the calculation by taking the governmental factories in Iraq as a case study. In his calculations, He adopted the "Compilation of air pollutant emission factors" (EPA, 1973) (calculation of pollutants loads emitted to the air as a type and quantity of fuel used) to calculate the pollutants loads instead of using the pollution factors of WHO (Rapid Inventory Technique; 1982). The reason (as he mention) that the pollutants loads emitted as a type of fuel used are greater than the ones that emitted from any manufacturing process stage. In liquid and solid waste, he applied WHO (1982) pollutants loads factors.

In this program, the information about each factories included in the study were be introduced with the calculation of their pollutants loads. He found that:

1. Cement and brick factories are the major source of emission loads (PM, SO₂, NO_x, HC).
2. In liquid pollutants, there are several factories contain heavy metals in their effluent they must be tested carefully to reduce these metals (the factories are textile, fertilizers, phosphates, and papers).
3. 50% of factories have treatment plant with partial treatment, 94% of them are working in a good condition.
4. Euphrates river received the greater quantity of pollutants loads (TDS, PO₄, SO₂, Cr, Pb, and Hg).

(Sawsan; 2000) ^[18] constructed an expert system (designated as rapid assessment expert system (RAES)) for the calculations of the environmental pollution (air pollution and liquid waste) of the industrial activities by application of the Rapid Assessment Inventory Techniques (WHO; 1993), and by taking the situation of the industrial activities of the city of Baghdad (private sector) as a case study. The factories, which are selected in her study are tanning of leather (28) factories, paints (35) factories, bricks (42), pharmaceutical & drugs (14), soap and detergents (29) factories, organic fertilizer (2) factories, and dairy products (12) factories.

RAES compares the calculated the pollutants loads with several guidelines, within the limitation of Iraqi and World Bank, She suggested the adequate treatment units and control equipments for the reduction of unaccepted pollutants loads. She found that:

1. There is a lack of air pollution control equipment in all factories included in the study.

2. The quantities of air pollutants in the bricks factories are high (TSP, SO₂, NO_x, VOC, and F₂). This is due to different reasons such as the use of old techniques in the manufacturing process which increases the quantity of pollutants, and the use of fuel oil as a fuel type which contains high percentage of sulfide (main source of SO₂ emission).

(Fredrick; 2000) ^[19] used the rapid assessment method to calculate the pollution loads for Pangani river in Tanzania. The main pollution sources to Pangani River are, domestic waste, agricultural and industrial wastewater occurring in Arusha and Kilimanjaro. He depended on the World Health Organization (WHO), (1982, 1989) and used the following equations:

Pollution load = (Functional variable). (Pollution factor). (Penetrating factor)

Generated load = (Functional variable). (Pollution factor)

The functional variables represent a characteristic parameter, which is assumed to be proportional to the amount of waste produced. Pollution factors from WHO (1982). Penetration factors are the efficiencies from domestic and industrial, waste water treatment facilities. If there is no treatment the efficiency is zero (0) (Penetration factor = 1). Penetration factor vary between 0 and 1. In his study he took the industrial activity which have liquid pollution load in Arusha and Kilimanjaro like dairy manufacturing and textile manufacturing.

He concluded that the Rapid Assessment Method is able to given an interest of the type of pollution loads including their location and emission levels. Also he found the generated loads are higher than the pollution load by a penetration factor. In Arusha region the generated and released BOD₅ load are (3474 ton/year ,3281 ton/year) respectively. In Kilimanjaro Region

the generated and released BOD₅ load are (9829 ton/year ,7489 ton/year) respectively.

(United Nations Environment Programme; 2003) ^[20] focuses on the state of Iraq's environment against the context of decades of armed conflict, strict economic sanctions and the absence of environmental management principles in national planning. Attention is drawn to possible next steps, including urgent measures to minimize, mitigate and remediate immediate environment-related threats to human health (e.g. from disrupted or contaminated water supplies, and from inadequate sanitation and waste systems). Suggestions are also made for wider measures, including field missions at an early stage to address the key environmental vulnerabilities and risks identified, and to prepare appropriate action plans, including clean-up and risk reduction measures. Restoring law and order is a key priority and a prerequisite for dealing effectively with humanitarian and environmental problems. This study has been prepared on the basis of a rapid of assessment of published and on-line information sources.

(W. Siobhan Fennessy et.al; 2004) ^[21] they said Rapid Assessment methods have been shown to be sensitive tools to assess anthropogenic impacts to wetland ecosystems. As such they can serve as a means to evaluate best management practices, to assess restoration and mitigation projects, to prioritize wetland related resource management decisions, and to establish aquatic life use standards for wetlands.

To establish an integrated steel plant near *Village Naharpali in District Raigarh* the writer studied the REIA from construction phase. And; the

operation phase on air quality, land environment, noise, soil and water quality, impact on ecology, health and traffic. ^[22]

(SUMATRA; 2004) ^[23] As a first step towards assessing the impacts of this disaster on the environment, a Rapid Environmental Assessment (REA) was initiated by the Ministry of Environment. Carried out by one international expert and a team of three people from the Ministry of Environment over a seven day period allowed some of the first concerted observations to be made of the situation on the ground. A number of potential future impacts were also identified, all of which have been considered and included in the final analysis of this REA findings.

This study showed REA is relatively quick and simple to use, and does not require expert knowledge if guided by someone with previous experience of environmental assessment and/or disaster situations. The REA, however, does not replace a formal environmental impact assessment (EIA). A legal requirement applied to many development-related activities in Indonesia and other countries. But it does fill a gap until such time as when a more thorough EIA can be safely and consistently carried out.

The Rapid Environmental Assessment (REA) does not provide answers as to how to resolve environmental problems, but it should provide sufficient information to allow those responding to a disaster to formulate practical solutions to most of the issues identified while conducting the exercise.

(Lowveld Center for Life Long Learning (C4L);2005) ^[24] used Rapid Environmental Impact Assessment in Disasters (REIA). The REIA is a tool to identify, define, characterize and prioritize potential environmental impacts in disaster situations which threaten human life and welfare. The

REA presents a simple, qualitative assessment process. It uses easy to understand descriptions, rating tables and lists to identify and rank environmental issues and appropriate follow-up actions during a disaster. The REIA improves humanitarian response in emergencies by incorporating critical environmental issues into disaster impact assessment, planning and operations. With awareness of these issues, humanitarian workers can take action to mitigate or avoid adverse impact on human lives and welfare and implement disaster responses which incorporate opportunities to protect the environment. The REIA is designed for natural, technological or political /conflict disasters, serving as a good practice tool for effective disaster assessment and management. Use of the REA supports the “Do no harm” approach to relief and facilitates compliance to SPHERE Standards.

(Unique Hospital and Research Institute at Dwarka; 2006) ^[25] The objective of the study is to carry out Rapid Environmental Impact Assessment (REIA) for a new construction of a modern hospital at Sector-19, Dwarka to meet the environmental compliances laid down by the Ministry of Environment and Forests (MOEF), Government of India. The scope of study includes:

- To assess the impact of the project on Ambient Air Quality, Water Quality, Noise levels and Socio economic status of area.
- To assess the impact of the projects on public health, quality of life etc. during construction and operation of the project.
- To assess the impact on human settlement in project influenced area1.
- To assess impact on infrastructure such as water supply, sewerage and sanitation, solid waste management, road, etc.

- To prepare environmental management plan (EMP) for mitigating adverse impacts due to proposed project.
- To prepare environmental monitoring plan for construction and operational phases.

The study included the description of project setting, appraisal of project activities and assessment of adverse impacts related to the location, design, construction and operation of the project. The cost would be worked out for the management and monitoring programmes.

There are three different methods for the inventory technique, as follows: ^[5].

- Waste Monitoring Programs.
- Modeling of Pollution Sources and Control Systems
- Rapid Assessment Technique

2.5 Rapid Assessment Technique

2.5.1 Rapid Assessment of Pollution Sources

The rapid assessment methodology provides a particularly effective way of assessing air, water, and solid wastes generated by each source or groups of similar sources, within the study area. In addition, it permits convenient assessment of the effectiveness of alternative pollution control options.

In the early 1980s, the World Health Organization (WHO) developed a manual for rapid assessment of sources of land, air, and water pollution (WHO, 1982). The rapid assessment procedure has been found useful in developing countries in the design of environmental control strategies using relatively modest financial and human resources ^[5].

2.5.2 Rapid Assessment Procedure

The rapid assessment procedure allows for quick estimation of releases of pollutants to the environment. The basic concept is illustrated in Fig. (2.2). The procedure uses information on existing pollution sources for a given study area. Inputs include the quantities of consumption and outputs of various industrial and urban processes, industrial production figures, fuel usage, number of motor vehicles, number of houses connected to sewers, etc. These data are multiplied by predetermined waste load factors to provide estimates of the generated loads for each pollution type. The generated loads provide a worst case estimate of the amount of pollutant that is being released to the environment. The next step is to identify the type of pollution control being used and estimate its effectiveness in reducing the level of pollutant. This allows for an estimate of the release to the environment to be made. Economopoulos (1993) ^[5] lists those activities for which waste load factors and control models have been developed (*Appendix -A-*). The activities are classified using the UN SIC system to make it easy to refer to the national statistics of a country to get data the level of industrial activity. The list of industrial sources and processes (*Appendix -A-*) accounts for most of the industrial pollution sources. This list may be used as a guide to identify major pollution sources during the initial phases of the inventory work.

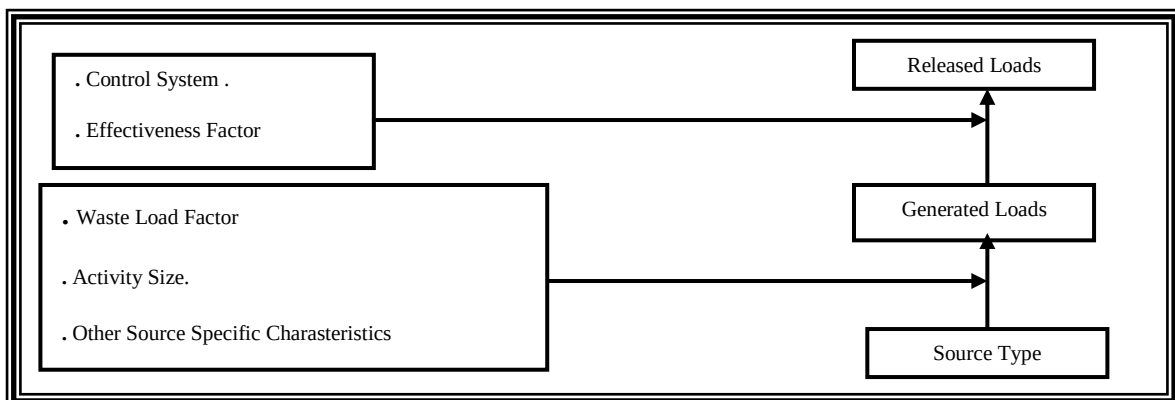


Fig. (2.2): Estimating Pollution Loading Using the Rapid Assessment Method ^[5].

2.5.3 Waste load factors

Waste load factors have been developed for air, water, and solid waste. For air emissions, Economopoulos (1993) ^[7] present tables of estimated per unit loading for TSP, SO₂, NO_x, CO, and VOC for the activities listed in WHO air pollutants factors (*Appendix -B-*). For liquid wastes, Economopoulos (1993) in Geneva presents tables of estimated per unit loading for BOD₅, TSS, Tot N, Tot P, and other pollutants (Phenol, Sulfide, Chromium, and Oil) for the activities listed in WHO liquid pollutants factors (*Appendix -C-*). This thesis concerns with air and water environmental component only. The equations were used to calculate *air pollution* are :

Design load (D.L) = Waste load factors (F) * Design Production Capacity (DPC)	...Eq (2.1)
Working load (W.L) = Waste load factors (F) * Working Production Capacity (WPC)	...Eq. (2.2)
Design concentration of element (D.C) = $\frac{\text{Design load for the element (D.L)}}{\text{Design Emission Rate (D.E.R)}}$ * 10 ¹²	Eq. (2.3)
Working concentration of element (W.C) = $\frac{\text{Working load for the element (W.L)}}{\text{Working Emission Rate (W.E.R)}}$ * 10 ¹²	Eq. (2.4)

The equations that used to calculate *liquid pollution* are :

Design load (D.L) = Waste load factors (F) * Design Production Capacity (DPC) *penetration factor	...Eq (2.5)
Working load (W.L) = Waste load factors (F)* Working Production Capacity (WPC) * Efficiency of Treatment	Eq (2.6)
Efficiency of Treatment (E.T) = $\frac{C_i - C_o}{C_i}$ = $\frac{\text{Concentration in} - \text{Concentration out}}{\text{Concentration in}}$	...Eq. (2.7)
Design Flow Rate (D.F.R) =Waste Volume Factor (Fa) * DPC	Eq. (2.8)
Design concentration of element (D.C) = $\frac{\text{Design load for the element (D.L)}}{\text{Design Flow Rate (D.F.R)}}$ *10 ³	Eq. (2.9)
Working concentration of element (W.C) = $\frac{\text{Working load for the element (W.L)}}{\text{Working Flow Rate(W.F.R)}}$ *10 ⁶	Eq. (2.10)

Where:

D.L and W.L: Design Load and Working Load in (tn/year).

F: Waste load factors obtained from WHO, 1993 in (Kg / Unit).

DPC: Design Production Capacity, obtained from questionnaire in (Unit/year).

WPC: Working Production Capacity, obtained from questionnaire in (Unit/year).

D.C: Design Concentration of Element, calculating, in $\mu\text{g}/\text{m}^3$ (air) and mg/l (liquid).

W.C: Working Concentration of Element, calculating in $\mu\text{g}/\text{m}^3$ (air) and mg/l (liquid).

D.E.R: Design Emission Rate, Estimation, there is no data, in (m^3/year).

W.E.R: Working Emission Rate, Estimation, there is no data, in (m^3/year).

Penetration factor: obtained from WHO, 1993 based on the type of treatment and appointed to efficiency of treatment in design state. It's a dimensionless. Table (2.1) shows penetration factors and treatment efficiency for each factory in the study area.

E.T : Efficiency of Treatment obtained from questionnaire. Its dimensionless.

Concentration in: Concentration inter the treatment plant, obtained from questionnaire in mg/l.

Concentration out: Concentration leaved the treatment plant obtained from questionnaire in mg/l. Table (2.2) shows the

concentrations of liquid wastes for the factories in the study area.

D.F.R: Design Flow Rate, calculating in (m^3/year).

Fa: factor of waste volume obtained from WHO, 1993 in m^3/Unit .

W.F.R: Working Flow Rate obtained from questionnaire in (m^3/year).

2.5.4 Rapid Assessment in EIA

The rapid assessment procedure may be used to assess the environmental impacts of developments. The use of waste load factors enables prediction of the approximate pollutant loadings generated by a new development project. This, in conjunction with knowledge about existing pollutant concentrations, allows a preliminary assessment of the degree to which the project would adversely affect the prevailing conditions of the proposed site. On a local basis, rapid assessment studies can provide the following contributions to environmental management agencies (WHO, 1983):

- define high priority control actions;
- organize effective detailed source survey programs;
- organize appropriate environmental monitoring programs;
- assess and evaluate the impacts of proposed pollution control strategies;
- assess impacts of new industrial development projects.

Table (2.1)*: Penetration Factor and Treatment Efficiency for Each Factory in the Study Area.

Governorate	Name of Factory	Penetration Factor (design state)			Treatment Efficiency	
		Pntr.				
		BOD ₅	TSS	Tot P	BOD ₅	TSS
Babylon	General company for textile industries	1.25	0.6	0	0.597	0.697

	Textile Factories (Abu-Zaid, Al-Ekwan, Al-Amal, Al-Hassen, Al-Hadi, Al-Kawther, Al-Huda and Arab Homeland factory).	1.25	0.6	0	1	1
	Al-Rifiq dairy products factory	0.205	1	0.78	0.967	0.844
	Dairy products factories(Babylon, Al-Sahal, Al-fiahaa, Al-Teeb and Awlad Jumaab Ebadi Selman)	0.205	1	0.78	1	1
	Babylon for soft drink	1	1	1	0.944	0.771
	General company for chemical industries	1	1	1	0.785	0.475
Al-Najaf	Al-kufa for soft drink	1	1	1	0.932	0.914
	Rubber production factory	1	1	1	0.913	0.87
Kerbela	Noor Kerbela for soft drink	1	1	1	1	1

Table (2.2) **: The Concentrations for the Factories that have Tests of Liquid Wastes in the Study Area.

Governorate	Name of Factory	BOD ₅		TSS	
		Ci	C _o	Ci	C _o
Babylon	General company for textile industries	83.3	33.5	170	51.51
	Al-Rifiq dairy products factory	1000	33	----	----
	General company for chemical industries	153.5	33	400	210
	Babylon for soft drink	429	24	430	98.5
Al-Najaf	Al-kufa for soft drink	430	29.33	220	19
Kerbela	Rubber production factory	400	35	200	26

* For other parameters that no mention in this table Penetration factor=1(WHO; 1993) & Treatment efficiency=1(if there is no treatment plant).

** 1- Ci, C_o obtained from questionnaire. 2-There is no tests of other parameters that no mention in this table.

2.6 General Description of the Rapid Assessment Techniques

The released loads from a given source are calculated based on the use of appropriate waste load factors, derived from the measured performance of similar sources. Each factor, (**ej**), is defined as the normalized released load

of pollutant (j) expressed in (kg / unit of activity) of the source under consideration. In principle, each factor can be expressed in the following mathematical form, as a function of several parameters:

$e_j = f'(\text{source type, process or design particularities, source age and technological sophistication, source maintenance and operating practices, type and quality of the raw materials used, type, design and age of the control systems employed, type and design of control systems employed in other media, ambient conditions and other parameters}) \dots \dots \dots \text{Eq.(2-11)}$

Where:

Source Type: is defined as the kind of pollution generating activity in general, more precise definition is provided through the other parameters which will be discussed below. In fact, the source type is a parameter, which is closely related to the type and quantity of pollutants emitted or generated.

Process or Design Particularities: are very much to the kinds and to the quantities of pollutants generated (liquid waste) or emitted (air pollution) from the industrial source and also related to the source type.

Source Age and Technological Sophistication: are important parameters, as they often significantly affect the emission and effluent loads. The aging of the source causes higher emission or effluent as system tends to fail more frequently and their operation tends to depart from the new equipment specification. In addition, older systems don't take full advantage of technical innovations, which tends to yield environmentally friendlier performance. Naturally, the technological sophistication does not only

depend on the age of the source alone, but also on the environmental legislation, as well as on the enforcement aspect.

Source Maintenance and Operating practices: it is also an important parameter, which affect the emission or the effluent loads. The property of this parameter is that, it is under control and practiced to acceptable standards because the maintenance and operation are related to production quality and costs.

The Type and Quality of the Raw Materials Used: this parameter basically depends on the type and quantity of raw materials used in the process which effect the selection of suitable operation will be used and type and quantity of effluent and emission loads.

The Type, Design and Age of the Control Systems: this factor determines the removal efficiencies of the source emission (air pollution), an effluent loads (liquid waste) and are thus intimately related to the loads eventually releases into the atmosphere and the impact of the discharges on the final receivers. The age of the control system affects the efficiency due to the progressive downgrading of the performance with time, but most importantly, due to generally more relaxed design specifications of the past. Old age of the equipment tends thus to be associated with lower design efficiencies.

The Ambient Conditions: may significantly affect the rate of emission and effluent loads. This parameter will be discussed in details for each type of waste in the following chapters.

The dependence of the waste factors (**ej**) on parameters such as these included in the equation (2-11) cannot be expressed as a continuous function because of the discrete nature of most parameters (such as the type of control systems employed) and the lack of sufficient information in relation to the remaining ones. A discrete functional form yielding a series of waste factor values, each valid under a specific set of common and important parameter combinations, is used instead. ^[5]

2.7 The ISO

ISO is the International Organization for Standardization. It is made up of national standards institutes from countries large and small, industrialized and developing, in all regions of the world. ISO develops voluntary technical standards which add value to all types of business operations. They contribute to making the development, manufacturing and supply of products and services more efficient, safer and cleaner. They make trade between countries easier and fairer. ISO standards also serve to safeguard consumers and users in general of products and services – and to make their lives simpler. ^[26]

ISO 14000 shares common management system features with the ISO 9000 series of quality system standards and firms can use their ISO 9000 management system as the basis for their environmental management.

In the early 1990s the International Organization for Standardization (ISO) recognized the need for standardization in the field of environmental management tools and in 1993 it set up a committee to write standards relating to the following 5 environmental management tools: ^[6].

1. Environmental Management Systems

2. Environmental Auditing
3. Environmental Labelling
4. Life Cycle Assessment
5. Environmental Indicators. The table (2.3) represents the ISO 14000 family of standards and ongoing work.

Table (2.3): The ISO 14000 Family of Standards and Ongoing Work ^[26].

Designation	Publication	Title
ISO 14001: 1996	1996	Environmental management systems – Specification with guidance for use
ISO 14004:1996	1996	Environmental management systems – General guidelines on principles, systems and supporting techniques
ISO 14010:1996	1996	Guidelines for environmental auditing – General principles
ISO 14011:1996	1996	Guidelines for environmental auditing – Audit procedures – Auditing of environmental management systems
ISO 14012:1996	1996	Guidelines for environmental auditing – Qualification criteria for environmental auditors
ISO/WD 14015	To be Determine	Environmental assessment of sites and entities
ISO 14020:1998	1998	Environmental labels and declarations – General principles
ISO/DIS 14021	1999	Environmental labels and declarations – Self-declared environmental claims
ISO/FDIS 14024	1998	Environmental labels and declarations – Type I environmental labelling – Principles and procedures
ISO/WD/TR	To be Determine	Environmental labels and declarations – Type III environmental declarations – Guiding principles and procedures
ISO/DIS 14031	1999	Environmental management – Environmental performance evaluation – Guidelines
ISO/TR 14032	1999	Environmental management – Environmental performance evaluation – Case studies illustrating the use of ISO 14031
ISO 14041:1998	1998	Environmental management – Life cycle assessment – Goal and scope definition and inventory analysis
ISO/CD 14042	1999	Environmental management – Life cycle assessment – Life cycle Impact assessment
ISO/DIS 14043	1999	Environmental management – Life cycle assessment – Life cycle Interpretation
ISO/TR 14048	1999	Environmental management – Life cycle assessment – Life cycle assessment data documentation format
ISO/TR 14049	1999	Environmental management – Life cycle assessment – Examples for the application of ISO 14041
ISO 14050:1998	1998	Environmental management – Vocabulary
ISO/TR 14061	1998	Information to assist forestry organizations in the use of the Environmental Management System standards ISO 14001 and ISO 14004
ISO Guide64:1997	1997	Guide for the inclusion of environmental aspects in product standards

2.8 Air Pollution

Air pollution is the term used to describe any harmful gases in the air we breathe. Pollution can be emitted from natural sources such as volcanoes, but humans are responsible for much of the pollution in our atmosphere (the layer of gases that surrounds the earth).

The problem of air pollution was first recognized about 500 years ago when the burning of coal in cities was increasing. About 200 years ago, a large growth was seen in the amount of coal burnt, as the industrial revolution took place in Britain. The industrial revolution was a fast growth in industry that was based around the use of fossil fuels. During foggy weather, when little wind was present the smoke produced by the coal would mix with the fog and form smog.

Smoke + Fog = Smog

The smog made it difficult for people to see and breathe. In 1952 the great London smog occurred, killing 4000 or more people^[27].

Pollution from industry was significantly reduced following the Clean Air Acts of 1956 and 1968, but still poses a problem in some areas. The two major pollutants produced by industry are: ^[28]

1. Sulphur dioxide, SO₂ is the main pollutant emitted from power stations. Once in the air, sulphur dioxide mixes with moisture to form sulphuric acid, which will later fall as acid rain.
2. Nitrogen oxides, NO_x are pollutants which are mainly associated with car exhausts, although some emissions come from industry. Again, they mix with moisture in the atmosphere and form nitric acid, which then falls as acid rain. Today, industries that emit air pollution must have stacks which

release the waste gases into the atmosphere at higher levels, thereby reducing the risk of ground level pollution. Power stations are now also required to reduce their emissions of sulphur dioxide by using specialized emission reduction technology.

The sources of air pollution resulting from *human activities* are of three broad types; stationary, mobile and indoor.

Stationary sources can be subdivided into:

1. Rural area sources such as agricultural production, mining and quarrying.
2. Industrial point and area sources such as manufacturing of chemicals, non-metallic mineral products, basic metal industries and power generation.
3. Community sources, for example heating of homes and buildings, municipal waste and sewage sludge incinerators, fireplaces, cooking facilities, laundry services and cleaning plants.

Mobile sources comprise of any form of combustion-engine vehicles, e.g. light duty petrol-powered cars, light and heavy-duty diesel-powered vehicles, motorcycles, aircraft, and including line sources such as fugitive dusts from vehicle traffic.

Indoor sources include: tobacco smoking, biological sources (such as pollen, mites, moulds, insects, microorganisms, pet allergens etc.), combustion emissions, indoor materials and consumer products releasing substances such as volatile organic compounds, lead, radon, asbestos, various synthetic chemicals and others. While outdoor air pollution is a source of indoor air pollution, indoor sources may under certain circumstances also influence outdoor air pollution.

In addition, there are also *natural sources* of pollution, e.g. eroded or decertified areas, volcanoes, certain plants that release great amounts of pollen, sources of bacteria, spores and viruses, etc.

Particulates in air pollution are one of the main causes of health problems. The very fine particulates can easily enter our lungs, where they can cause breathing problems, and over time even lead to cancer.

Ozone that forms near to the ground can also damage our lungs and throats. If you have asthma (A disease that makes it difficult for a person to breathe, especially during exercise) then the symptoms may be even more severe.

Carbon monoxide, from transport, cigarette smoke and faulty gas fires, affects the blood and is especially dangerous to pregnant women and their unborn babies. The babies may be born with brain damage.

Before 2000, lead from petrol fumes was a potential cause of damage to organs in the body such as the kidneys, heart and brain. Children were more sensitive to the effects of lead pollution than adults.^[28]

Air pollution can negatively impact public health when present in the atmosphere in sufficient quantities. Most rural areas rarely experience air quality problems, while elevated concentrations of air pollution are commonly found in many urban environments.^[27]

2.9 Water Pollution

Water is one of the most essential constituents of the human environment. The water resources generate development in socio-economical issues crucial to the society in general and more specifically for industries, agricultural activities and for the public use. Although it is agreed that water is an economic good, it is also a social good, finite, non-substitutable and vital to all forms of life ^[29].

Water quality refers to the physical, chemical and biological characteristics of water in relation to the existence of life and especially the activities of man. All natural water contains substances derived from the environment, both natural and man-made. The amounts of these constituents in the water determine its quality. Consequently sampling of water and measuring the concentrations of various constituents can qualify the quality of that water.

The fate of a pollutant discharged to aquatic environment depends on its own characteristics, such as its solubility, biodegradability, potential for biological accumulation along the food chain etc. ^[30].

The first real effort to deal with problems of waterborne waste was seen in Rome, where the municipal sanitary waste disposal problem of a large number of people living in a small area forced the construction Cloaca Maxima, or great sewer, for the collection of the sanitary and commercial wastes for discharge to the Tiber River. The problems of contagious disease transmission also existed but were not recognized. In the end of the nineteenth century the program deals with controlling of water born infectious disease started. In 1900s several countries adopted regulation and

standards to arrange the correct using of water and control, reducing, or removing of water pollutants.

The water is used in every sector of life ,FWPCA Committee (Federal Water Pollution Control Administration) divides water and uses into a five categories 1-Puplic supply, 2- Recreation and aesthetic value, 3- Preserveation of fish and wildlife, 4- Agricultural, and 5- Industrial use. Industrial activity used about 973 Km³ from fresh water, 23%from total usage of fresh water. ^[3].

2.10 Guidelines and Standards

Air quality guidelines (AQG) should be clearly distinguished from air quality standards (AQS). AQG are derived from purely epidemiological /toxicological (or environment-related) data while AQS are AQG promulgated through legislation in a country or community, and in the process of promulgation issues of technological feasibility, costs of compliance, prevailing exposure levels , social, economic and cultural conditions are possibly taken into consideration^[31].

Environmental standards are numerical concentrations of environmental parameters recommended to support or maintain a designated use of a resource in an ecosystem, area, or region. Environmental standards are established to protect human health and ensure the long-term sustainability of an environmental resource. Air quality standards are set to protect human health, while water quality standards are designed to support the intended use of water, and protect the aquatic ecosystem as well as human health. Soil quality standards are designed to protect agriculture, human health, and

surface and groundwater resources. There are 2 kinds of standards: (i) ambient or sink, and (ii) emission or discharge ^[32 & 33].

2.10.1 Ambient Environmental Standards

Ambient standards (often referred to as environmental criteria) are concentrations of environmental parameters in an environmental medium (e.g. air, water, and soil quality) that must not be exceeded, or levels of environmental quality (e.g. dissolved oxygen level in waters) that must be maintained. They generally define the prescribed limits to which levels of environmental resources may be permitted to fall, or the upper limits to which pollutants may be allowed to reach in the environment.

2.10.2 Discharge Standards

Emission or discharge standards are the maximum concentration level of environmental parameters emitted or discharged to the environment. Emission or discharge standards are the maximum concentration level of environmental parameters emitted or discharged to the environment. Emission or discharge standards are usually specific to an area or ecological zone, and may be set for specific industries. Discharge standards are set for emissions and effluents from projects and activities. They define the maximum acceptable quantity of pollutants that may be discharged into the ecosystem, area or region. They are set for specific pollutants and often stated as concentrations or discharge rates to reflect the temporal dimension.

2.11 Air Pollution and Liquid Waste Standards

Iraq published in 1967 the law number 25 which established the acceptable limits of liquid pollutants. This law is reviewed and updated in the law of the saving and maintenance environment (law number (3) in 1997) which arrange the authorities and responsibilities related to the control of the environmental pollution. (Appendix (D)).

The World Health Organization (WHO) has been concerned with air pollution and its impact on human health for 40 years. The first WHO conference on public health aspects of air pollution on Europe was held in 1957, and was followed by several activities of the Regional Office for Europe (EURO) in this field, all aiming at international corporation and harmonization of environmental policies in the European Region .These activities culminated in the development of the WHO Air Quality Guideline for Europe. (Appendix (E)). (WHO; 1987) In the field of liquid waste, WHO put the guidelines for the water quality in 1988 ^[7].These guideline have been published by the EURO in 1987 (WHO; 1987) .Since 1993 they are being reviewed and updated (WHO; 1992, WHO; 1994 WHO; 1995a, b, c& WHO; 1996) ^[31].

CHAPTER THREE

3

GENERAL SURVEY AND DATA BASE

3.1 Introduction

The interesting of the impacts of small industries has been devoted recently when the man realized their effects on humans and their environment.

Small industries rarely follow safety regulations and most don't have any pollution control equipment and discharged their liquid waste into the sewerage system or on land or in water bodies in nearby areas ^[34].

Survey procedures were adopted to construct and analyze data base information. General information's about the industrial activities as well as, detail information's about technical path, manufacturing processes, raw material balance, water balance, sources of pollution, quality of disposals, quantify of pollutants, and efficiency of treatment plant, were studied and analyzed.

3.2 Description of the Study Area

The industrial pollution in the middle Euphrates region (Babylon, Al-Najaf and Kerbela) was studied.

The middle Euphrates region includes Babylon, Al-Najaf, Kerbela cities. It lies in the middle of the lower half section of Iraq. Its total area around 24,975 km². Populations are 5,551,565 million capita^[35,36 & 37]. Fig (3.1) shows the plan of Iraq which includes location of the study area (Babylon, Al-Najaf and Kerbela cities).

In general, the climate of this area may be defined as semi-arid, subtropical and continental; of dry, hot and long summers, cool winters and short and mild springs. The features of this climate are^[38]:

- Large differences in temperature between day and night and between winter and summer (the maximum recorded temperature in the summer is 51 °C at 30 % humidity).
- Low atmospheric humidity particularly in summer (16%) with high evaporation (1900 mm/yr from open waters and 1100 mm/yr from agricultural area^[39]).
- Scantly rainfall on the average on 30 days annually mainly is the period from November to April and of the early average of 150mm.
- Almost constant movement of mass of air while the prevailing wind for the most part of the year is northwest.

Single river determines the hydrological conditions in the region: The Euphrates.



Fig. (3.1): The Plan of Iraq. [38].

3.3 Selective Industries in the Study Area

Table (3.1) shows the name of the factories and their addresses that selected in the present work. The selected factories are governmental and private activity.

Table (3.1): Name & Addresses of Factories Included In the Present Work.

(Arabic Version of this Table is Included in Appendix F).

Property Industries	Name of Factory	Address		
		Governorate	City	Sector
Textile	General company for textile industries	Babylon	Hilla	Nadir (2) area
	Arab Homeland factory	Babylon	Hilla	Industrial zone
	Al-Hadi factory	Babylon	Hilla	Industrial zone
	Al-Huda factory	Babylon	Hilla	Industrial zone
	Al-Hassen factory	Babylon	Hilla	Industrial zone
	Al-Amal factory	Babylon	Hilla	Industrial zone
	Al-Ekwan factory	Babylon	Hilla	Industrial zone
	Abu-Zaid factory	Babylon	Hilla	Industrial zone
	Al-Kawther factory	Babylon	Hilla	Industrial zone
Chemical	General company for chemical industries	Babylon	Al-musaib	Al-sadaa
Grain Mill	Euphrates company	Babylon	Hilla	Industrial zone
	Al-Eklass factory	Babylon	Hilla	Industrial zone
	Tariq factory	Babylon	Hilla	Industrial zone
	Babylon factory	Babylon	Hilla	Industrial zone
Brick	Al-Mahawil factory	Babylon	Al-Mahawil	Alkatonia
	Al-Eetimad factory	Babylon	Al-kifil	Al-kifil
	Al-Rafidain factory	Babylon	Al-Mahawil	Al-Mahawil
	Al-Salaam factory	Babylon	Al-Mahawil	Hatfara
	Al-Hashimia factory	Babylon	Al-Hashimia	Abu-Hema
	Sabir Al-Timimy factory	Al-Najaf	sea zone	Al-Heera
	Jubran factory	Babylon	Al-Mahawil	Hatfara

	Al-Nile factory	Babylon	Al-Mahawil	Hatfara
	Euphrates factory	Babylon	Al-Kifil	Al-Kifil
	Al-Faihaa factory	Babylon	Al-Kifil	Al-Kifil
Cement	Al-Sada cement factory	Babylon	Al-musaib	Al-sadaa
	Kerbela cement factory	Kerbela	Al-Nikib	Al-Nikib
	Al-Najaf Al-Ashraf cement factory	Al-Najaf	kufa	Al-Barakia
	Al-kufa cement factory	Al-Najaf	kufa	Al-Barakia
Lime	Lime- Kerbela factory	Kerbela	Al-Nikib	Al-Nikib
Soft Drink	Babylon for soft drink	Babylon	Hilla	Al-Jumhuri area
	Al-kufa for soft drink	Al-Najaf	kufa	Al-Abbasia
	Noor Kerbela for soft drink	Kerbela	Kerbela	Al-Maamalgy
Power Station	Al-Musaib power plant	Babylon	Al-musaib	Eskandaria
Rubber(Tire)	Rubber production factory	Al-Najaf	Al-Najaf	Addan area
Dairy	Al-Rifiq factory	Babylon	Al-musaib	Mhram area
	Al-Teeb factory	Babylon	Al-Mahawil	Hatfara
	Al-fiahaa factory	Babylon	Hilla	Industrial zone
	Babylon factory	Babylon	Abu- garak	Abu- garak
	Awlad Jumaa Ebadi Selman	Babylon	Al-musaib	Eskandaria
	Al-Sahal factory	Babylon	Al-musaib	Eskandaria
	Al-Wissam factory	Kerbela	Kerbela	Al-Maamalgy
Asphalt	Babylon asphalt factory	Babylon	Hilla	Al-tajia
	Ashur asphalt factory	Babylon	Hilla	Al-tajia
	Al-Janaeen asphalt factory	Babylon	Al-musaib	Eskandaria
	Qasim asphalt factory	Babylon	Al-musaib	Eskandaria

3.4 Data Collection

To obtain data about the industries, a site visits to the Directorate of environment in the study area (Babylon, Al-Najaf and Kerbela) were arranged.

Three forms of questionnaire paper were prepared and designated to collect data. The requested data was filled by the responsible engineer in each Directorate. The forms were arranged to include all necessary requested data to calculate the loads and for the studies EIA, They are:

- “*Form of general information*”, this form was designed to include all general information about the industry (name of industry, name of owner, position, land use in the past, production type, production capacity etc...). This form shows in Fig. (3.2).
- “*Form of liquid waste*”, this form was arranged to include all necessary information about the water and waste water (quantities, origin, control equipment, etc). This form shows in Fig. (3.3).
- “*Form of air pollution*”, this form was arranged to include the necessary information about the emission from industry (type of fuel used, control equipment, etc). Fig. (3.4) shows this form.

Fig. (3.2): Form of General Information (Researcher).

<u>General Information</u>	
▪ Activity name:	-----
▪ Activity type :	Non private -----
	Private -----
	Both -----
▪ Activity owner:	-----
▪ Type of production :	-----
▪ Site of activity:	Governorate -----
	District -----
	Sub district -----
▪ The activity lies in :	Popular residence ☐
	Industrial zone ☐
	Commercial zone ☐
	Agriculture zone ☐
▪ Nearest popular residence distance	----- (Km)
▪ SIC number	-----
▪ Date of construction	-----
▪ Design production capacity	----- (mention the units)
▪ Working production capacity	----- (mention the units)
▪ Is there any increasing in the production capacity?	Yes ☐ No ☐

Fig. (3.2): continued

The raw material used:

Raw material	Quantity (mention the units)	Origin	
		The present time	In the past

- The additional material : Acids

☐

Alkaline

☐

Paints

☐

Chemical material

☐

Others

☐

- Diagram to illustrate the process of the production :

- Number of working shift -----
- Number of working hours for each shift -----
- Total number of workers -----

Fig. (3.3): Form of Liquid Waste (Researcher).

<u>Liquid Waste</u>																																							
▪ liquid waste disposed ----- m³/year ▪ Source of water used in the industry: <table style="width: 100%; border: none;"> <tr> <td style="width: 30%;">Purification</td> <td style="width: 10%; text-align: center;">☐</td> <td style="width: 30%;">Wells</td> <td style="width: 10%; text-align: center;">☐</td> <td style="width: 20%;"></td> </tr> <tr> <td>Tanks</td> <td style="text-align: center;">☐</td> <td>River (name)</td> <td style="text-align: center;">☐</td> <td>Use ☐</td> </tr> </table> ▪ Quantity of water used in the industry: ----- (mention the units) ▪ Is there any treatment plant? yes ☐ No ☐ Treatment process and units ----- Year of operation ----- ▪ Ultimate disposal of water: <table style="width: 100%; border: none; margin-top: 10px;"> <tr> <td style="width: 30%;">Treatment plant</td> <td style="width: 10%; text-align: center;">☐</td> <td style="width: 30%;">well</td> <td style="width: 10%; text-align: center;">☐</td> <td style="width: 20%;"></td> </tr> <tr> <td colspan="3" style="margin-top: 10px;">Surface water (mention the name)</td> <td style="text-align: center;">☐</td> <td></td> </tr> </table> ▪ Is there any testing for the effluent from the factory? Yes ☐ No ☐ ▪ Type of test: <table style="width: 100%; border: none; margin-top: 10px;"> <tr> <td style="width: 15%;">BOD</td> <td style="width: 10%; text-align: center;">☐</td> <td style="width: 15%;">COD</td> <td style="width: 10%; text-align: center;">☐</td> <td style="width: 15%;">temperature</td> <td style="width: 10%; text-align: center;">☐</td> <td style="width: 15%;">Color</td> <td style="width: 10%; text-align: center;">☐</td> </tr> <tr> <td colspan="8" style="margin-top: 10px;">Other ----- (mention the name)</td> </tr> </table> ▪ Responsible of testing ----- ▪ Time interval between each test ----- ▪ Location of liquid waste disposal -----				Purification	☐	Wells	☐		Tanks	☐	River (name)	☐	Use ☐	Treatment plant	☐	well	☐		Surface water (mention the name)			☐		BOD	☐	COD	☐	temperature	☐	Color	☐	Other ----- (mention the name)							
Purification	☐	Wells	☐																																				
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Surface water (mention the name)			☐																																				
BOD	☐	COD	☐	temperature	☐	Color	☐																																
Other ----- (mention the name)																																							

Fig. (3.4): Form of Air Emissions (Researcher).

<u>Air Emissions</u>	
▪ Type of fuel used : fuel oil ☐ kerosene ☐ Else (mention of type) ----- ▪ Quantity of fuel used: ----- (mention the units) ▪ Is there any monitoring equipment? yes ☐ No ☐ Efficiency: ----- operating time: ----- Year of production: -----	Is there any maintenance for this monitoring equipment? Yes ☐ No ☐
▪ Is there any air pollution control? yes ☐ No ☐ Type: ----- number: ----- efficiency: -----	Operating time: ----- year of production: ----- Working situation work: ----- stopped: -----
Is the factory having an incinerator? Yes ☐ No ☐ Number----- efficiency: ----- capacity: -----	
▪ Number of stacks : ----- construction material ----- Inner diameter: ----- outside diameter: ----- height: -----	
▪ Wind direction : ----- ▪ Emission of unpleasant odors? yes ☐ No ☐ ▪ Rising of black cloud above the factory ?yes ☐ No ☐	

3.5 Classification of the Industries

The SIC (Standards Industrial Classification) was used to classified the industries in the present study (this standard number was arranged and adopted by UN in 1980 and rearranged in 1989) ^[40 & 41]. Appendix -A- represents the industrial activities classification.

Actually there are several standards for industrial classification, such as Canadian classification. The ministry of industry in Iraq adopted the SIC of UN for each governmental or private factories.

3.6 Environmental Pollution of Industrial Activities

3.6.1 Environmental Pollution of Bricks Manufacturing:

There are several potential sources of air emissions in the bricks industry: Particulate matter is the primary emission in the manufacture of bricks. The main source of dust is the materials handling procedure, which includes drying, grinding screening, and storing the raw material. Combustion products are emitted from the fuel consumed in the dryer and the kiln. Fluorides, largely in gaseous form, are also emitted from brick manufacturing operations. Sulfur dioxide may be emitted from the bricks when temperatures reach or exceed 1370C° (2500F°), but no data on such emissions are available ^[42 & 43].

No liquid wastes are generated from the production of bricks. ^[44].

3.6.2 Environmental Pollution of Cement Manufacturing:

There are several potential sources of air emissions in the cement industry: ^[45].

☒ *Emission of Particulate Matter (PM_{10})* may occur during:

- quarrying and crushing;
- raw material storage;
- grinding and blending (in the dry process only);
- clinker production;
- finish grinding; and
- Packaging and loading.

The largest single source of PM_{10} within cement plants is the preprocessing system that includes the kiln and raw material grinding exhaust stacks. The major constituents of PM_{10} as cement kiln dust are alumina, silica, calcium carbonate, and clay (the primary constituents of cement itself).

☒ *Emission of Nitrogen Oxides (NO_x)*: NO_x is generated in both the burning zone of the kiln and the burning zone of the precalcining vessel. Fuel use affects the quantity and type of NO_x generated.

☒ *Emission of Sulfur Dioxide (SO_2)*: SO_2 emissions may be generated both from the sulfur compounds in the raw materials and from the sulfur content of the fuel.

☒ *Emission of Metal Compounds*: Emissions of metal compounds from cement kilns can be grouped into three general classes: volatile metals,

e.g. mercury; semi-volatile metals, including antimony, cadmium, lead, selenium, and zinc; and refractory or non-volatile metals, including chromium, arsenic, nickel, manganese, and copper.

No liquid wastes are generated from the production of cement ^[46].

3.6.3 Environmental Pollution of Lime Manufacturing

Air emissions in lime manufacturing are generated by the handling and storage of intermediate and final materials, and by the operation of kiln systems, clinker coolers, and mills. These emissions are: ^[47].

- *Emission of Particulate Matter:* Particulate matter (PM₁₀) emissions are among the most significant impacts of lime manufacturing. For PM₁₀ emissions associated with intermediate and final materials handling and storage (including crushing and grinding of raw materials); handling and storage of solid fuels; transportation of materials (e.g. by trucks or conveyor belts), and bagging activities.
- *Emission of Nitrogen Oxides:* NO_x emissions are generated in the high temperature combustion process of the lime kiln, emissions depended mainly on the quality of lime produced and the design of kiln. Low-NO_x burners have been fitted to a few rotary kilns.
- *Emission of Sulfur Dioxides:* SO₂ emissions, principally from rotary kilns, depend on the sulphur content of the fuel, the design of kiln and the required sulphur content of the lime produced.
- *Emission of Carbon dioxide:* Carbon dioxide is emitted from the kiln as a result of the carbonate in the limestone being reduced to CO₂ gas, and the carbon in the fuel oxidizing.

No liquid wastes are generated from the production of lime. ^[47]

3.6.4 Environmental Pollution of Textile Manufacturing

The amount of the air pollutants such as PM and odor are few and for this reason the air emission can be regarded as no significant effect on the environment. ^[46].

The waste water is highly alkaline, colored, high BOD and temperature, high suspended solids ^[31]. These pollutants result from: ^[48].

- Many of the pollutants from fabric preparation result from the removal of previously applied processing chemicals and agricultural residues.
- Typically, scouring wastes contribute a large portion of biological oxygen demand (BOD₅) loads from preparation processes.
- Wastewater from mercerizing can contain amounts of high pH alkali, accounting for about 20 percent of the weight of goods.

3.6.5 Environmental Pollution of Grain Mill Manufacturing

There are several potential sources of air emissions in the grain mill industry: ^[49, 50 & 9].

- *Emission of Particulate Matter (PM₁₀)*: this pollutant could be emitted during the grain receiving, handling, cleaning, and storage, milling and loading.
- *Emission of VOC*: may occur during tempering.

The waste water in the grain mill factories depending on type of milling, liquid emission are BOD₅, TSS. The grain mill factories in this study didn't have water pollution.^[46].

3.6.6 Environmental Pollution of Soft Drink Manufacturing

No air emission from the soft drink industry.^[63] The waste water in the soft drink factories are high pH, suspended solids, and BOD.^[51 & 52]. In the present work the source of BOD₅ is the leak in device of drink's filler and from release production which unaccepted with limit.

3.6.7 Environmental Pollution of Dairy Products Manufacturing:

No air emission from the dairy product industry^[46]. Dairy effluents contain dissolved sugars and proteins, fats possibly residues of additives, and may be pathogens from contaminated materials or productions processes^[53 & 54]. Dairy wastes are largely neutral or slightly alkaline, but have tendency to become acid quickly because of the fermentation of milk sugar to lactic acid. Cheese plant waste is decidedly acid, because of the presence of whey.

Milk wastes contain very little suspended material (except the fine crud found in cheese waste).^[52].

3.6.8 Environmental Pollution of Steam Power Plant:

Air emissions are depended on the type of fuel (gaseous, liquid and solids).^[46]

The water pollution that produced from power plant is:^[11].

- 1) hot, concentrated water saline from boiler and evaporator blow down;
- 2) acid and alkaline chemical solutions used in cleaning power plant equipment;
- 3) water from blow down of cooling towers, containing minerals in high concentrations;
- 4) waste water from washing stack gases;
- 5) acid and caustic solutions resulting from the regeneration of ion-exchange softeners and demineralization water-treatment plants which are used for conditioning feed water for boilers and evaporators;
- 6) hot alkaline water from blowing down chemical softening plants;
- 7) acid water drainage from coal storage;
- 8) drainage from cinder and ash dumps;
- 9) sanitary sewage;
- 10) oil, greases, miscellaneous solid and liquid wastes;

3.6.9 Environmental Pollution of Asphalt Manufacturing:

The most significant source of emissions from hot mix asphalt plants is the dryer. The emission from HMA includes: [55, 56 & 57].

- *Particulate Matter (PM_{10})* emissions from:
 - ❖ Aggregate storage piles are generally caused by front-end loader operations that transport the aggregate to the cold feed unit hoppers.

The amount of PM₁₀ emissions from aggregate piles will be greater in strong winds.

- ❖ PM₁₀ emissions from parallel flow drum mix plants are reduced because the aggregate and asphalt cement mix for a longer time.
- ❖ The amount of PM₁₀ generated within the dryer in this process is usually lower than that generated within batch dryers, but because the bitumen is heated to higher temperatures for a longer period of time.
- VOC emissions from the transport and handling of the hot-mix from the mixer to the storage silo and also from the load-out operations to the delivery trucks. Storage tanks may be a source of VOC emissions.
- Incomplete combustion in the dryer burner increases emissions of CO and organics (gaseous and liquid aerosol). This may be caused by:
 - ❖ Improper air and fuel mixtures such as poor mixing prior to combustion;
 - ❖ Inadequate residence time, and temperature that is too low; and
 - ❖ Flame quenching.
- NO_x is formed by conversion of some of the nitrogen in the burner fuel. Residual fuel oils may contain significant amounts of nitrogen, distillate oils and natural gas contain very little.
- The type of fuel and its sulfur content will affect SO₂, Sulfur in the burner fuel will convert to sulfur oxides during combustion; burner operation will have little effect on the percent of this conversion.

No liquid wastes are generated from the production of asphalt^[46].

3.6.10 Environmental Pollution of Chemical Manufacturing:

The Air pollution is: ^[58].

- The contaminants are HCl gas, chlorine, and chlorinated organic compounds. Emissions from HCl production result primarily from gases exiting the HCl purification system. The sulfur dioxide in the gas is contaminated with dust, acid mist, and gaseous impurities.
- Air emissions consist of mercury vapour and chlorine gas.
- Major emissions from wet process Phosphoric acid production include; gaseous fluorides, mostly silicon tetrafluoride (SiF₄) and hydrogen fluoride (HF).
- The major source of emissions from the thermal Phosphoric process is H₃PO₄ mist contained in the gas stream from the hydrator. The particle size of the acid mist ranges from 1.4 to 2.6mm.
- Nearly all sulfur dioxide emissions from sulfuric acid plants are found in the exit stack gases.

Wastewater streams from mercury cell facilities arise from the chlorine drying process, brine purge, and miscellaneous sources.

3.6.11 Environmental Pollution of Tire Manufacturing:

Air emissions from tire manufacturing originate from two general sources: ^[59] (1) The rubber compounds themselves; and (2) solvents used for cement, inks, or lubrication. The emissions from these two general sources include both PM and VOC.

Particulate emissions occur primarily from mixing and grinding. Particulate emissions have been identified in the milling process, however the quantity of these emissions appear to be small.

VOC emissions from rubber tire manufacturing originate from three general processes:

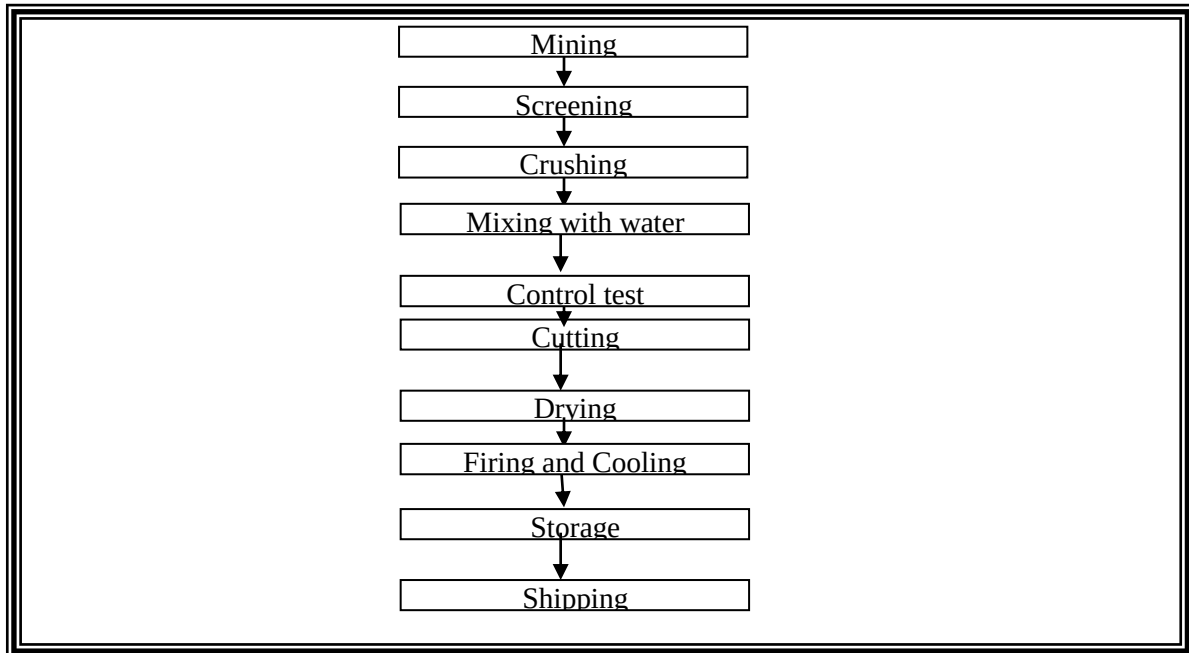
- (1) The mixing and milling of rubber compounds, where these compounds are manipulated and generate heat;
- (2) The incorporation of solvent and cementing liquids on components for tire building, such as beads, under treads, and sidewalls, and the use of solvents in lubricating the green tire; and,
- (3) Curing.

In this study the amount of the air pollutants such as PM and VOC are few and for this reason the air emission can be regarded as no significant effect on the environment. ^[63].

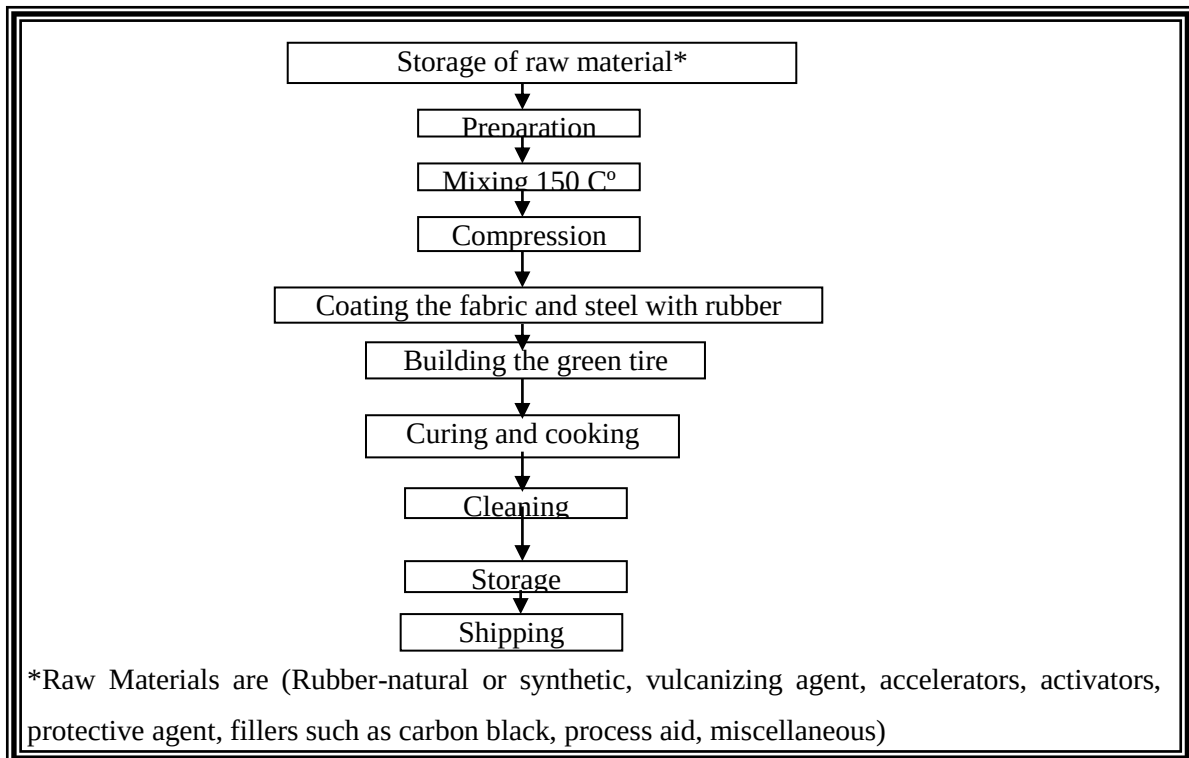
The waste water contains high BOD and odor, high suspended solids, variable pH, high chlorides. These waste result from washing of latex, coagulated rubber, exuded impurities from crude rubber. ^[52].

3.7 Existing Technical Path for the Industries in the Present Work

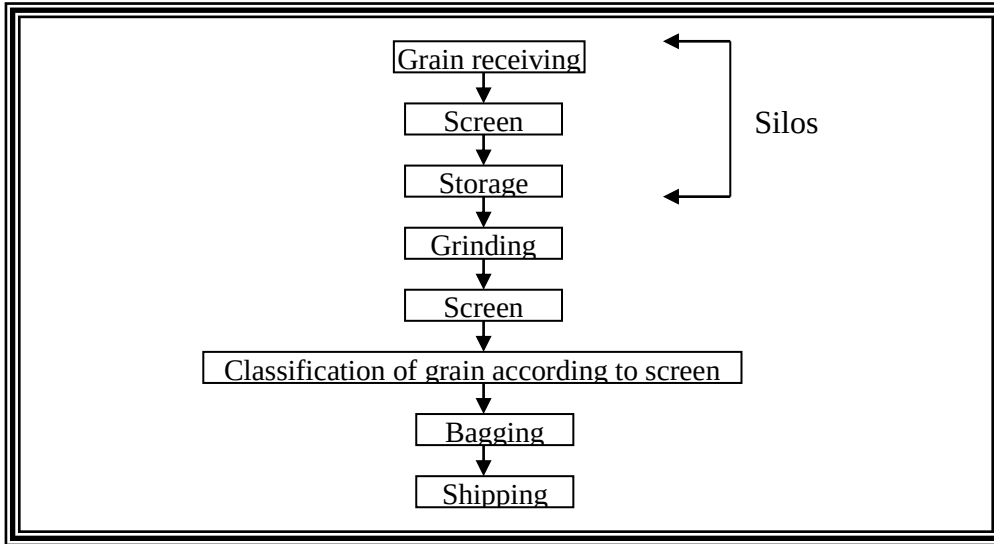
3.7.1 Bricks Manufacturing Processes: ^[35 & 36]



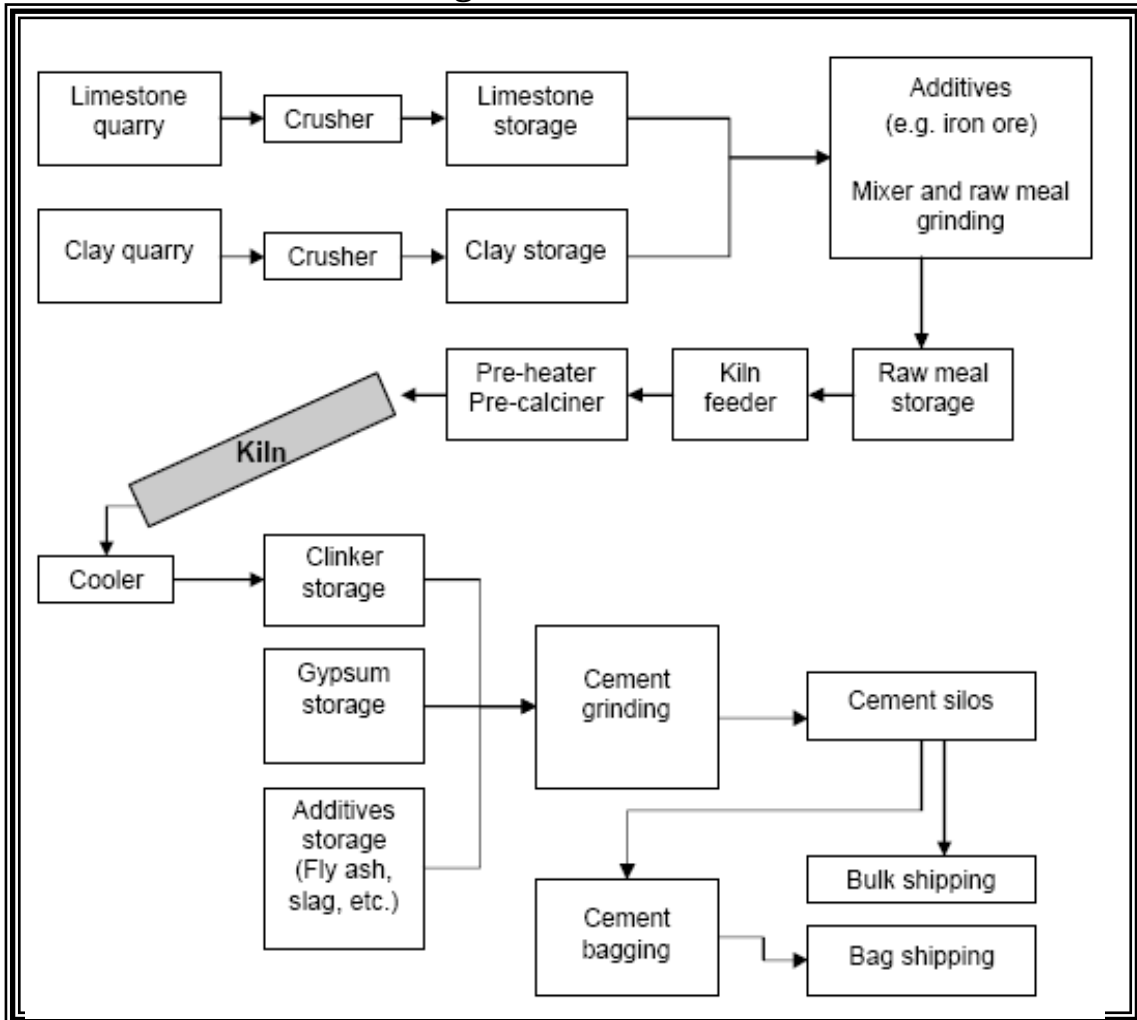
3.7.2 Tire Manufacturing Process: ^[35]



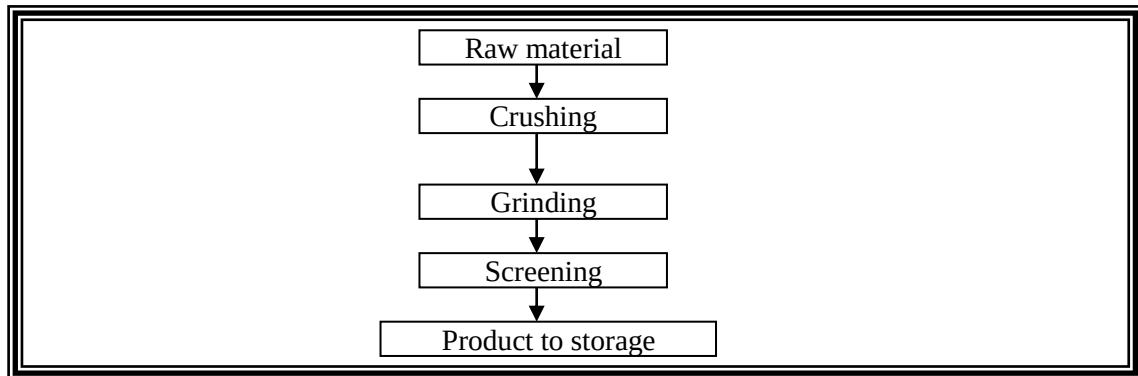
3.7.3 Grain Mill Manufacturing Processes: ^[36].



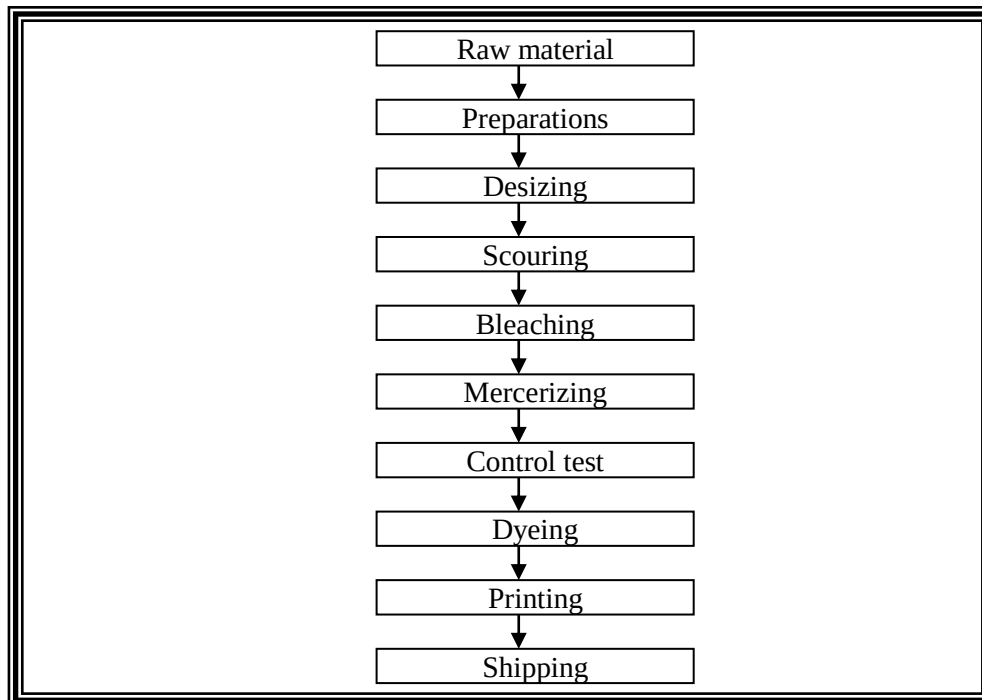
3.7.4 Cement Manufacturing Processes: ^[35, 36 & 37].



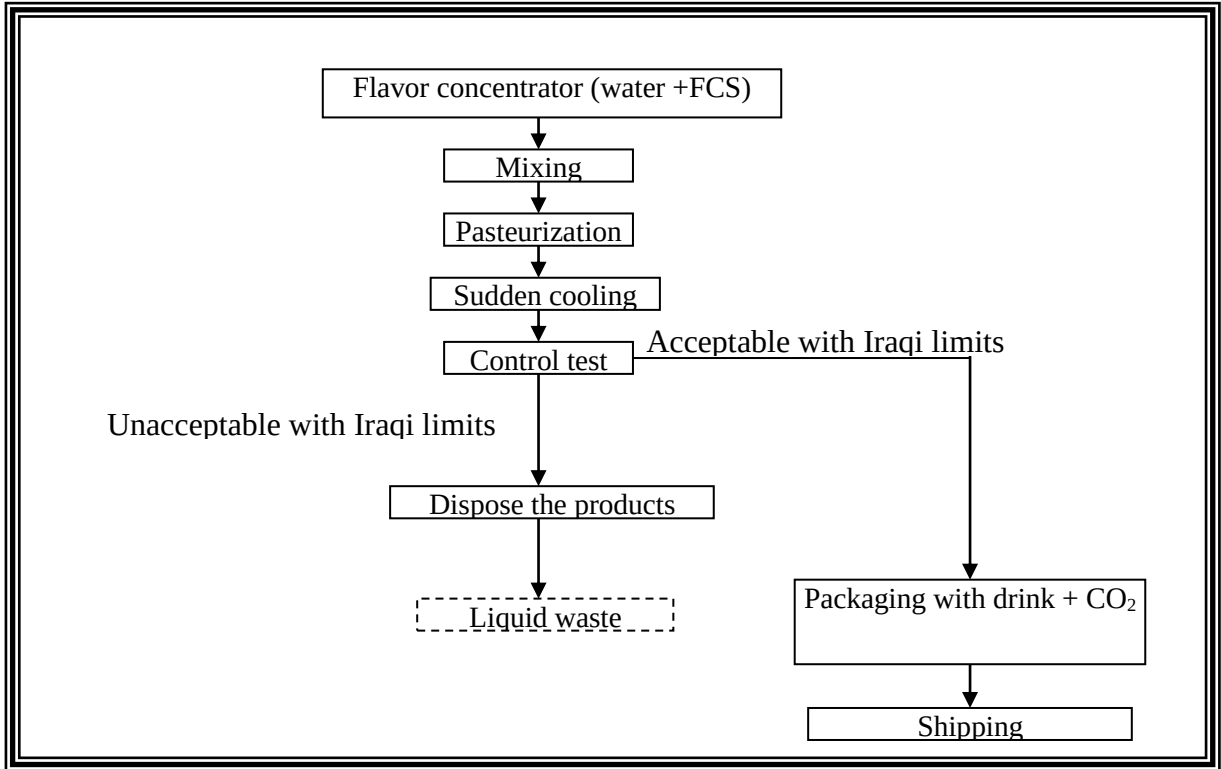
3.7.5 Lime Manufacturing Process: ^[37].



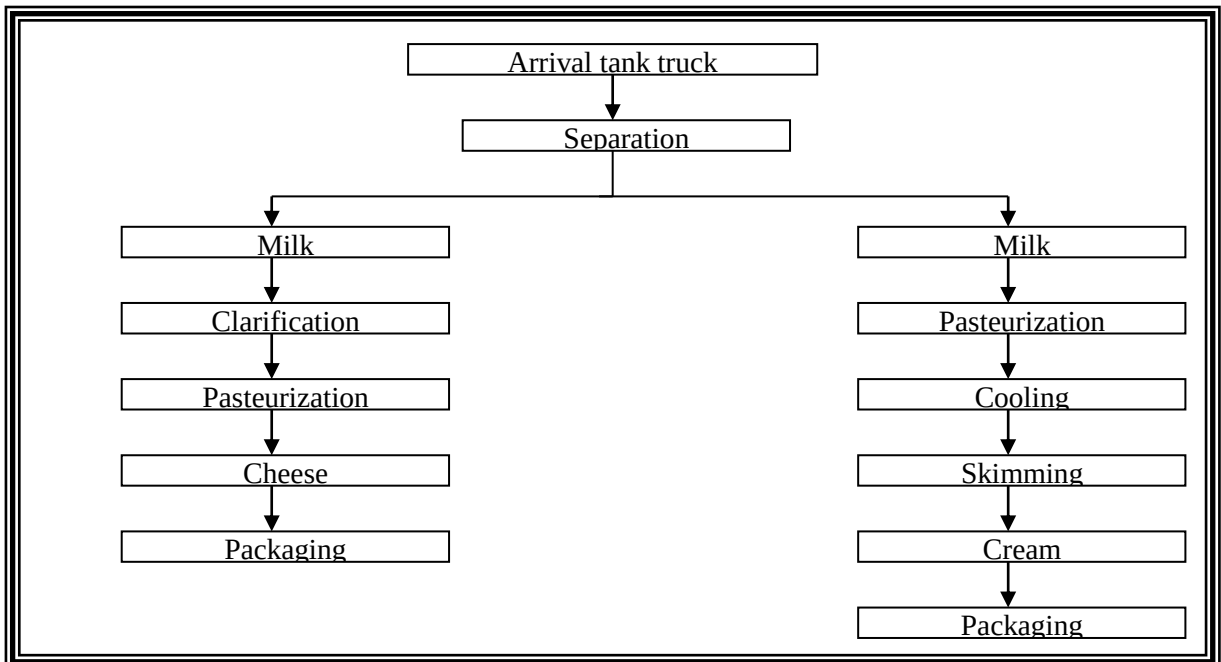
3.7.6 Textile Manufacturing Processes: ^[36].



3.7.7 Soft Drink Manufacturing Processes: [35, 36 & 37].

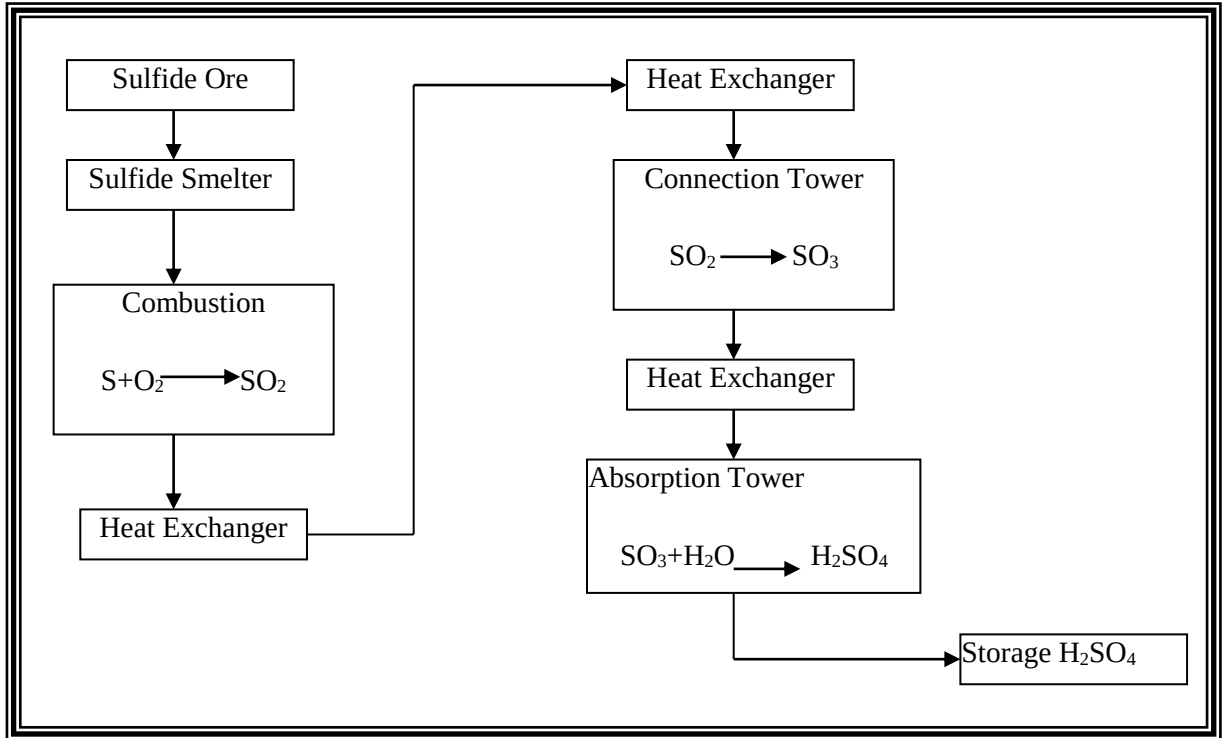


3.7.8 Dairy Manufacturing Processes: [36 & 37].

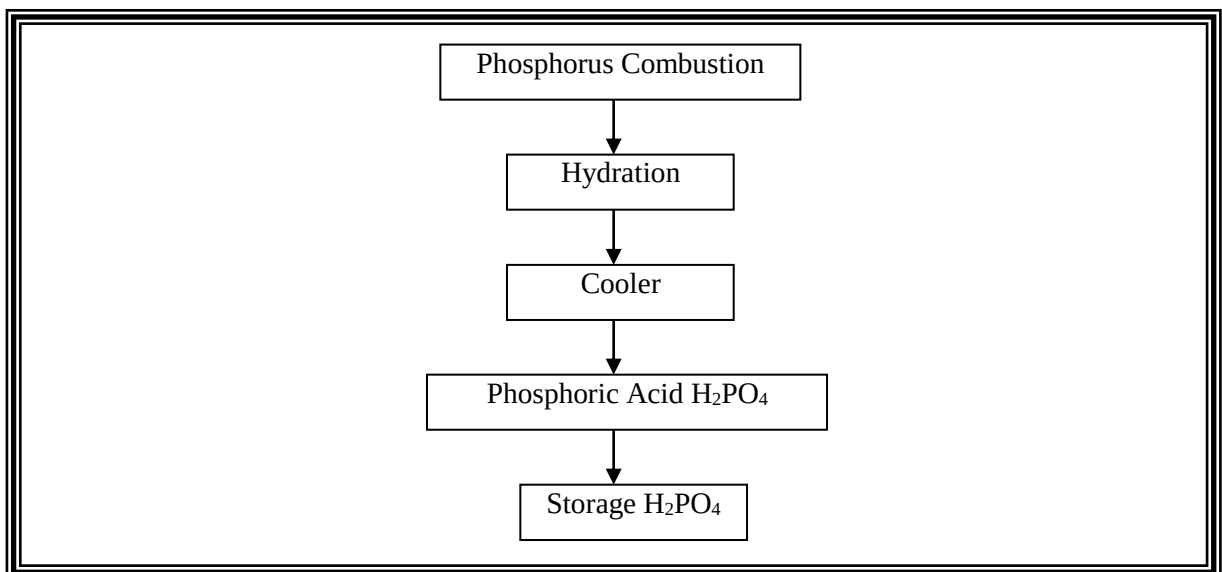


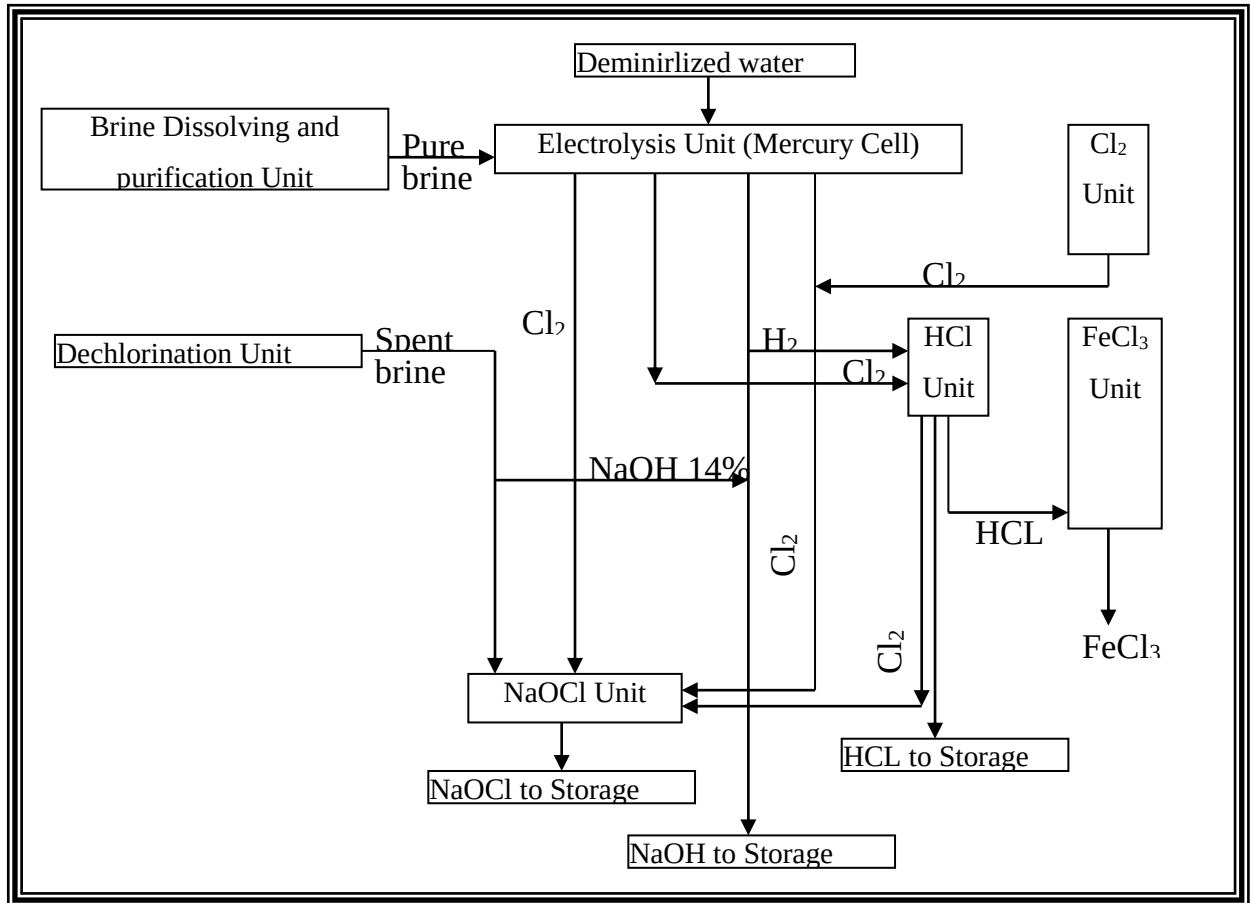
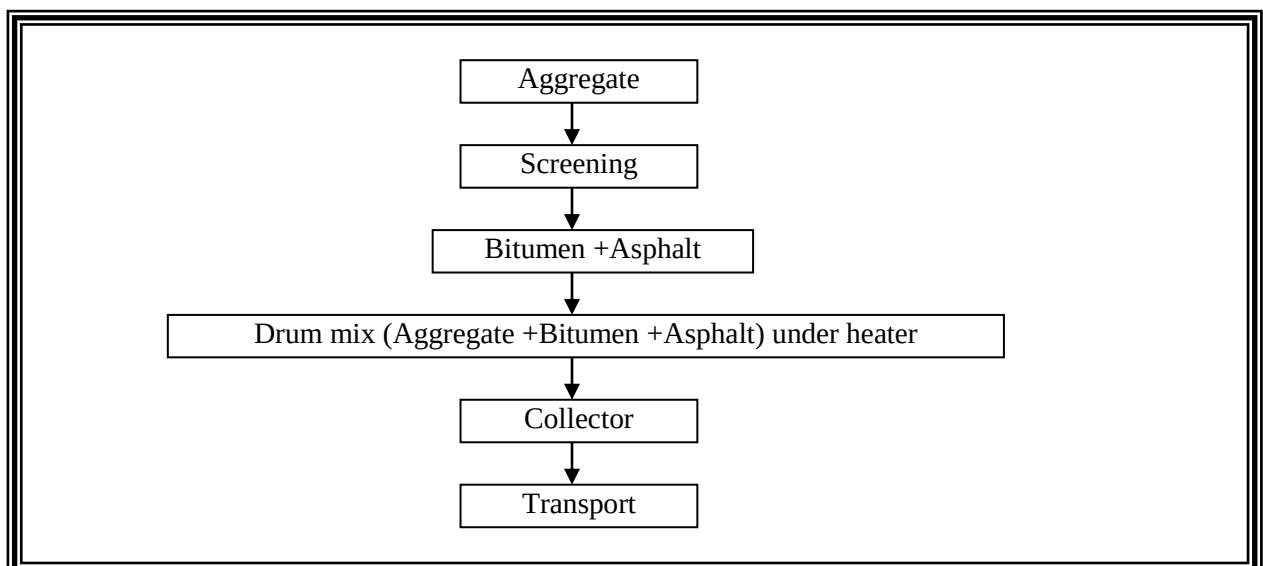
3.7.9 Chemical Manufacturing Processes: ^[36].

3.7.9.1 Sulfuric Acid



3.7.9.2 Phosphoric Acid: ^[36].



3.7.9.3 Caustic Soda and HCL: ^[36].3.7.10 Asphalt Manufacturing Processes: ^[36].

CHAPTER FOUR

4

COMPUTER PROGRAM

4.1 Introduction

This chapter includes the Rapid Environmental Impact Assessment Program (expert system), flow chart, and applying this expert system for Al-Hassan textile factory to show how the computer program was done.

4.2 Expert System Computer Program

A computer program in a Visual Basic(version 6.0) was designed to construct an expert system that works with the information gathered in this thesis and calculate the pollution load and pollutants concentration for the factories in the study.

The program was divided into three main parts: 1st named *Listing of general information*, 2nd named *Calculation of the pollution loads* and the 3rd name *Data Updating*.

Each part in the above division is divided into sub parts which helps to choose the desired information's for each factory or industrial activity.

Fig. (4.1) shows the structure of the program. The data entered to the expert system are written. The industry includes:

1. APPA (appendix A listing the activities including the air, water and solids waste inventory control models, classification under SIC system, UN (1989)).
2. APPB (appendix B for air pollutants factors (WHO; 1993)).
3. APC (appendix C for liquid waste factors (WHO; 1993)).
4. General information about each factory in the present work was written.
5. Summary, The summary includes:
 - a) GOV.(the name of governorate)
 - b) FAC. (The name of factory).
 - c) SIC (Standard Industrial Classification).
 - d) DPC (Design Production Capacity).
 - e) WPC (Working Production Capacity).
 - f) DISWW (working discharge of liquid waste)
 - g) Q air (design and working emission to air)
 - h) RES (Type of receiver).
 - i) TP (Treatment Plant).
 - j) Working efficiency of treatment.

The steps of computer program are as follows:

Part 1: Listing of the General Information

In this part, general information about the selected factory (information which gathered from general information) is shown in the monitor forms. The user can select the factory according to:

1. The industrial activity type.
2. The position (according to the governorate) of the factory.
3. The name of factory. Then, click Factory's Information button.

Part 2: Calculation of the Pollution Loads

This part of program calculates the design, working pollution loads, concentration of pollutants resulted from the factory which polluted the environment component (air, water) then compared these concentrations with Iraqi and WHO limits (eq. (2.1 – 2.10)). The computer program presents the results as a table. The calculation depends on the data base information about the factory and the pollution factors accomplished by (WHO). The user can:

1. Click (CALCULATIONS) button to obtain the environmental assessment of the industrial activity.
2. Select the industrial activity type.
3. Click the (SELECT PROCESS).
4. Select the first manufacturing process of the industrial activity from the appendix B (Air pollutants factors) and C (Liquid waste

factors).

5. Click the (SELECT PROCESS) button.
6. Select second process if its exist.
7. Click the (SELECT PROCESS) button and repeat from step (3) for the factory has more manufacturing process.
8. Click the (FACTORY EVALUATE) button to obtain the table with results.
9. Click the (PLEASE PRESS ME TO CALCULATE THE AIR POLLUTION) button if the factory produced liquid wastes in addition to air pollution and repeat the steps from (2).

Part 3: Data Updating

Data updating is permitted for all information in the data base (summary). Updating includes:

1. Adding.
 - A. New factories and corresponding information's.
 - B. New industrial activity (this need write the information in industry file, write only the steps 4 and 5).
2. Delete any factory or industrial activity with all corresponding data.
3. Updating of the existing data.

4.3 Applying Expert System Computer Program

The expert system computer program would apply for Al-Hassen textile factory in Babylon governorate .

The screenshot shows a window titled 'Form1' with a light orange background. At the top, there are two dropdown menus: 'INDUSTRIAL ACTIVITY TYPE' and 'CHOOSE GOVERNORATE'. Below these is a grey button labeled 'BROWSING FACTORIES'. At the bottom, there are three orange buttons: 'UPDATING', 'CALCULATIONS', and 'FACTORIES INFORMATION'.

The screenshot shows the same 'Form1' window, but now the 'INDUSTRIAL ACTIVITY TYPE' dropdown is set to 'الصناعات النسيجية' (Textile Industries) and the 'CHOOSE GOVERNORATE' dropdown is set to 'BABIL'. The 'BROWSING FACTORIES' button is still present. Below it, a list box is open, displaying a list of factories in Arabic. The list includes: 'شركة الوطن العربي', 'معمل نسيج ابو زيد', 'معمل نسيج الاخوان', 'معمل نسيج الامل', 'معمل نسيج الخنيس', 'معمل نسيج الحلة', 'معمل نسيج الكوثر', and 'معمل نسيج الهادي'. The 'FACTORIES INFORMATION' button is highlighted in orange.

LIQUIDS

SELECT THE INDUSTRIAL TYPE

THE MANUFACTURING PROCESS

SIC	Process	UNIT	WASTE VOLUME	BOD5	TSS	TOTN	TOTP	OIL	CR	PH	SUL	HG	FL
	Desizing	tn of cotton	22	58	30								
	Kiering	tn of cotton	100	53	22								
	Bleaching	tn of cotton	100	8	5								
	Mercerizing	tn of cotton	35	8	2.5								
	Dyeing	tn of cotton	50	60	25								
	Printing	tn of cotton	14	54	12								
	Rayon processing	tn of rayon	42	30	55								
	Acetate process	tn of acetate	75	45	40								
	Nylon process	tn of nylon	125	45	30								
	Acrylic process	tn of acrylic	210	125	87								
	Polyester process	tn of polyester	100	185	95								
	Sedimentation			0.6	0.4								

SIC	Process	UNIT	WASTE VOLUME	BOD5	TSS	TOTN	TOTP	OIL	CR	PH	SUL	HG	FL

LIQUIDS

SELECT THE INDUSTRIAL TYPE

THE MANUFACTURING PROCESS

SIC	Process	UNIT	WASTE VOLUME	BOD5	TSS	TOTN	TOTP	OIL	CR	PH	SUL	HG	FL
	Dyeing	tn of cotton	50	60	25								
	Printing	tn of cotton	14	54	12								
	Rayon processing	tn of rayon	42	30	55								
	Acetate process	tn of acetate	75	45	40								
	Nylon process	tn of nylon	125	45	30								
	Acrylic process	tn of acrylic	210	125	87								
	Polyester process	tn of polyester	100	185	95								
	Sedimentation			0.6	0.4								
	Coagulation / Sedimentation			0.6	0.15								
	Anaerobic lagoon			0.2	0.3								
	Aerobic lagoon			0.05	0.05								
	Activated sludge			0.4	0.05								

	BOD5	TSS	TOTN	TOTP	WASTE VOL								
DESIGN LOAD	3.375	2.97	0	0	3.78								
WORKING LOAD	1.8	3.3	0	0	584								
CONCENTRATION.(DESIGN)	892.8	785.7	0	0									
CONCENTRATION.(WORKING)	3082	5650	0	0									
EVAL IRAQ STNAD.(DESIGN)	ACCEPTABLE	UNACCEPT	Pending	Pending	Pending								
EVAL IRAQ STNAD.(WORKING)	UNACCEPT	UNACCEPT	Pending	Pending	Pending								

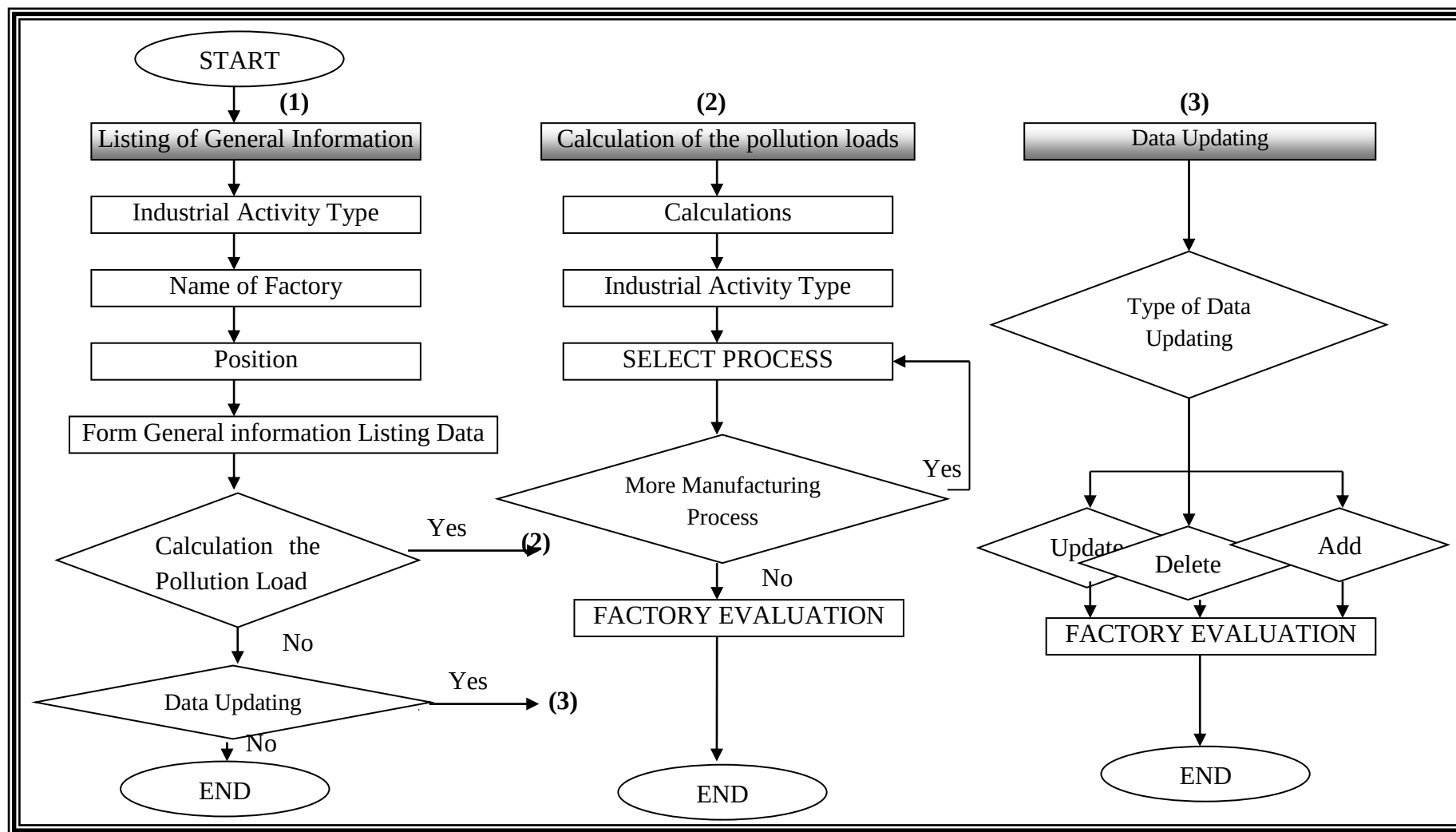


Fig (4.1): Structure of the Expert System (Researcher)

CHAPTER FIVE

5

CALCULATIONS AND RESULTS

5.1 Introduction

This chapter was divided into three parts, the first part is *air pollution calculations* (pollution loads and concentration of air pollutants) using equations (2.1 to 4). The pollutants that concerned for the industries in the present work are: TSP, SO₂, NO_x, VOC, CO, Cl₂, HCL, SO₃ and F₂ as listed in WHO air pollutants factors (appendix-B-).

The second part is *liquid pollution calculations* (pollution loads and concentration of liquid pollutants) using equations (2.5 to 9). The pollutants that concerned for the industries in the present work are: BOD₅, TSS, Tot N , Tot P, Oil, Cr, Cu, Ni, Zn and Hg as listed in WHO liquid pollutants factors (appendix-C-).

Table (5.1) shows the indicators, abbreviations and their units that used in first part and second part.

The third part is *applying Environmental Impact Assessment (EIA)* using Leopold matrix method to assess impact.

5.2 Air Pollutants Calculations

The industrial facilities that included in the present study and have significant air pollution in WHO inventory technique are industries of bricks, cement, lime, grain mill, power plant, asphalt and chemical industries. The pollutants that concerned for these industries are: TSP, SO₂, NO_x, VOC, CO, Cl₂, HCL, SO₃, and F₂ according to WHO Rapid Technique. Tables (5.2 to 7) show the design and working pollutants loads from asphalt, bricks, cement and lime, chemical industries, grain mill factories and power plant. While tables (5.8 to 13) show the design and working concentration of these pollutants that result from these industries. Table (5.14) shows the design and working air pollution loads for the middle Euphrates region. Table (5.15) shows the working air pollution loads for the middle Euphrates region with percentage. While table (5.16) shows the design and working concentration of pollutants from these industries in the middle Euphrates region.

5.3 Liquid Waste Calculations

The industrial facilities that included in the present study are: dairy products, power plant, rubber products, soft drink and textile manufacturing. The pollutants that concerned these industries are BOD₅, TSS, total N, total P, Oil, Cr, Cu, Ni, Zn and Hg according to WHO Rapid Technique. For these industries loads and concentration were calculated. Tables (5.17 – 5.22) show the pollutants loads from chemical industries, dairy products, power plant, rubber products, and soft drink and textile factories respectively. While tables (5.23 - 5.28) show the concentration of

these pollutants that result from chemical industries, dairy products, power plant, rubber products, and soft drink and textile factories respectively. Table (5.29) shows the design and working liquid pollution loads for the middle Euphrates region , while the working liquid pollution loads for the middle Euphrates region with percentage shows in table (5.30).The design and working concentration of liquid pollutants from these industries in the middle Euphrates region show in table (5. 31) .

5.4 Comparison of Pollutants Concentrations with Available Limits

To knowledge that the pollution generated from the industrial activity if it is compliance with the environmental limits, a comparison of pollutants concentration that calculated from equation (2.4) for air pollution and equation (2.9) for liquid pollution, were done with the Iraqi limits and WHO limits .Table (5.32) shows the comparison of design and working air pollutants concentration that emission from each factory with WHO limits .While table (5.33) shows the comparison of design and working liquid pollutants concentration that released from each factory with Iraqi effluent standards.

5.5 Applying An EIA

The magnitude of the impacts (b) was calculated by division concentration of any element (in working state) on standard limits (concentration), If there is no guideline for any parameter the magnitude of the impacts was calculated from division concentration of the element (in working state) on concentration of the element (in design state) while importance of the impacts (a) was selected between (0–5). The matrices (5.1-5.45) show the Leopold matrix of each factory in the present work. Tables (5.34 – 5.42) represent the impact of Q, TSP, SO₂, NO_x, CO, VOC, F₂ and SO₃ on the air environment. While tables (5.43 – 5.53) represent the impact of Q, BOD₅, TSS, TotN, TotP, Oil, Cr, Cu, Ni, Zn and Hg on the water environment.

Table (5.1): Indicators, Abbreviations and Units for parameters.

<i>Indicators</i>	<i>Abbreviations</i>	<i>Units</i>
Accepted with limits	Acc.	$\mu\text{g}/\text{m}^3$ (air) , mg/l (liquid)
Design Production Capacity	DPC	10^3 U/y
Design Flow Rate, Waste Volume (liquid)	D.F.R =W.V	$10^3\text{m}^3/\text{y}$
Design Emission Rate (air)	D.E.R	m^3/y
Design Load	D.L	tn/y
Design Concentration	D.C	$\mu\text{g}/\text{m}^3$ (air) , mg/l (liquid)
Efficiency of Treatment	E.T	-----
Euphrates river	Euph.r	-----
Factor of waste volume	Fa	m^3/U
Load	L	tn/y
Name of other pollutants	Na	-----
Factor of air pollution	F	Kg/U
Pending	Pen.	-----
Factor of liquid waste (design state)	F.d	Kg/U
Factor of liquid waste (working state)	F.w	Kg/U
Flow Rate (liquid), emission rate (air)	Q	m^3/y
Sewerage system	S.sy	-----
Unit	U	-----
Unaccepted with limits	Unacc.	$\mu\text{g}/\text{m}^3$ (air) , mg/l (liquid)
Working Concentration	W.C	$\mu\text{g}/\text{m}^3$ (air) , mg/l (liquid)
Working Load	W.L	tn/y
Working Production Capacity	WPC	10^3 U/y
Working Flow Rate (liquid)	W.F.R	m^3/y
Working Emission Rate (air)	W.E.R	m^3/y

Table (5.2): Design and Working Air Pollutants Loads for Asphalt Factories.

Source	U	DPC	WPC	TSP		
				F	D.L	W.L
354 Manufacture of Miscellaneous Products of Petroleum and Coal						
معمل إسفلت شركة آشور						
Asphaltic Concrete Plants						
Dryer Drum Hot Mix						
Cyclone or Multicyclone	tn	525.6	438	0.34	178.7	148.9
معمل إسفلت بابل						
Asphaltic Concrete Plants						
Dryer Drum Hot Mix						
Cyclone or Multicyclone	tn	700.8	700.8	0.34	238.3	238.3
معمل إسفلت الجنائن						
Asphaltic Concrete Plants						
Dryer Drum Hot Mix						
Cyclone or Multicyclone	tn	131.4	87.6	0.34	44.7	44.7
معمل إسفلت قاسم						
Asphaltic Concrete Plants , Dryer Drum Hot Mix						
Cyclone or Multicyclone	tn		87.6	0.34	44.7	29.8
Total					506.4	461.7

Table (5.3): Design and Working Air Pollutants Loads for Bricks Factories.

Source	U	DPC	WPC	TSP			SO ₂			NO _x			CO			VOC			F ₂		
				F	D.L	W.L	F	D.L	W.L	F	D.L	W.L	F	D.L	W.L	F	D.L	W.L	F	D.L	W.L
3691 Manufacture of Structural Clay Products																					
Bricks and Clay Products																					
معمل طابوق الاعتماد																					
Raw Materials Handling																					
Drying																					
Uncontrolled	tn	47.3	36.8	35	1656	1288	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grinding																					
Uncontrolled	tn	47.3	36.8	38	1797	1398	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage																					
Uncontrolled	tn	47.3	36.8	17	804	626	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Curing and Firing																					
Periodic Kilns																					
Oil Fired	tn	47.3	36.8	0.44	20.8	16.2	11.72	554	431.3	0.81	38.3	29.8	0.095	4.5	3.5	0.025	1.2	0.92	0.5	23.7	18.4
Sub Total					4278	3328		554	431.3		38.3	29.8		4.5	3.5		1.2	0.92		23.7	18.4
معمل طابوق جبران																					
Raw Materials Handling																					
Drying																					
Uncontrolled	tn	78.8	39.4	35	2758	1379	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grinding																					
Uncontrolled	tn	78.8	39.4	38	2994	1497	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage																					
Uncontrolled	tn	78.8	39.4	17	1340	670	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Curing and Firing																					
Periodic Kilns																					
Oil Fired	tn	78.8	39.4	0.44	34.7	17.3	11.72	924	461.8	0.81	63.8	31.9	0.095	7.5	3.7	0.025	2.0	0.99	0.5	39.4	19.7
Sub Total					7127	3563		924	461.8		63.8	31.9		7.5	3.7		2.0	0.99		39.4	19.7

معمل طابوق الراقدين																					
Raw Materials Handling																					
Drying																					
Uncontrolled	tn	78.8	47.3	35	2758	1656	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grinding																					
Uncontrolled	tn	78.8	47.3	38	2994	1797	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage																					
Uncontrolled	tn	78.8	47.3	17	1340	804	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Curing and Firing																					
Periodic Kilns																					
Oil Fired	tn	78.8	47.3	0.44	34.7	20.8	11.72	924	554	0.81	63.8	38.3	0.095	7.5	4.5	0.025	2.0	1.2	0.5	39.4	23.7
Sub Total					7127	4278		924	554		63.8	38.3		7.5	4.5		2.0	1.2		39.4	23.7
معمل طابوق السلام																					
Raw Materials Handling																					
Drying																					
Uncontrolled	tn	59.1	39.4	35	2067	1379	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grinding																					
Uncontrolled	tn	59.1	39.4	38	2246	1497	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage																					
Uncontrolled	tn	59.1	39.4	17	1005	670	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Curing and Firing																					
Periodic Kilns																					
Oil Fired	tn	59.1	39.4	0.44	26.0	17.3	11.72	693	461.8	0.81	47.9	31.9	0.095	5.6	3.7	0.025	1.5	0.99	0.5	30.0	19.7
Sub Total					5345	3563		693	461.8		47.9	31.9		5.6	3.7		1.5	0.99		30.0	19.7
معمل طابوق صابر التميمي																					
Raw Materials Handling																					
Drying																					
Uncontrolled	tn	197	92	35	6895	3320	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grinding																					
Uncontrolled	tn	197	92	38	7486	3496	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Storage																					
Uncontrolled	tn	197	92	17	3349	1564	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Curing and Firing																					
Periodic Kilns																					
Oil Fired	tn	197	92	0.44	86.7	40.5	11.72	2309	1078	0.81	159.6	74.5	0.095	18.7	8.7	0.025	4.9	2.3	0.5	98.5	46
Sub Total					17817	8320		2309	1078		159.6	74.5		18.7	8.7		4.9	2.3		98.5	46
معمل طابوق الفرات																					
Raw Materials Handling																					
Drying																					
Uncontrolled	tn	39.4	39.4	35	1379	1379	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grinding																					
Uncontrolled	tn	39.4	39.4	38	1497	1497	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage																					
Uncontrolled	tn	39.4	39.4	17	670	670	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Curing and Firing																					
Periodic Kilns																					
Oil Fired	tn	39.4	39.4	0.44	17.3	17.3	11.72	461.8	461.8	0.81	31.9	31.9	0.095	3.7	3.7	0.025	0.99	0.99	0.5	19.7	19.7
Sub Total					3563	3563		461.8	461.8		31.9	31.9		3.7	3.7		0.99	0.99		19.7	19.7
معمل طابوق الفيحاء																					
Raw Materials Handling																					
Drying																					
Uncontrolled	tn	39.4	32.9	35	1379	1152	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grinding																					
Uncontrolled	tn	39.4	32.9	38	1497	1250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage																					
Uncontrolled	tn	39.4	32.9	17	670	559	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Curing and Firing																					
Periodic Kilns																					
Oil Fired	tn	39.4	32.9	0.44	17.3	14.5	11.72	461.8	385.6	0.81	31.9	26.6	0.095	3.7	3.1	0.025	0.99	0.82	0.5	19.7	16.5
Sub Total					3563	2975		461.8	385.6		31.9	26.6		3.7	3.1		0.99	0.82		19.7	16.5

معمل طابوق المحاويل																					
Raw Materials Handling																					
Drying																					
Uncontrolled	tn	576	34.6	35	20160	1211	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grinding																					
Uncontrolled	tn	576	34.6	38	21888	1315	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage																					
Uncontrolled	tn	576	34.6	17	9792	588	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Curing and Firing																					
Periodic Kilns																					
Oil Fired	tn	576	34.6	0.44	167.0	10.0	11.72	4562	274.0	0.81	302.4	18.2	0.095	34.6	2.1	0.025	9.5	0.57	0.5	288	17.3
Sub Total					52007	3124		4562	274.0		302.4	18.2		34.6	2.1		9.5	0.57		288	17.3
معمل طابوق النيل																					
Raw Materials Handling																					
Drying																					
Uncontrolled	tn	552	158	35	19320	5530	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grinding																					
Uncontrolled	tn	552	158	38	20976	6004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage																					
Uncontrolled	tn	552	158	17	9384	2686	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Curing and Firing																					
Periodic Kilns																					
Oil Fired	tn	552	158	0.44	242.9	69.5	11.72	6469	851.8	0.81	447.1	128	0.095	52.4	15.0	0.025	13.8	4.0	0.5	276	79
Sub Total					49923	14290		6469	851.8		447.1	128		52.4	15.0		13.8	4.0		276	79
معمل طابوق الهاشمية																					
Raw Materials Handling																					
Drying																					
Uncontrolled	tn	46	39.4	35	1610	1379	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grinding																					
Uncontrolled	tn	46	39.4	38	1748	1497	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Storage																					
Uncontrolled	tn	46	39.4	17	782	670	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Curing and Firing																					
Periodic Kilns																					
Oil Fired	tn	46	39.4	0.44	20.24	17.3	11.72	539	461.8	0.81	37.3	31.9	0.095	4.4	3.7	0.025	1.15	0.99	0.5	23	19.7
Sub Total					4160	5345		539	461.8		37.3	31.9		4.4	3.7		1.15	0.99		23	19.7
Total					154910	52349		17898	5422		1224	443		142.6	51.7		38.0	13.8		857.4	279.7

Table (5.4): Design and Working Air Pollutants Loads the Cement and Lime Factories.

Source	U	DPC	WPC	TSP			SO ₂			NO _x			CO		
				F	D.L	W.L	F	D.L	W.L	F	D.L	W.L	F	D.L	W.L
3692 Manufacturing of Cement, Lime and Plaster															
Lime Manufacturing															
معمل النوره - كربلاء															
Raw Materials Storage	tn	110	73	0.16	17.6	11.7	0	0	0	0	0	0	0	0	0
Crushing & Screening															
Uncontrolled	tn	110	73	1.5	165	109.5	0	0	0	0	0	0	0	0	0
Crushed Material Storage															
Open Piles	tn	110	73	1.0	110	73	0	0	0	0	0	0	0	0	0
Raw Materials Conveying															
Uncontrolled	tn	110	73	1.2	132	87.6	0	0	0	0	0	0	0	0	0
Raw Material Calcining															
Vertical Shaft Kiln															
Uncontrolled	tn	110	73	3.0	330	219	3.6	396	262.8	0.1	11	7.3	2.0	220	146
Lime Packaging / Shipping	tn	110	73	0.12	13.2	8.8	0	0	0	0	0	0	0	0	0
Sub Total					767.8	400		396	262.8		11	7.3		220	146
3692 Manufacturing of Cement, Lime and Plaster															
Cement Manufacturing															

معمل سمنت السدة															
Raw Materials Storage Crushing & Screening															
Primary and Secondary Crushing															
Uncontrolled	tn	210	96	4.2	882	403.2	0	0	0	0	0	0	0	0	0
Raw Materials Conveying															
Uncontrolled	tn	210	96	1.5	315	144	0	0	0	0	0	0	0	0	0
Raw Material Grinding and Calcining															
Dry Process Kiln															
Uncontrolled	tn	210	96	128	26880	12288	1.02	214.2	97.9	2.15	451.5	206.4	0	0	0
Clinker storing															
Open Piles	tn	210	96	5.4	1134	518	0	0	0	0	0	0	0	0	0
Clinker Grinding															
Tube Mill / Open Piles															
ESP or FF	tn	210	96	0.05	10.5	4.8	0	0	0	0	0	0	0	0	0
Cement Storing in Silos	tn	210	96	0.13	27.3	12.5	0	0	0	0	0	0	0	0	0
Cement Shipment															
Bulk Loading	tn	210	96	0.1	21	9.6	0	0	0	0	0	0	0	0	0
Packaging															
Uncontrolled	tn	210	96	2.2	462	211.2	0	0	0	0	0	0	0	0	0
Sub Total					29732	13592		214.2	97.9		451.5	206.4		0	0
معمل سمنت كربلاء															
Raw Materials Storage Crushing & Screening															
Primary and Secondary Crushing															
Uncontrolled	tn	2000	216	4.2	8400	907	0	0	0	0	0	0	0	0	0
Raw Materials Conveying															
Uncontrolled	tn	2000	216	1.5	3000	324	0	0	0	0	0	0	0	0	0
Raw Material Grinding and Calcining															
Dry Process Kiln															
Uncontrolled	tn	2000	216	128	256000	27648	1.02	2040	220.3	2.15	4300	464.4	0	0	0
Clinker storing															

Open Piles	tn	2000	216	5.4	10800	1166	0	0	0	0	0	0	0	0	0
Clinker Grinding															
Tube Mill / Open Piles															
ESP or FF	tn	2000	216	0.05	100	10.8	0	0	0	0	0	0	0	0	0
Cement Storing in Silos	tn	2000	216	0.13	260	28.1	0	0	0	0	0	0	0	0	0
Cement Shipment															
Bulk Loading	tn	2000	216	0.1	200	21.6	0	0	0	0	0	0	0	0	0
Packaging															
Uncontrolled	tn	2000	216	2.2	4400	475.2	0	0	0	0	0	0	0	0	0
Sub Total					283160	30581		2040	220.3		4300	464.4		0	0
معمل سمنت الكوفة الجديد															
Raw Materials Storage Crushing & Screening															
Primary and Secondary Crushing															
Uncontrolled	tn	2190	548	4.2	9198	2302	0	0	0	0	0	0	0	0	0
Raw Materials Conveying															
Uncontrolled	tn	2190	548	1.5	3285	822	0	0	0	0	0	0	0	0	0
Raw Material Grinding and Calcining															
Dry Process Kiln															
Uncontrolled	tn	2190	548	128	280320	70144	1.02	2234	559	2.15	4709	1178	0	0	0
Clinker storing															
Open Piles	tn	2190	548	5.4	11826	2959	0	0	0	0	0	0	0	0	0
Clinker Grinding															
Tube Mill / Open Piles															
ESP or FF	tn	2190	548	0.05	109.5	27.4	0	0	0	0	0	0	0	0	0
Cement Storing in Silos	tn	2190	548	0.13	284.7	71.2	0	0	0	0	0	0	0	0	0
Cement Shipment															
Bulk Loading	tn	2190	548	0.1	219	54.8	0	0	0	0	0	0	0	0	0
Packaging															
Uncontrolled	tn	2190	548	2.2	4818	1205.6	0	0	0	0	0	0	0	0	0
Sub Total					310060	77586		2234	559		4709	1178		0	0

معمل سمنت التجف الاشراف															
Raw Materials Storage Crushing & Screening															
Primary and Secondary Crushing															
Uncontrolled	tn	219	183	4.2	920	769	0	0	0	0	0	0	0	0	0
Raw Materials Conveying															
Uncontrolled	tn	219	183	1.5	328.5	274.5	0	0	0	0	0	0	0	0	0
Raw Material Grinding and Calcining															
Dry Process Kiln															
Uncontrolled	tn	219	183	128	28032	23424	1.02	223.4	186.7	2.15	470.9	393.5	0	0	0
Clinker storing															
Open Piles	tn	219	183	5.4	1183	988	0	0	0	0	0	0	0	0	0
Clinker Grinding															
Tube Mill / Open Piles															
ESP or FF	tn	219	183	0.05	11.0	9.15	0	0	0	0	0	0	0	0	0
Cement Storing in Silos	tn	219	183	0.13	28.5	23.8	0	0	0	0	0	0	0	0	0
Cement Shipment															
Bulk Loading	tn	219	183	0.1	21.9	18.3	0	0	0	0	0	0	0	0	0
Packaging															
Uncontrolled	tn	219	183	2.2	481.8	402.6	0	0	0	0	0	0	0	0	0
Sub Total					31006	25909		223.4	186.7		470.9	393.5		0	0
Total					654726	148068		5080.6	1326.7		9942.4	2249.6		220	146

S%= 4 contents of sulfur in the fuel (reference 5).

Table (5.5): Design and Working Air Pollutants Loads for *Chemicals Industrial Factory*.

Source	U	DPC	WPC	TSP			SO ₂			Other Pollutants			
				F	D.L	W.L	F	D.L	W.L	Na.	F	D.L	W.L
3511 Manufacturing of Industrial Chemical													
351 Basic Industrial Chemical Except Fertilizers													
الشركة العامة للصناعات الكيماوية/معمل حرير السدة													
<i>Chlor-Alkali Production</i>													
Mercury Cell Process													
Air Blowing the Cell Brine	tn	8.8	2.6	0	0	0				Cl ₂	2.5	22	6.5
Blow Gases from Liquefaction													
Caustic or Lime Absorber	tn	8.8	2.6	0	0	0				Cl ₂	0.5	4.4	1.3
Loading of Chlorine													
Storage & Tank Car Vents	tn	8.8	2.6	0	0	0				Cl ₂	8.25	27.6	21.5
<i>Hydrochloric Acid (by-product process)</i>													
Uncontrolled	tn	13.5	2.2	0	0	0				HCL	3.0	40.5	6.6
<i>Sulfuric Acid</i>													
Sulfide Ores	tn	14.6	11	0	0	0	14	204.4	154	SO ₃	2.15	31.4	23.7
<i>Phosphoric Acid</i>													
Thermal Process													
Controlled	tn	6.6	5.1	1.0	6.6	5.1					0	0	0
Total					6.6	5.1		204.4	154	D.Cl₂=54,	W.Cl₂=29.3,	D.HCL=40.5,	
										W.HCL=6.6,	D.SO₃=31.4,	W.SO₃= 23.7	

e = 98% single absorption plants.

Table (5.6): Design and Working Air Pollutants Loads for Grain Mill Factories.

Source	U	DPC	WPC	TSP		
				F	D.L	W.L
3116 Grain Mills						
معمل طحين الإخلاص						
Wheat Milling						
Uncontrolled	tn	22	18.3	38.0	836	695
معمل طحين بابل						
Wheat Milling						
Uncontrolled	tn	4.2	3	38.0	159.6	114
معمل طحين طارق						
Wheat Milling						
Uncontrolled	tn	8.4	6	38.0	319.2	228
شركة الفرات لطحن الحبوب						
Wheat Milling						
Uncontrolled	tn	54.8	43.8	38.0	2082	1664
Total					3397	2701

Table (5.7): Design and Working Air Pollutants Loads for the *Power Station*.

Source	U	DPC	WPC	TSP	SO ₂	NO _x	CO	VOC	SO ₃
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				F	D.L	W.L	F	D.L	W.L	F	D.L	W.L	F	D.L	W.L	F	D.L	W.L	F	D.L	W.L
410 Electricity Gas and Steam																					
محطة كهرباء المسيب الحرارية																					
Liquid Fuels																					
Residual Fuel Oil																					
Utility Boilers																					
Uncontrolled	tn	0.05	0.035	5.68	0.3	0.2	80	4	2.8	8.5	0.43	0.3	0.64	0.03	0.02	0.127	0.01	0.004	1	0.05	0.035

Table (5.8): Design and Working Concentration of Air Pollutants for Asphalt Factories.

Source	U	Q		TSP			
		D.E.R	W.E.R	D.L	W.L	D.C	W.C
معمل إسفلت شركة آشور	tn	2*10 ¹²	1.2*10 ¹²	178.7	148.9	89.4	124
معمل إسفلت بابل	tn	3*10 ¹²	3*10 ¹²	238.3	238.3	79.4	79.4
معمل إسفلت الجنائن	tn	0.5*10 ¹²	0.3*10 ¹²	44.7	44.7	89.4	149
معمل إسفلت قاسم	tn	0.5*10 ¹²	0.3*10 ¹²	44.7	29.8	89.4	99.3
Total		6*10¹²	4.8*10¹²	506.4	461.7	347.6	451.7

Table (5.9): Design and Working Concentration of Air Pollutants for the Bricks Factories.

Source	U	Q		TSP				SO ₂				NO _x				CO				VOC				F ₂			
		D.E.R	W.E.R	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C
طابق الاعتماد	tn	43*10 ¹²	0.14*10 ¹²	4278	99.5	3328	23771	554	12.9	431.3	3081	38.3	0.9	29.8	212.9	4.5	0.1	3.5	25	1.2	0.02	0.92	6.6	23.7	0.6	18.4	131.4
طابق جبران	tn	70*10 ¹²	1.5*10 ¹²	7127	101.8	3563	2375	924	31.2	461.8	307.8	63.8	0.9	31.9	21.3	7.5	0.1	3.7	2.6	2.0	2.8	0.99	0.7	39.4	0.6	19.7	13.1
طابق الرافدين	tn	71*10 ¹²	1.4*10 ¹²	7127	100.4	4278	3056	924	13	554	396	63.8	0.9	38.3	27.4	7.5	0.1	4.5	3.2	2.0	2.8	1.2	0.9	39.4	0.6	23.7	16.9
طابق السلام	tn	54*10 ¹²	1.3*10 ¹²	5345	99	3563	2741	693	12.8	461.8	340	47.9	0.9	31.9	24.5	5.6	0.1	3.7	2.8	1.5	2.7	0.99	0.8	30	0.4	19.7	15.2
طابق صابر التميمي	tn	456*10 ¹² ₂	3.5*10 ¹²	17817	39.1	8320	2377	2309	5.1	1078	308	159.6	0.3	74.5	21.3	18.7	4.1	8.7	2.5	4.9	1.1	2.3	0.66	98.5	0.2	46	13.1
طابق الفرات	tn	35*10 ¹²	1.4*10 ¹²	3563	101.8	3563	2545	461.8	13.2	461.8	325	31.9	0.9	31.9	22.8	3.7	0.1	3.7	2.6	0.99	2.8	0.99	0.7	19.7	0.6	19.7	14
طابق الفيحاء	tn	40*10 ¹²	1.4*10 ¹²	3563	89	2975	2125	461.8	11.5	385.6	275.4	31.9	0.8	26.6	19	3.7	0.09	3.1	2.2	0.99	0.02	0.82	0.6	19.7	0.5	16.5	11.8
طابق المحاويل	tn	496*10 ¹² ₂	6.5*10 ¹²	52007	104.8	3124	480.6	4562	9.2	274	42.2	302.4	0.6	18.2	2.8	34.6	6.7	2.1	0.3	9.5	1.9	0.57	0.1	288	0.6	17.3	2.7
طابق النيل	tn	454*10 ¹² ₂	8*10 ¹²	49923	110	14290	1786	6469	14.2	851.8	106.5	447.1	1	128	16	52.4	0.1	15	1.9	13.8	3	4	0.5	276	0.6	79	9.9
طابق الهاشمية	tn	37*10 ¹²	1*10 ¹²	4160	112.4	5345	5345	539	14.6	461.8	461.8	37.3	1	31.9	31.9	4.4	0.1	3.7	3.7	1.15	3.1	0.99	0.99	23	0.6	19.7	19.7
Total		1756*10 ¹²	26.1*10 ¹²	154910	957.8	52349	46602	17898	137.7	5422	5644	1224	8.2	443	400	142.6	11.6	51.7	46.8	38.0	20.2	13.8	46.8	857.4	5.3	279.7	247.8

Table (5.10): Design and Working Concentration of Air Pollutants for the *Cement and Lime* Factories.

Source	U	Q		TSP				SO ₂				NO _x				CO			
		D.E.R	W.E.R	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C
معمل النورة-كربلاء	tn	10*10 ¹²	2.5*10 ¹²	767.8	77	400	160	396	36.9	262.8	105	11	1.1	7.3	2.9	220	22	146	58.4
معمل سميت السدة	tn	416*10 ¹²	45*10 ¹²	29732	71.5	13592	302	214.2	0.5	97.9	2.2	451.5	1.1	206.4	4.6	0	0	0	0
معمل سميت كربلاء	tn	3750*10 ¹²	71*10 ¹²	283160	75.5	30581	431	2040	0.5	220.3	3.1	4300	1.1	464.4	6.5	0	0	0	0
معمل سميت الكوفة الجديد	tn	4250*10 ¹²	128*10 ¹²	310060	73	77586	606	2234	0.5	559	4.4	4709	1.1	1178	9.2	0	0	0	0
معمل سميت النجف الاشرف	tn	430*10 ¹²	76*10 ¹²	31006	72	25909	341	223.4	0.5	186.7	2.5	470.9	1.1	393.5	5.2	0	0	0	0
Total		8856*10 ¹²	322.5*10 ¹²	654726	369	148068	1840	5080.6	38.9	1326.7	117.2	9942.4	5.5	2249.6	28.4	220	22	146	58.4

Table (5.11): Design and Working Concentration of Air Pollutants for the *Industrial Chemical Factory*.Table (5.12): Design and Working Concentration of Air Pollutants for the *Grain Mill*

Source	U	Q		TSP				SO ₂				Other Pollutant				
		D.E.R	W.E.R	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C	Na.	D.L	D.C	W.L	W.C
الشركة العامة للصناعات الكيماوية/معمل حرير السدة																
Chlor-Alkali Production	tn	5*10 ¹²	1.2*10 ¹²	0	0	0	0	0	0	0	0	CL ₂	54	11	29.3	24.4
Hydrochloric Acid (by-product process)	tn	0.45*10 ¹²	0.3*10 ¹²	0	0	0	0	0	0	0	0	HCL	40.5	90	6.6	22
Sulfuric Acid	tn	2 *10 ¹²	1 *10 ¹²	0	0	0	0	204.4	102.2	154	154	SO ₃	31.4	16	23.7	23.7
Phosphoric Acid	tn	0.07*10 ¹²	0.03*10 ¹²	6.6	94.3	5.1	170	0	0	0	0		0	0	0	0
Total		7.5*10 ¹²	2.5*10 ¹²	6.6	94.3	5.1	170	204.4	102.2	154	154					

Source	U	Q	TSP
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		D.E.R	W.E.R	D.L	D.C	W.L	W.C
معمل طحين الإخلاص	tn	$7*10^{12}$	$4*10^{12}$	836	119.4	695	173.8
معمل طحين بابل	tn	$2*10^{12}$	$0.7*10^{12}$	159.6	80	114	162.9
معمل طحين طارق	tn	$3*10^{12}$	$1*10^{12}$	319.2	106.4	228	228
شركة الفرات لطحن الحبوب	tn	$20*10^{12}$	$11*10^{12}$	2082	104.1	1664	151.3
Total		$32*10^{12}$	$16.7*10^{12}$	3397	410	2701	716

Table (5.13): Design and Working Concentration of Air Pollutants for the Power Station.

Source	U	Q		TSP				SO ₂				NO _x				CO				VOC				SO ₃			
		D.E.R	W.E.R	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C
محطة كهرباء	tn	$0.04*10^{12}$	$0.02*10^{12}$	0.3	7.5	0.2	10	4	100	2.8	140	0.43	10.8	0.3	15	0.03	0.75	0.02	1	0.01	0.25	0.004	0.2	0.05	1.25	0.035	1.75
المسيب الحرارية																											

Table (5.14): Design and Working Air Pollutants Loads of the Middle Euphrates region.

Governorate	Industrial activity	No. of Factories	Q		TSP		SO ₂		NO _x		CO		VOC		F ₂		CL ₂		HCL		SO ₃	
			D.E.R	W.E.R	D.L	W.L	D.L	W.L	D.L	W.L	D.L	W.L	D.L	W.L	D.L	W.L	D.L	W.L	D.L	W.L	D.L	W.L
Babylon	Asphalt	4	$6*10^{12}$	$4.8*10^{12}$	506.4	461.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Bricks	9	1300*10 ¹²	19.1*10 ¹²	137093	44029	15589	4344	1064	368.5	123.9	43	33.1	11.5	758.9	233.7	0	0	0	0	0	0
	Cement	1	416*10 ¹²	45*10 ¹²	29732	13592	214.2	97.9	451.5	206.4	0	0	0	0	0	0	0	0	0	0	0	0
	Chemical	1	7.5*10 ¹²	2.5*10 ¹²	6.6	5.1	204.4	154	0	0	0	0	0	0	0	0	54	29.3	40.5	6.6	31.4	23.7
	Grain mill	4	32*10 ¹²	16.7*10 ¹²	3397	2701	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Power station	1	0.04*10 ¹²	0.02*10 ¹²	0.3	0.2	4	2.8	0.43	0.3	0.03	0.02	0.01	0.004	0	0	0	0	0	0	0.05	0.035
Sub Total		20	1761.5*10¹²	88.12*10¹²	170735	60789	16012	4598.7	1516	575.2	124	43.02	33.11	11.504	758.9	233.7	54	29.3	0	6.6	31.4	23.735
Al-Najaf	Bricks	1	456*10 ¹²	3.5*10 ¹²	17817	8320	2309	1078	159.6	74.5	18.7	8.7	4.9	2.3	98.5	46	0	0	0	0	0	0
	Cement	2	4680*10 ¹²	204*10 ¹²	341066	103495	2457.4	745.7	5179.9	1571.5	0	0	0	0	0	0	0	0	0	0	0	0
Sub Total		3	5136*10¹²	207.5*10¹²	358883	111815	4766	1823.7	5340	1646	18.7	8.7	4.9	2.3	98.5	46	0	0	0	0	0	0
Kerbala	Cement	1	3750*10 ¹²	71*10 ¹²	283160	30581	2040	220.3	4300	464.4	0	0	0	0	0	0	0	0	0	0	0	0
	Lime	1	10*10 ¹²	2.5*10 ¹²	767.8	400	396	262.8	11	7.3	220	146	0	0	0	0	0	0	0	0	0	0
Sub Total		2	3760*10¹²	73.5*10¹²	283928	30981	2436	483.1	4300	471.7	220	146	0	0	0	0	0	0	0	0	0	0
Total		25	10658*10¹²	369*10¹²	813546	203585	23214	6906	11156	2693	362.7	197.72	38	13.804	857.4	279.7	54	29.3	40.5	6.6	31.4	23.735

Table (5.15): Working Air Pollutants Loads of the Middle Euphrates region with Percentage.

Governorate	Industrial activity	No. of Factories	Q		TSP		SO ₂		NO _x		CO		VOC		F ₂		CL ₂		HCL		SO ₃	
			W.E.R	%	W.L	%	W.L	%	W.L	%	W.L	%	W.L	%	W.L	%	W.L	%	W.L	%	W.L	%
Babylon	Asphalt	4	4.8*10 ¹²	1	461.7	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Bricks	9	19.1*10 ¹²	5	44029	22	4344	63	368.5	14	43	22	11.5	83	233.7	84	0	0	0	0	0	0
	Cement	1	45*10 ¹²	12	13592	7	97.9	1	206.4	8	0	0	0	0	0	0	0	0	0	0	0	0
	Chemical	1	2.5*10 ¹²	0.7	5.1	0	154	2	0	0	0	0	0	0	0	0	29.3	100	6.6	100	23.7	100
	Grain mill	4	16.7*10 ¹²	5	2701	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Power station	1	0.02*10 ¹²	0	0.2	0	2.8	0	0.3	0	0.02	0	0.004	0	0	0	0	0	0	0	0.035	0
Sub Total		20	88.12*10¹²	24	60789	30	4598.7	66	575.2	22	43.02	22	11.504	83	233.7	84	29.3	100	6.6	100	23.735	100
Al-Najaf	Bricks	1	3.5*10 ¹²	1	8320	4	1078	16	74.5	3	8.7	4	2.3	17	46	16	0	0	0	0	0	0
	Cement	2	204*10 ¹²	55	103495	50	745.7	11	1571.5	58	0	0	0	0	0	0	0	0	0	0	0	0
Sub Total		3	207.5*10¹²	56	111815	54	1823.7	27	1646	61	8.7	4	2.3	17	46	16	0	0	0	0	0	0
Kerbala	Cement	1	71*10 ¹²	19	30581	15	220.3	3	464.4	17	0	0	0	0	0	0	0	0	0	0	0	0
	Lime	1	2.5*10 ¹²	0.7	400	0.2	262.8	4	7.3	0.3	146	74	0	0	0	0	0	0	0	0	0	0
Sub Total		2	73.5*10¹²	20	30981	15	483.1	7	471.7	17	146	74	0	0	0	0	0	0	0	0	0	0
Total		25	369*10¹²	100	203585	100	6906	100	2693	100	197.7	100	13.804	100	279.7	100	29.3	100	6.6	100	23.735	100

Table (5.16): Design and Working Air Pollutants Concentration of the Middle Euphrates region.

Governorate	Industrial activity	No. of Factories	TSP		SO ₂		NO _x		CO		VOC		F ₂		CL ₂		HCL		SO ₃	
			D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C
<i>Babylon</i>	Asphalt	4	347.6	96.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Bricks	9	918.7	44225	132.6	227	7.9	19.3	7.5	2.3	19.1	0.6	5.1	12.2	0	0	0	0	0	0
	Cement	1	71.5	302	0.5	2.2	1.1	4.6	0	0	0	0	0	0	0	0	0	0	0	0
	Chemical	1	49.3	2	102.2	61.6	0	0	0	0	0	0	0	0	11	11.7	90	2.6	16	9.5
	Grain mill	4	410	161.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Power station	1	7.5	10	100	140	10.8	15	0.75	1	0.25	0.2	0	0	0	0	0	0	1.25	1.75
Sub Total		20	1804.6	44495	335.3	430.8	19.8	39	8.25	3.3	19.35	0.8	5.1	12.2	11	11.7	90	2.6	17.25	11.3
Al-Najaf	Bricks	1	39.1	2377	5.1	308	0.3	21.3	4.1	2.5	1.1	0.7	0.2	13.1	0	0	0	0	0	0
	Cement	2	145	507	1	3.7	2.2	7.7	0	0	0	0	0	0	0	0	0	0	0	0
Sub Total		3	184.1	2884	6.1	311.7	2.5	29	4.1	2.5	1.1	0.7	0.2	13.1	0	0	0	0	0	0
Kerbala	Cement	1	75.5	431	0.5	3.1	1.1	6.5	0	0	0	0	0	0	0	0	0	0	0	0
	Lime	1	77	160	36.9	105	1.1	2.9	22	58.4	0	0	0	0	0	0	0	0	0	0
Sub Total		2	152.5	591	37.4	108.1	2.2	9.4	22	58.4	0	0	0	0	0	0	0	0	0	0
Total		25	2141.2	47970	378.8	850.6	24.5	77.3	34.35	64.2	20.45	1.5	5.3	25.3	11	11.7	90	2.6	17.25	11.3

Table (5.17): Design and Working Liquid Pollutants Loads for *Chemical Industries Factory*.

Source	U	DPC	WPC	Q			TSS				Hg			
				Fa	D.F.R	W.F.R	F.d	F.w	D.L	W.L	F.d	F.w	D.L	W.L
الشركة العامة للصناعات الكيماوية/معمل حرير السدة														
Chlor-alkali														

Mercury Cell																
Untreated	tn	8.8	2.6	1.2 ⁽⁶³⁾	10.6	10950	5.6	2.66	49.3	6.9	0.15	0.15	1.32	0.39		

Table (5.18): Design and Working Liquid Pollutants Loads for the *Dairy Products Factories*.

Source	U	DPC	WPC	Q			BOD ₅				TSS			Tot N			Tot P			
				Fa	D.F.R	W.F.R	F.d	F.w	D.L	W.L	F.d,F.w	D.L	W.L	F.d,F.w	D.L	W.L	F.d	F.w	D.L	W.L
معمل البان أولاد جمعة عبادي سلمان																				
Dairies																				
Receiving Station																				
Bulk	tn	0.18	0.18	0.08	0.01		0.035	0.17	0.006	0.03	0.03	0.005	0.005	0.06	0.01	0.01	0.01	0.013	0.002	0.002
Fluid Products	tn	0.18	0.18	3.1	0.56		0.66	3.21	0.12	0.58	1.5	0.27	0.27	0.31	0.06	0.06	0.53	0.68	0.10	0.12
Cottage Cheese																				
With Whey Recovery	tn	0.18	0.18	7.7	1.4		4.45	21.7	0.8	3.9	3.4	0.61	0.61	0	0	0	0	0	0	0
Natural Cheese																				
With Whey Recovery	tn	0.18	0.18	2.3	0.41		0.45	2.2	0.08	0.4	0.2	0.04	0.04	1.56	0.28	0.28	0.27	0.34	0.05	0.06
Sub Total					2.37	912.5			1.01	4.9		0.92	0.92		0.35	0.35			0.15	0.19
معمل البان بابل																				
Dairies																				
Receiving Station																				
Bulk	tn	0.09	0.06	0.08	0.007		0.035	0.17	0.003	0.01	0.03	0.003	0.002	0.06	0.005	0.004	0.01	0.013	0.001	0.001
Fluid Products	tn	0.09	0.06	3.1	0.28		0.66	3.21	0.06	0.19	1.5	0.14	0.09	0.31	0.03	0.02	0.53	0.68	0.05	0.04
Cottage Cheese																				
With Whey Recovery	tn	0.09	0.06	7.7	0.7		4.45	21.7	0.40	1.3	3.4	0.31	0.20	0	0	0	0	0	0	0
Natural Cheese																				
With Whey Recovery	tn	0.09	0.06	2.3	0.21		0.45	2.2	0.04	0.13	0.2	0.02	0.01	1.56	0.14	0.09	0.27	0.34	0.02	0.02
Sub Total					1.2	273.8			0.50	1.6		0.46	0.31		0.17	0.12			0.07	0.06
معمل البان السهل																				
Dairies																				

Receiving Station																				
Bulk	tn	0.18	0.18	0.08	0.01		0.035	0.17	0.006	0.03	0.03	0.005	0.005	0.06	0.01	0.01	0.01	0.013	0.002	0.002
Fluid Products	tn	0.18	0.18	3.1	0.56		0.66	3.21	0.12	0.58	1.5	0.27	0.27	0.31	0.06	0.06	0.53	0.68	0.10	0.12
Cottage Cheese																				
With Whey Recovery	tn	0.18	0.18	7.7	1.4		4.45	21.7	0.8	3.9	3.4	0.61	0.61	0	0	0	0	0	0	0
Natural Cheese																				
With Whey Recovery	tn	0.18	0.18	2.3	0.41		0.45	2.2	0.08	0.4	0.2	0.04	0.04	1.56	0.28	0.28	0.27	0.34	0.05	0.06
Sub Total					2.37	912.5			1.01	4.9		0.92	0.92		0.35	0.35			0.15	0.19
معمل ألبان الطيب																				
Dairies																				
Receiving Station																				
Bulk	tn	1.1	1.1	0.08	0.09		0.035	0.17	0.04	0.19	0.03	0.03	0.03	0.06	0.07	0.07	0.01	0.013	0.01	0.01
Fluid Products	tn	1.1	1.1	3.1	3.4		0.66	3.21	0.72	3.5	1.5	1.65	1.65	0.31	0.34	0.34	0.53	0.68	0.58	0.75
Cottage Cheese																				
With Whey Recovery	tn	1.1	1.1	7.7	8.5		4.45	21.7	4.9	23.9	3.4	3.7	3.7	0	0	0	0	0	0	0
Natural Cheese																				
With Whey Recovery	tn	1.1	1.1	2.3	2.5		0.45	2.2	0.49	2.42	0.2	0.22	0.22	1.56	1.72	1.72	0.27	0.34	0.29	0.37
Sub Total					14.5	27375			6.1	30		5.6	5.6		2.13	2.13			0.9	1.13
معمل ألبان الفيحاء																				
Dairies																				
Receiving Station																				
Bulk	tn	0.18	0.18	0.08	0.01		0.035	0.17	0.006	0.03	0.03	0.005	0.005	0.06	0.01	0.01	0.01	0.013	0.002	0.002
Fluid Products	tn	0.18	0.18	3.1	0.56		0.66	3.21	0.12	0.58	1.5	0.27	0.27	0.31	0.06	0.06	0.53	0.68	0.10	0.12
Cottage Cheese																				
With Whey Recovery	tn	0.18	0.18	7.7	1.4		4.45	21.7	0.8	3.9	3.4	0.61	0.61	0	0	0	0	0	0	0
Natural Cheese																				
With Whey Recovery	tn	0.18	0.18	2.3	0.41		0.45	2.2	0.08	0.4	0.2	0.04	0.04	1.56	0.28	0.28	0.27	0.34	0.05	0.06
Sub Total					2.37	912.5			1.01	4.9		0.92	0.92		0.35	0.35			0.15	0.19
معمل ألبان الرفق																				
Dairies																				

Receiving Station																				
Bulk	tn	1.5	1.5	0.08	0.12		0.035	0.16	0.05	0.25	0.03	0.05	0.04	0.06	0.09	0.09	0.01	0.013	0.02	0.02
Fluid Products	tn	1.5	1.5	3.1	4.7		0.66	3.10	0.99	4.7	1.5	2.3	1.9	0.31	0.47	0.47	0.53	0.68	0.8	1.02
Cottage Cheese																				
With Whey Recovery	tn	1.5	1.5	7.7	11.6		4.45	21.0	6.7	31.5	3.4	5.1	4.3	0	0	0		0	0	0
Natural Cheese																				
With Whey Recovery	tn	1.5	1.5	2.3	3.5		0.45	2.1	0.68	3.2	0.2	0.3	0.25	1.56	2.3	2.3	0.27	0.34	0.40	0.51
Sub Total					19.8	8760			8.4	39.6		7.7	6.5		2.9	2.9			1.2	1.5
شركة الوسام للمنتجات الغذائية																				
Dairies																				
Receiving Station																				
Bulk	tn	6.6	6.2	0.08	0.53		0.035	0.17	0.23	1.1	0.03	0.20	0.19	0.06	0.4	0.37	0.01	0.013	0.07	0.08
Fluid Products	tn	6.6	6.2	3.1	20.5		0.66	3.21	4.3	19.9	1.5	9.9	9.3	0.31	2.0	1.9	0.53	0.68	3.5	4.2
Cottage Cheese																				
With Whey Recovery	tn	6.6	6.2	7.7	50.8		4.45	21.7	29.4	134.5	3.4	22.4	21.1	0	0	0	0	0	0	0
Natural Cheese																				
With Whey Recovery	tn	6.6	6.2	2.3	15.2		0.45	2.2	3.0	13.6	0.2	1.3	1.2	1.56	10.3	9.7	0.27	0.34	1.8	2.1
Sub Total					87.0	17520			37.0	169.1		33.9	31.8		12.7	11.9			5.3	6.4
Total					129.6	56667			55	255		50.4	47		18.9	18.1			7.9	9.7

Table (5.19): Design and Working Liquid Pollutants Loads for the *Power Station*.

Source	U	DPC	WPC	Q			BOD ₅			TSS			Tot P			Other Pollutants			
				Fa	D.F.R	W.F.R	F.d,F.w	D.L	W.L	F.d,F.w	D.L	W.L	¹ F.d,F.w	D.L	W.L	Na.	F.d,F.w	D.L	W.L
410 Electricity Gas and Steam																			
محطة كهرباء المسيب الحرارية																			
4101 Steam turbines	GWH	467.2	438	129 ⁽⁶³⁾	60269	131400	2.2	1028	964	286	133619	125268	0.05	23.4	21.9	Oil	0.047	22	20.6
																Cr	0.006	2.8	2.6

																	Cu	0.005	2.3	2.2
																	Ni	0.047	22	20.6
																	Zn	0.012	5.6	5.3

Table (5.20): Design and Working Liquid Pollutants Loads for *Rubber Products Factory*.

Source	U	DPC	WPC	Q			BOD ₅				TSS				Other Pollutants			
				Fa	D.F.I	W.F.I	F.d	F.w	D.L	W.L	F.d	F.w	D.L	W.L	Na.	F.d,F.w	D.L	W.L
355 Manufacture of Rubber Products																		
معمل المنتجات المطاطية																		
3551 Tire and tube industries	tn	0.29	0.16	37	10.7	1460	0.4	0.365	0.12	0.06	1	0.87	0.29	0.14	Oil	0.12	0.03	0.02

¹ Fd = Fw (Efficiency of treatment=1)

Table (5.21): Design and Working Liquid Pollutants Loads for *Soft Drink Factories*.

Source	U	DPC	WPC	Q			BOD ₅				TSS				
				Fa	D.F.R	W.F.R	F.d	F.w	D.L	W.L	F.d	F.w	D.L	W.L	
3134 Soft Drinks															
شركة بابل للمشروبات الغازية															
Franchise plant															
With no syrup prepare on															
Bottled	m ³	16.4	2.6	4.3	70.5	4380	2.1	2	34.4	5.2	0.7	0.54	11.5	1.4	
شركة نور كربلاء للمشروبات الغازية والمياه الصحية															

Franchise plant														
With no syrup prepare on														
Bottled	m ³	78.8	9.2	4.3	338.8	2433.3	2.1	2.1	165.5	19.3	0.7	0.7	55.2	6.4
Canned	m ³	26.3	3.1	2	52.6	1216.7	0.8	0.8	21	2.5	0.3	0.3	7.9	0.9
Sub Total					391.4	3650			186.5	21.8			63	7.3
معمل الكوفة للمشروبات الغازية والمياه الصحية														
Franchise plant														
With no syrup prepare on														
Bottled	m ³	65.7	59	4.3	282.5	29200	2.1	2	138	118	0.7	0.75	46	44.3
Canned	m ³	22	19.7	2	44	14600	0.8	0.75	17.6	14.8	0.3	0.27	6.6	5.3
Sub Total					326.5	43800			155.6	132.8			52.6	49.6
Total					788.4	51830			376.5	159.8			127.1	58.3

Table (5.22): Design and Working Liquid Pollutants Loads for the *Textile Factories*.

Source	U	DPC	WPC	Q			BOD ₅				TSS			
				Fa	D.F.R	W.F.R	F.d	F.w	D.L	W.L	F.d	F.w	D.L	W.L
321 Manufacture of Textiles														
الشركة العامة للصناعات النسيجية/ معمل نسيج الحلة														
Cotton Processing														
Process - specific														
Yarn sizing	tn	1981	557	4.2	8320	11550425	3.5	1.672	6934	931	0	0	0	0
Desizing	tn	1981	557	22	43582		72.5	34.626	143623	19287	18	20.91	35658	11647

Bleaching	tn	1981	557	100	198100		10	4.776	19810	2660	3	3.485	5943	1941
Mercerizing	tn	1981	557	35	69335		10	4.776	19810	2660	1.5	1.743	2792	971
Dyeing	tn	1981	557	50	99050		75	35.82	148575	19952	15	17.425	29715	9706
Printing	tn	1981	557	14	27734		67.5	32.238	133718	17957	7.2	8.364	14263	4659
Sub Total					446121	11550425			472469	63447			88551	28923
معمل نسيج أبو زيد														
Rayon Processing	tn	0.08	0.07	42	3.4	657	37.5	30	3	2.1	33	55	2.6	3.9
معمل نسيج الإخوان														
Rayon Processing	tn	0.007	0.005	42	0.29	511	37.5	30	0.26	0.15	33	55	0.23	0.28
معمل نسيج الأمل														
Rayon Processing	tn	0.007	0.006	42	0.29	58.4	37.5	30	0.26	0.18	33	55	0.23	0.33
معمل نسيج الحسن														
Rayon Processing	tn	0.09	0.06	42	3.78	584	37.5	30	3.375	1.8	33	55	2.97	3.3
معمل نسيج الكوثر														
Rayon Processing	tn	0.004	0.003	42	0.17	29.2	37.5	30	0.15	0.09	33	55	0.13	0.17
معمل نسيج الهادي														
Rayon Processing	tn	0.16	0.09	42	6.7	876	37.5	30	6	2.7	33	55	5.3	5.0
معمل نسيج الهدى														
Rayon Processing	tn	0.007	0.004	42	0.29	365	37.5	30	0.26	0.12	33	55	0.23	0.22
شركة الوطن العربي														
Rayon Processing	tn	0.11	0.04	42	4.6	365	37.5	30	4.1	1.2	33	55	3.6	2.2
Sub Total					446141	11553871			472486	63455			88566	28938

Table (5.23): Design and Working Concentration of Liquid Pollutants for the *Chemical Industries Factory*.

Source	U	Q	TSS	Hg
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		D.F.R	W.F.R	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C
الشركة العامة للصناعات الكيماوية /معمل حرير السدة	tn	10.6	10950	49.3	4651	6.9	630	1.32	125	0.39	36

Table (5.24): Design and Working Concentration of Liquid Pollutants for the *Dairy Products Factories*.

Source	U	Q		BOD ₅				TSS				Tot N				Tot P			
		D.F.R	W.F.R	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C
معمل ألبان أولاد جمعة عبادي سلمان	tn	2.37	912.5	1.01	426.2	4.9	5370	0.92	388.2	0.92	1008	0.35	147.7	0.35	383.6	0.15	63.3	0.19	208.2
معمل ألبان بابل	tn	1.2	273.8	0.50	416.7	1.6	5844	0.46	383.3	0.31	1132	0.17	141.7	0.12	438.3	0.07	58.3	0.06	219.1
معمل ألبان السهل	tn	2.37	912.5	1.01	426.2	4.9	5370	0.92	388.2	0.92	1008	0.35	147.7	0.35	383.6	0.15	63.3	0.19	208.2
معمل ألبان الطيب	tn	14.5	27375	6.1	420.7	30	1096	5.6	386.2	5.6	204.6	2.13	144.8	2.13	77.2	0.9	62.1	1.13	41.3
معمل ألبان الفيحاء	tn	2.37	912.5	1.01	426.2	4.9	5370	0.92	388.2	0.92	1008	0.35	147.7	0.35	383.6	0.15	63.3	0.19	208.2
معمل ألبان الرقق	tn	19.8	8760	8.4	424.2	39.6	4521	7.7	388.9	6.5	742	2.9	146.5	2.9	33	1.2	60.6	1.5	171.2
شركة الوسام للمنتجات الغذائية	tn	87	17520	37	425.3	169.1	9652	33.9	389.7	31.8	1815	12.7	146	11.9	679.2	5.3	60.9	6.4	365.3
Total		129.6	56667	55	2966	255	37223	50.4	2713	47	7446	18.9	1022	18.1	2677	7.9	431.8	9.7	1422

Table (5.25) : Design and Working Concentration of Liquid Pollutants for the *Power Station*.

Source	U	Q		BOD ₅				TSS				Tot P				Other Pollutants				
		D.F.R	W.F.R	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C	Na.	D.L	D.C	W.L	W.C
محطة كهرياء المسيب الحرارية	GWH	60269	131400	1028	17.1	964	7333	133619	2217	125268	953333	23.4	0.4	21.9	167	Oil	22	0.4	20.6	157

																Cr	2.8	0.05	2.6	20
																Cu	2.3	0.04	2.2	17
																Ni	22	0.4	20.6	157
																Zn	5.6	0.09	5.3	40.3

Table (5.26): Design and Working Concentration of Liquid Pollutants for the *Rubber Products Factory*.

Source	U	Q		BOD ₅				TSS				Oil			
		D.F.R	W.F.R	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C
معمل المنتجات المطاطية	tn	10.7	1460	0.12	11.2	0.06	41.1	0.29	27	0.14	95.9	0.03	2.8	0.02	13.7

Table (5.27): Design and Working Concentration of Liquid Pollutants for the *Soft Drink Factories*.

Source	U	Q		BOD ₅				TSS			
		D.F.R	W.F.R	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C
شركة بابل للمشروبات الغازية	tn	70.5	4380	34.4	487.9	5.2	1187	11.5	163	1.4	319.6
شركة نور كربلاء للمشروبات الغازية والمياه الصحية	tn	391.4	3650	186.5	476.5	21.8	5973	63	161	7.3	2000
شركة الكوفة للمشروبات الغازية والمياه الصحية	tn	326.5	43800	155.6	476.6	132.8	3032	52.6	161	49.6	1132
Total		788.4	51830	376.5	1441	159.8	10192	127.1	485	58.3	3452

Table (5.28): Design and Working Concentration of Liquid Pollutants for the *Textile Factories*.

Source	U	Q		BOD ₅				TSS			
		D.F.R	W.F.R	D.L	D.C	W.L	W.C	D.L	D.C	W.L	W.C

الشركة العامة للصناعات النسيجية /معمل نسيج الحلة	tn	446121	11550425	472469	1059	63447	5493	88551	198.5	28923	2504
معمل نسيج أبو زيد	tn	3.4	657	3	882.4	2.1	3196	2.6	764.7	3.9	5936
معمل نسيج الإخوان	tn	0.29	511	0.26	896.6	0.15	293.5	0.23	793	0.28	547.9
معمل نسيج الأمل	tn	0.29	58.4	0.26	896.6	0.18	3082	0.23	793	0.33	5651
معمل نسيج الحسن	tn	3.78	584	3.375	892.8	1.8	3082	2.97	785.7	3.3	5650
معمل نسيج الكوثر	tn	0.17	29.2	0.15	882.4	0.09	3082	0.13	764.7	0.17	5822
معمل نسيج الهادي	tn	6.7	876	6	895.5	2.7	3082	5.3	791	5	5708
معمل نسيج الهدى	tn	0.29	365	0.26	896.6	0.12	328.8	0.23	793	0.22	602.7
شركة الوطن العربي	tn	4.6	365	4.1	891.3	1.2	3287.7	3.6	782.6	2.2	6027
Total		446141	11553871	472486	8229	63455	24927	88566	6466	28938	38449

Table (5.29): Design and Working Liquid Pollution Loads by Rapid Environmental Assessment of the Middle Euphrates region.

Governorate	Industrial activity	No. of Factories	Type of Receiver	Q		BOD ₅		TSS		Tot N		Tot P		Other Pollutants		
				D.F.R	W.F.R	D.L	W.L	D.L	W.L	D.L	W.L	D.L	W.L	Na.	D.L	W.L
Babylon	Dairy	6	S.sy	42.6	39147	18	86	16.5	15.2	6.2	6.2	2.6	3.3		0	0
	Power station	1	S.sy	60269	13140	1028	964	133619	125268	0	0	23.4	21.9	oil	22	20.6
														Cr	2.8	2.6
														Cu	2.3	2.2
														Ni	22	20.6
														Zn	5.6	5.3
	Chemical	1	S.sy	10.6	10950	0	0	49.3	6.9	0	0	0	0	Hg	1.32	0.39
	Soft drinks	1	S.sy	70.5	4380	34.4	5.2	11.5	1.4	0	0	0	0	---	0	0

	Textile	9	S.sy	446141	11553871	472486	63455	88566	28938	0	0	0	0	---	0	0
Sub Total		18		506534	11621488	473566	64510	222262	154230	6.2	6.2	2.6	25.2	---	0	0
Al-Najaf	Rubber	1	S.sy	10.7	1460	0.12	0.06	0.29	0.14	0	0	0	0	oil		0.02
	Soft drinks	1	Euph.r	326.5	43800	155.6	132.8	52.6	49.6	0	0	0	0	---	0	0
Sub Total		2		337.2	45260	155.72	132.9	52.9	49.7	0	0	0	0	---	0	0
Kerbala	Dairy	1	S.sy	87	17520	37	169.1	33.9	31.8	12.7	11.9	5.3	64	---	0	0
	Soft drinks	1	Euph.r	391.4	3650	186.5	21.8	63	7.3	0	0	0	0	---	0	0
Sub Total		2		478.4	21170	223.5	190.9	97	39.1	12.7	11.9	5.3	64	---	0	0
Total		22		507345	11687918	273945	64834	222412	154319	18.9	18.1	31.3	89.2			

Table (5.30): Working Liquid Pollution Loads by Rapid Environmental Assessment of the Middle Euphrates region with Percentage.

Governorate	Industrial activity	No. of Factories	Type of Receiver	Q		BOD ₅		TSS		Tot N		Tot P		Other Pollutants		
				W.F.R	%	W.L	%	W.L	%	W.L	%	W.L	%	Na.	W.L	%
Babylon	Dairy	6	S.sy	39147	0.3	86	0.1	15.2	0	6.2	34	3.3	3.7		0	0
	Power station	1	S.sy	13140	0.1	964	1.4	125268	81	0	0	21.9	24.6	Oil	20.6	99.9
														Cr	2.6	100
														Cu	2.2	100
														Ni	20.6	100
														Zn	5.3	100
	Chemical	1	S.sy	10950	0.1	0	0	6.9	0	0	0	0	0	Hg	0.39	100
	Soft drinks	1	S.sy	4380	0	5.2	0	1.4	0	0	0	0	0	---	0	0
	Textile	9	S.sy	11553871	99	63455	98	28938	19	0	0	0	0	---	0	0
Sub Total		18		11621488	99.5	64510	99.5	154230	100	6.2	34	25.2	28.3	---	0	0

Al-Najaf	Rubber	1	S.sy	1460	0	0.06	0	0.14	0	0	0	0	0	Oil	0.02	0.1
	Soft drinks	1	Euph.r	43800	0.4	132.8	0.2	49.6	0	0	0	0	0	---	0	0
Sub Total		2		45260	0.4	132.9	0.2	49.7	0	0	0	0	0	---	0	0
Kerbala	Dairy	1	S.sy	17520	0.1	169.1	0.3	31.8	0	11.9	66	64	71.7	---	0	0
	Soft drinks	1	Euph.r	3650	0	21.8	0	7.3	0	0	0	0	0	---	0	0
Sub Total		2		21170	0.1	190.9	0.3	39.1	0	11.9	66	64	71.7	---	0	0
Total		22		11687918		64834		154319		18.1		89.2				

Table (5.31): Design and Working Liquid Pollutants Concentration of the Middle Euphrates region.

Governorate	Industrial activity	No. of Factories	Type of Receiver	BOD ₅		TSS		Tot N		Tot P		OIL		Cr		Cu		Zn		Ni		Hg	
				D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C
Babylon	Dairy	6	S.sy	2541	2751	2323	5103	876	1998	371	1057	0	0	0	0	0	0	0	0	0	0	0	
	Power station	1	S.sy	17.1	7333	2217	953333	0	0	0.4	167	0.4	157	0.05	20	0.04	17	0.4	157	0.09	40.3	0	0
	Chemical	1	S.sy	0	0	4651	630	0	0	0	0	0	0	0	0	0	0	0	0	0	125	36	
	Soft drinks	1	S.sy	487.9	1187	163	319.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Textile	9	S.sy	8229	24927	6466	38449	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Sub Total		18		11277	36198	15824	997836	876	1998	371.4	1224	0.4	157	0.05	20	0.04	17	0.4	157	0.09	40.3	0	36
Al-Najaf	Rubber	1	S.sy	11.2	41.1	27	95.9	0	0	0	0	2.8	13.7	0	0	0	0	0	0	0	0	0	
	Soft drinks	1	Euph.r	476.6	10192	161	3452	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Sub Total		2		487.8	10233	11361	3548	0	0	0	0	2.8	13.7	0	0	0	0	0	0	0	0	0	
Kerbala	Dairy	1	S.sy	425.3	9652	389.7	1815	146	679.2	60.9	365.3	0	0	0	0	0	0	0	0	0	0	0	

	Soft drinks	1	Euph.r	476.5	5973	161	2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub Total		2		901.8	15625	550.7	3815	146	679.2	60.9	365.3	0	0	0	0	0	0	0	0	0	0	0	0
Total		22		12665	62056	27732	1005198	1022	2677.2	432.3	1589.3	3.2	170.7	0.05	20	0.04	17	0.4	157	0.09	40.3	125	36

Table (5.32): Comparison Design and Working Air Pollutants Concentration from Each Factory in the Study with WHO Limits.

SIC	Name of Factory	Industrial Activity	TSP		SO ₂		NO _x		CO		VOC		F ₂		CL ₂		HCL		SO ₃	
			D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C
3540	معمل إسفلت شركة آشور	Asphalt	Acc.	Unacc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3540	معمل إسفلت بابل	Asphalt	Acc.	Acc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3540	معمل إسفلت الجنائن	Asphalt	Acc.	Unacc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3540	معمل إسفلت قاسم	Asphalt	Acc.	Acc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3691	معمل طابوق الاعتماد	Bricks	Acc.	Unacc.	Acc.	Unacc.	Acc.	Acc.	Acc.	Acc.	Pen.	Pen.	Pen.	Pen.	0	0	0	0	0	0

3691	معمل طابوق جبران	Bricks	Acc.	Unacc.	Acc.	Unacc.	Acc.	Acc.	Acc.	Acc.	Pen.	Pen.	Pen.	Pen.	0	0	0	0	0	0
3691	معمل طابوق الرافدين	Bricks	Acc.	Unacc.	Acc.	Unacc.	Acc.	Acc.	Acc.	Acc.	Pen.	Pen.	Pen.	Pen.	0	0	0	0	0	0
3691	معمل طابوق السلام	Bricks	Acc.	Unacc.	Acc.	Unacc.	Acc.	Acc.	Acc.	Acc.	Pen.	Pen.	Pen.	Pen.	0	0	0	0	0	0
3691	معمل طابوق صابر التميمي	Bricks	Acc.	Unacc.	Acc.	Unacc.	Acc.	Acc.	Acc.	Acc.	Pen.	Pen.	Pen.	Pen.	0	0	0	0	0	0
3691	معمل طابوق الفرات	Bricks	Acc.	Unacc.	Acc.	Unacc.	Acc.	Acc.	Acc.	Acc.	Pen.	Pen.	Pen.	Pen.	0	0	0	0	0	0
3691	معمل طابوق الفيحاء	Bricks	Acc.	Unacc.	Acc.	Unacc.	Acc.	Acc.	Acc.	Acc.	Pen.	Pen.	Pen.	Pen.	0	0	0	0	0	0
3691	معمل طابوق المحاويل	Bricks	Acc.	Unacc.	Acc.	Unacc.	Acc.	Acc.	Acc.	Acc.	Pen.	Pen.	Pen.	Pen.	0	0	0	0	0	0
3691	معمل طابوق النيل	Bricks	Acc.	Unacc.	Acc.	Unacc.	Acc.	Acc.	Acc.	Acc.	Pen.	Pen.	Pen.	Pen.	0	0	0	0	0	0
3691	معمل طابوق الهاشمية	Bricks	Acc.	Unacc.	Acc.	Unacc.	Acc.	Acc.	Acc.	Acc.	Pen.	Pen.	Pen.	Pen.	0	0	0	0	0	0
3692	معمل النورة-كربلاء	Lime	Acc.	Unacc.	Acc.	Acc.	Acc.	Acc.	Acc.	Acc.	0	0	0	0	0	0	0	0	0	0
3692	معمل سمنت السدة	Cement	Acc.	Unacc.	Acc.	Acc.	Acc.	Acc.	0	0	0	0	0	0	0	0	0	0	0	0
3692	معمل سمنت كربلاء	Cement	Acc.	Unacc.	Acc.	Acc.	Acc.	Acc.	0	0	0	0	0	0	0	0	0	0	0	0
3692	معمل سمنت الكوفة الجديد	Cement	Acc.	Unacc.	Acc.	Acc.	Acc.	Acc.	0	0	0	0	0	0	0	0	0	0	0	0
3692	معمل سمنت النجف الاشرف	Cement	Acc.	Unacc.	Acc.	Acc.	Acc.	Acc.	0	0	0	0	0	0	0	0	0	0	0	0
3511	الشركة العامة للصناعات الكيمياوية/معمل حرير السدة	Chemical Industries	Acc.	Unacc.	Acc.	Unacc.	0	0	0	0	0	0	0	0	Pen.	Pen.	Pen.	Pen.	Pen.	Pen.
3116	معمل طحين الإخلاص	Grain mill	Acc.	Unacc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3116	معمل طحين بابل	Grain mill	Acc.	Unacc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3116	معمل طحين طارق	Grain mill	Acc.	Unacc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3116	شركة الفرات لطحن الحبوب	Grain mill	Acc.	Unacc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

410	محطة كهرباء المسيب الحرارية	Power Station	Acc.	Acc.	Acc.	Unacc.	Acc.	Acc.	Acc.	Acc.	Pen.	Pen.	0	0	0	0	0	0	0	Pen.	Pen.
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Table (5.33): Comparison Design and Working Liquid Pollutants Concentration from Each Factory in the Study with Iraqi Limits.

SIC	Name of Fctory	Industrial Activity	Type of Receiver	BOD ₅		TSS		Tot N		Tot P		OIL		Cr		Cu		Zn		Ni		Hg	
				D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C	D.C	W.C
3511	الشركة العامة للصناعات الكيماوية/معمل حرير السدة	Chemical	S.sy	0	0	Unacc.	Acc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unacc.	Unacc.
3112	معمل ألبان أولاد جمعة عبادي سلمان	Dairy	S.sy	Acc.	Unacc.	Acc.	Unacc.	Pen.	Pen.	Pen.	Pen.	0	0	0	0	0	0	0	0	0	0	0	0
3112	معمل ألبان بابل	Dairy	S.sy	Acc.	Unacc.	Acc.	Unacc.	Pen.	Pen.	Pen.	Pen.	0	0	0	0	0	0	0	0	0	0	0	0
3112	معمل ألبان السهل	Dairy	S.sy	Acc.	Unacc.	Acc.	Unacc.	Pen.	Pen.	Pen.	Pen.	0	0	0	0	0	0	0	0	0	0	0	0
3112	معمل ألبان الطيب	Dairy	S.sy	Acc.	Acc.	Acc.	Unacc.	Pen.	Pen.	Pen.	Pen.	0	0	0	0	0	0	0	0	0	0	0	0
3112	معمل ألبان الفحاء	Dairy	S.sy	Acc.	Unacc.	Acc.	Unacc.	Pen.	Pen.	Pen.	Pen.	0	0	0	0	0	0	0	0	0	0	0	0
3112	معمل ألبان الرقق	Dairy	S.sy	Acc.	Unacc.	Acc.	Acc.	Pen.	Pen.	Pen.	Pen.	0	0	0	0	0	0	0	0	0	0	0	0
3112	شركة الوسام للمنتجات الغذائية	Dairy	Euph.r	Acc.	Unacc.	Acc.	Unacc.	Pen.	Pen.	Pen.	Pen.	0	0	0	0	0	0	0	0	0	0	0	0
410	محطة كهرباء المسيب الحرارية	Power station	S.sy	Acc.	Unacc.	Unacc.	Unacc.	0	0	Pen.	Pen.	Pen.	Pen.	Acc.	Unacc.	Pen.	Pen.	Acc.	Unacc.	Unacc.	0	0	0
3551	معمل المنتجات المطاطية	Rubber	S.sy	Acc.	Acc.	Acc.	Acc.	0	0	0	0	Pen.	Pen.	0	0	0	0	0	0	0	0	0	0
3134	شركة بابل للمشروبات الغازية	Soft drinks	S.sy	Acc.	Unacc.	Acc.	Acc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3134	بركة نور كربلاء للمشروبات الغازية والمياه الصحية	Soft drinks	Euph. r	Unacc.	Unacc.	Unacc.	Unacce	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

3134	معمل الكوفة للمشروبات الغازية والمياه الصحية	Soft drinks	Euph. r	Unacc.	Unacc.	Unacc.	Unacc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3210	الشركة العامة للصناعات النسيجية/معمل نسيج الحلة	Textile	S.sy	Unacc.	Unacc.	Acc.	Unacc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3210	معمل نسيج ابو زيد	Textile	S.sy	Acc.	Unacc.	Unacc.	Unacc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3210	معمل نسيج الاخوان	Textile	S.sy	Acc.	Unacc.	Unacc.	Unacc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3210	معمل نسيج الامل	Textile	S.sy	Acc.	Unacc.	Unacc.	Unacc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3210	معمل نسيج الحسن	Textile	S.sy	Acc.	Unacc.	Unacc.	Unacc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3210	معمل نسيج الكوثر	Textile	S.sy	Acc.	Unacc.	Unacc.	Unacc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3210	معمل نسيج الهادي	Textile	S.sy	Acc.	Unacc.	Unacc.	Unacc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3210	معمل نسيج الهدى	Textile	S.sy	Acc.	Acc.	Unacc.	Acc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3210	شركة الوطن العربي	Textile	S.sy	Acc.	Unacc.	Unacc.	Unacc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.1): Leopold Matrix of Ashur Asphalt Factory.

Pollution Parameters: From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.6
	2.4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.4
	44	56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.2): Leopold Matrix of Babylon Asphalt Factory.

Pollution Parameters: From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	1	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.7
	4	2.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.1
	65.6	34.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.3): Leopold Matrix of Al-Janaeen Asphalt Factory.

Pollution Parameters: From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.6	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.8
	2.4	3.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
	40	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.4): Leopold Matrix of Qasim Asphalt Factory.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.6	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.4
	2.4	2.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.8
	50	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.5): Leopold Matrix of Al-Eetimid Bricks Factory .

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.0	198	24.6	1.4	0.0	330	0	0	0	219	0	0	0	0	0	0	0	0	0	0	773
	0	594	123	7	0	660	0	0	0	876	0	0	0	0	0	0	0	0	0	0	2260
	0	26.3	5.4	0.3	0	29.2	0	0	0	38.8	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.6): Leopold Matrix of Jubran Bricks Factory.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.0	19.8	2.5	0.14	0.0	0.3	0	0	0	21.8	0	0	0	0	0	0	0	0	0	0	44.5
	0	59.4	12.5	2	0	0.6	0	0	0	87.2	0	0	0	0	0	0	0	0	0	0	161.7
	0	36.7	7.7	1.2	0	0.4	0	0	0	54	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.7): Leopold Matrix of Al-Rafidain Bricks Factory.

Pollution Parameters From Environmental Action Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.0	25.5	3.2	0.2	0.0	0.3	0	0	0	46.7	0	0	0	0	0	0	0	0	0	0	57.1
	0	76.5	16	1	0	0.6	0	0	0	112.8	0	0	0	0	0	0	0	0	0	0	206.9
	0	37	7.7	0.5	0	0.3	0	0	0	54.5	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.8): Leopold Matrix of Al-Salaam Bricks Factory.

Pollution Parameters From Environmental Action Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.0	34.3	2.7	0.2	0.0	0.3	0	0	0	38	0	0	0	0	0	0	0	0	0	0	75.5
	0	102.9	13.5	1	0	0.6	0	0	0	152	0	0	0	0	0	0	0	0	0	0	270
	0	38.1	5	0.4	0	0.2	0	0	0	56.3	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.9): Leopold Matrix of Sabir Al-Timimy Bricks Factory.

Pollution Parameters From Environmental Action Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.0	49.8	2.5	0.14	0.0	0.6	0	0	0	65.5	0	0	0	0	0	0	0	0	0	0	88.5
	0	59.4	12.5	0.7	0	1.2	0	0	0	262	0	0	0	0	0	0	0	0	0	0	335.8
	0	17.7	3.7	0.2	0	0.63	0	0	0	78	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.10): Leopold Matrix of Euphrates Bricks Factory.

Pollution Parameters From Environmental Action Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.0	21.1	2.6	0.2	0.0	0.3	0	0	0	23.3	0	0	0	0	0	0	0	0	0	0	47.6
	0	63.6	13.1	1	0	0.6	0	0	0	93.2	0	0	0	0	0	0	0	0	0	0	171.4
	0	37	7.6	0.6	0	0.4	0	0	0	54.4	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.11): Leopold Matrix of Al-Faihaa Bricks Factory .

Pollution Parameters From Environmental Action Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.0	17.2	2.2	0.13	0.0	30	0	0	0	23.6	0	0	0	0	0	0	0	0	0	0	73.6
	0	53.1	1.1	0.65	0	60	0	0	0	94.4	0	0	0	0	0	0	0	0	0	0	209.3
	0	25.4	0.5	0.3	0	28.7	0	0	0	45.1	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.12): Leopold Matrix of Al-Mahawil Bricks Factory.

Pollution Parameters From Environmental Action Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.0	4	0.3	0.02	0.0	1.6	0	0	0	4.5	0	0	0	0	0	0	0	0	0	0	10.4
	0	12	1.5	0.1	0	3.2	0	0	0	18	0	0	0	0	0	0	0	0	0	0	34.8
	0	34.5	4.3	0.3	0	9.2	0	0	0	51.7	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.13): Leopold Matrix of Al-Nile Bricks Factory.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.0	14.9	0.9	0.1	0.0	0.2	0	0	0	16.5	0	0	0	0	0	0	0	0	0	0	32.6
	0	44.7	4.5	0.5	0	0.4	0	0	0	66	0	0	0	0	0	0	0	0	0	0	116.1
	0	38.5	3.9	0.4	0	0.3	0	0	0	56.8	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.14): Leopold Matrix of Al-Hashimia Bricks Factory.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.0	44.3	3.7	0.2	0.0	0.3	0	0	0	32.8	0	0	0	0	0	0	0	0	0	0	81.5
	0	133.5	18.5	1	0	0.6	0	0	0	131.2	0	0	0	0	0	0	0	0	0	0	284.6
	0	46.8	6.4	0.0	0	0.7	0	0	0	46.1	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.15): Leopold Matrix of Lime- Kerbela Factory.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.3	13	0.8	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.4
	1.2	3.9	4	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.1
	13.2	42.8	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.16): Leopold Matrix of Al-Sada Cement Factory.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.1	2.5	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.6
	0.4	7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7.9
	5.1	94.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.17): Leopold Matrix of Kerbela Cement Factory.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.0	3.6	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.6
	0.0	10.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.8
	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.18): Leopold Matrix of Al-kufa Cement Factory.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.0	5.1	0.0	0.1	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.2
	0.0	15.3	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15.8
	0	96.8	0	3.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.19): Leopold Matrix of Al-Najaf Al-Ashraf Cement Factory.

Pollution Parameters From Environmental Action Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.2	2.8	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
	0.8	8.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.2
	8.7	91.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.20): Leopold Matrix of General Company For Chemical Industries.

Pollution Parameters From Environmental Action Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.3	1.4	1.2	0.0	0.0	0.0	2.2	0.2	1.5	0	0	0	0	0	0	0	0	0	0	0	6.8
	1.2	4.2	6	0	0	0	4.4	0.6	4.5	0	0	0	0	0	0	0	0	0	0	0	20.9
	5.7	20.1	28.7	0	0	0	21.1	2.9	21.5	0	0	0	0	0	0	0	0	0	0	0	100
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	1	0	0	0	0	0	0	0	0	0	0	0.84	0	0	0	0	0	0	0	56000	36002
	4	0	0	0	0	0	0	0	0	0	0	3.36	0	0	0	0	0	0	0	180000	180004
	0.0	0	0	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0	100	100

Matrix (5.21): Leopold Matrix of Al-Eklass Grain Mill Factory.

Pollution Parameters From Environmental Action Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.6	1.4	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	2.4	4.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.6
	36.4	63.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.22): Leopold Matrix of Babylon Grain Mill Factory.

Pollution Parameters: From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.4	1.4	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.8
	1.6	4.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.8
	27.6	72.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.23): Leopold Matrix of Tariq Grain Mill Factory.

Pollution Parameters: From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.3	1.9	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.2
	1.2	5.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.9
	17.4	82.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.24): Leopold Matrix of Euphrates Grain Mill Company.

Pollution Parameters: From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.6	1.3	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.9
	2.4	3.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.3
	38.1	61.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Water environment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix (5.25): Leopold Matrix of Al-Musaib Power Plant.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0.5	0.1	1.1	0.1	0.0	0.8	0	0	1.4	0	0	0	0	0	0	0	0	0	0	0	4
	2	0.3	5.5	0.5	0	1.6	0	0	4.2	0	0	0	0	0	0	0	0	0	0	0	14.1
	14.2	2.1	39	3.5	0	11.3	0	0	29.9	0	0	0	0	0	0	0	0	0	0	0	100
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	0	0	0	0	0	0	0	0	0	0	7.3	271	0	417.5	392.5	200	425	1570	403	0	4686
	0	0	0	0	0	0	0	0	0	0	36.5	5084	0	1670	1570	1000	1275	4710	1612	0	16958
	0	0	0	0	0	0	0	0	0	0	0.2	30	0	9.8	9.3	5.9	7.5	27.8	9.5	0	100

Matrix (5.26): Leopold Matrix of Awlad Jumaa Ebadi Selman For Dairy Products

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	0.4	0	0	0	0	0	0	0	0	0	5.4	1.3	2.6	3.3	0	0	0	0	0	0	13
	1.6	0	0	0	0	0	0	0	0	0	27	5.2	10.4	13.2	0	0	0	0	0	0	57.4
	2.8	0	0	0	0	0	0	0	0	0	47	9.1	18.1	23	0	0	0	0	0	0	100

Matrix (5.27): Leopold Matrix of Babylon Factory For Dairy Products.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	2.3	0	0	0	0	0	0	0	0	0	5.8	1.5	3.1	3.8	0	0	0	0	0	0	16.5
	9.2	0	0	0	0	0	0	0	0	0	29	6	12.4	15.2	0	0	0	0	0	0	71.8
	12.8	0	0	0	0	0	0	0	0	0	40.3	8.4	17.3	21.2	0	0	0	0	0	0	100

Matrix (5.28): Leopold Matrix of Al-Sahal Factory For Dairy Products.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	0.4	0	0	0	0	0	0	0	0	0	5.4	1.3	2.6	3.3	0	0	0	0	0	0	13
	1.6	0	0	0	0	0	0	0	0	0	27	5.2	10.4	13.2	0	0	0	0	0	0	57.4
	2.8	0	0	0	0	0	0	0	0	0	47	9.1	18.1	23	0	0	0	0	0	0	100

Matrix (5.29): Leopold Matrix of Al-Fiahaa Factory For Dairy Products.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	0.4	0	0	0	0	0	0	0	0	0	5.4	1.3	2.6	2.6	0	0	0	0	0	0	13
	1.6	0	0	0	0	0	0	0	0	0	27	5.2	10.4	13.2	0	0	0	0	0	0	57.4
	2.8	0	0	0	0	0	0	0	0	0	47	9.1	18.1	23	0	0	0	0	0	0	100

Matrix (5.30): Leopold Matrix of Al-Teeb Factory For Dairy Products.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	1.9	0	0	0	0	0	0	0	0	0	1.1	0.3	0.5	0.7	0	0	0	0	0	0	4.5
	7.6	0	0	0	0	0	0	0	0	0	5.5	1.2	2	2.8	0	0	0	0	0	0	19.1
	39.8	0	0	0	0	0	0	0	0	0	28.8	6.3	10.4	14.7	0	0	0	0	0	0	100

Matrix (5.31): Leopold Matrix of Al-Rifiq Factory For Dairy Products.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	0.4	0	0	0	0	0	0	0	0	0	4.5	0.9	2.3	2.8	0	0	0	0	0	0	10.9
	1.6	0	0	0	0	0	0	0	0	0	18	3.6	9.2	11.2	0	0	0	0	0	0	43.6
	3.7	0	0	0	0	0	0	0	0	0	41.3	8.3	21.1	25.6	0	0	0	0	0	0	100

Matrix (5.32): Leopold Matrix of Al-Wissam Factory For Dairy Products.

Pollution Parameters From Environmental Action Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	0.2	0	0	0	0	0	0	0	0	0	9.7	2.4	4.7	6	0	0	0	0	0	0	23
	0.8	0	0	0	0	0	0	0	0	0	48.5	9.6	18.8	24	0	0	0	0	0	0	101.7
	0.8	0	0	0	0	0	0	0	0	0	47.7	9.4	18.5	23.6	0	0	0	0	0	0	100

Matrix (5.33): Leopold Matrix of Rubber Production Factory.

Pollution Parameters From Environmental Action Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	1	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	0.1	0	0	0	0	0	0	0	0	0	0	0.1	0	0	5	0	0	0	0	0	5.2
	0.4	0	0	0	0	0	0	0	0	0	0	0.4	0	0	20	0	0	0	0	0	20.8
	1.9	0	0	0	0	0	0	0	0	0	1.9	0	0	0	96.2	0	0	0	0	0	100

Matrix (5.34): Leopold Matrix of Babylon For Soft Drink.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	0.1	0	0	0	0	0	0	0	0	0	1.2	0.4	0	0	0	0	0	0	0	0	1.7
	0.4	0	0	0	0	0	0	0	0	0	6	1.2	0	0	0	0	0	0	0	0	7.6
	5.3	0	0	0	0	0	0	0	0	0	78.9	15.8	0	0	0	0	0	0	0	0	100

Matrix (5.35): Leopold Matrix of Noor Kerbela For Soft Drinks.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	0.0	0	0	0	0	0	0	0	0	0	6	2.7	0	0	0	0	0	0	0	0	3.3
	0	0	0	0	0	0	0	0	0	0	30	10.8	0	0	0	0	0	0	0	0	40.8
	0	0	0	0	0	0	0	0	0	0	66.7	33.3	0	0	0	0	0	0	0	0	100

Matrix (5.36): Leopold Matrix of Al-kufa For Soft Drinks.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	0.1	0	0	0	0	0	0	0	0	0	3	1.5	0	0	0	0	0	0	0	0	4.5
	0.4	0	0	0	0	0	0	0	0	0	12	6	0	0	0	0	0	0	0	0	18.4
	2.2	0	0	0	0	0	0	0	0	0	65.2	32.6	0	0	0	0	0	0	0	0	100

Matrix (5.37): Leopold Matrix of General Company For Textile Manufacturing.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	25.9	0	0	0	0	0	0	0	0	0	5.5	3.3	0	0	0	0	0	0	0	0	34.7
	103.6	0	0	0	0	0	0	0	0	0	27.5	13.2	0	0	0	0	0	0	0	0	144.3
	71.8	0	0	0	0	0	0	0	0	0	19.1	9.1	0	0	0	0	0	0	0	0	100

Matrix (5.38): Leopold Matrix of Abu-Zaid Factory For Textile Manufacturing.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	193	0	0	0	0	0	0	0	0	0	3.2	7.9	0	0	0	0	0	0	0	0	204.1
	772	0	0	0	0	0	0	0	0	0	16	31.6	0	0	0	0	0	0	0	0	819.6
	94.2	0	0	0	0	0	0	0	0	0	1.9	3.9	0	0	0	0	0	0	0	0	100

Matrix (5.39): Leopold Matrix of Al-Ekwan Factory For Textile Manufacturing.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	1762	0	0	0	0	0	0	0	0	0	0.3	0.7	0	0	0	0	0	0	0	0	176.3
	7048	0	0	0	0	0	0	0	0	0	1.5	2.8	0	0	0	0	0	0	0	0	7052.3
	99.95	0	0	0	0	0	0	0	0	0	0.02	0.03	0	0	0	0	0	0	0	0	100

Matrix (5.40): Leopold Matrix of Al-Amal Factory For Textile Manufacturing.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	201	0	0	0	0	0	0	0	0	0	3.1	7.5	0	0	0	0	0	0	0	0	211.6
	804	0	0	0	0	0	0	0	0	0	15.5	30	0	0	0	0	0	0	0	0	849.5
	94.6	0	0	0	0	0	0	0	0	0	1.9	3.5	0	0	0	0	0	0	0	0	100

Matrix (5.41): Leopold Matrix of Al-Hassen Factory For Textile Manufacturing

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	154	0	0	0	0	0	0	0	0	0	3.1	7.5	0	0	0	0	0	0	0	0	164.6
	616	0	0	0	0	0	0	0	0	0	15.5	30	0	0	0	0	0	0	0	0	661.5
	92.9	0	0	0	0	0	0	0	0	0	2.3	4.6	0	0	0	0	0	0	0	0	100

Matrix (5.42): Leopold Matrix of Al-Kawther Factory For Textile Manufacturing.

Pollution Parameters From Environmental Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	176	0	0	0	0	0	0	0	0	0	3.1	7.8	0	0	0	0	0	0	0	0	186.9
	704	0	0	0	0	0	0	0	0	0	15.5	31.2	0	0	0	0	0	0	0	0	750.7
	95.7	0	0	0	0	0	0	0	0	0	2.1	4.2	0	0	0	0	0	0	0	0	100

Matrix (5.43): Leopold Matrix of Al-Hadi Factory For Textile Manufacturing.

Pollution Parameters From Environmental Action Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	131	0	0	0	0	0	0	0	0	0	3.1	7.6	0	0	0	0	0	0	0	0	141.7
	524	0	0	0	0	0	0	0	0	0	15.5	30.4	0	0	0	0	0	0	0	0	569.9
	91.9	0	0	0	0	0	0	0	0	0	2.7	5.4	0	0	0	0	0	0	0	0	100

Matrix (5.44): Leopold Matrix of Al-Huda Factory For Textile Manufacturing.

Pollution Parameters From Environmental Action Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	1259	0	0	0	0	0	0	0	0	0	0.3	0.8	0	0	0	0	0	0	0	0	1260
	5036	0	0	0	0	0	0	0	0	0	1.5	3.2	0	0	0	0	0	0	0	0	5040.3
	99.9	0	0	0	0	0	0	0	0	0	0.04	0.06	0	0	0	0	0	0	0	0	100

Matrix (5.45): Leopold Matrix of Arab Homeland Factory For Textile Manufacturing

Pollution Parameters From Environmental Action Media	Q	TSP	SO ₂	NO _x	CO	VOC	CL ₂	HCL	SO ₃	F ₂	BOD ₅	TSS	TotN	TotP	Oil	Cr	Cu	Ni	Zn	Hg	Total
Air environment	4	3	5	5	4	2	2	3	3	4	0	0	0	0	0	0	0	0	0	0	35
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water environment	4	0	0	0	0	0	0	0	0	0	5	4	4	4	4	5	3	3	4	5	41
	79	0	0	0	0	0	0	0	0	0	3.3	8	0	0	0	0	0	0	0	0	90.3
	316	0	0	0	0	0	0	0	0	0	16.5	32	0	0	0	0	0	0	0	0	364.5
	86.7	0	0	0	0	0	0	0	0	0	4.5	8.8	0	0	0	0	0	0	0	0	100

Table (5.34): Impact of Emission Rate on the Air Environment for the Factories that Produce Air Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
معمل إسفلت (أشور, الجنائن , قاسم)	2.4	2			
معمل إسفلت بابل	4	1			
كل معامل الطابوق	0	8			
معمل النورة - كربلاء	1.2	5			
معمل سمنت السدة	0.4	7			
معمل سمنت (كربلاء , الكوفة)	0	6			
معمل سمنت النجف الاشرف	0.8	5			
الشركة العامة للصناعات الكيماوية / معمل حرير السدة	1.2	2			
معمل طحين (الإخلاص, الفرات)	2.4	4			
معمل طحين بابل	1.6	5			
معمل طحين طارق	1.2	5			
محطة كهرباء المسيب الحرارية	2	3			

Table (5.35): Impact of Total Suspended Particle on the Air Environment for the Factories that Produce Air Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
معمل إسفلت أشور	3	1	معمل إسفلت الجنائن	3.6	17
معمل إسفلت بابل	2.1	3	معمل طابوق الاعتماد	594	3
معمل إسفلت قاسم	2.4	2	معمل طابوق جبران	59.4	6
			معمل طابوق الرافدين	76.5	4
			معمل طابوق السلام	102.9	2
			معمل طابوق صابر التميمي	59.4	6
			معمل طابوق الفرات	63.6	5
			معمل طابوق الفيحاء	53.1	7
			معمل طابوق المحاول	12	10
			معمل طابوق النيل	44.7	8
			معمل طابوق الهاشمية	133.5	1
			معمل النورة - كربلاء	3.9	16
			معمل سمنت السدة	7.5	13
			معمل سمنت كربلاء	10.8	11
			معمل سمنت الكوفة	15.3	9
			معمل سمنت النجف الاشرف	8.4	12
			الشركة العامة للصناعات الكيماوية / معمل حرير السدة	4.2	15
			معمل طحين الإخلاص	4.2	15
			معمل طحين بابل	4.2	15
			معمل طحين طارق	5.7	14
محطة كهرباء المسيب الحرارية	0.3	1	شركة الفرات لطحن الحبوب	3.9	16

Table (5.36): Impact of Sulfur Dioxide on the Air Environment for the Factories that Produce Air Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
كل معامل الإسفلت	0	4	معمل طابوق الاعتماد	123	1
معمل طابوق المحاول	1.5	3	معمل طابوق جبران	12.5	5
معمل طابوق النيل	4.5	1	معمل طابوق الرافدين	16	3
معمل النورة - كربلاء	4	2	معمل طابوق السلام	13.5	4
كل معامل السمنت	0	4	معمل طابوق صابر التميمي	12.5	5
كل معامل الطحين	0	4	معمل طابوق الفرات	13	6
			معمل طابوق الفيحاء	1.1	8
			معمل طابوق الهاشمية	18.5	2
			الشركة العامة للصناعات الكيماوية / معمل حرير السدة	6	6
			محطة كهرباء المسيب الحرارية	5.5	7

Table (5.37): Impact of Nitrogen Oxide on the Air Environment for the Factories that Produce Air Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
كل معامل الإسفلت	0	7	معمل طابوق الاعتماد	7	1
معمل طابوق جبران	2	1			
معمل طابوق الرافدين	1	2			
معمل طابوق السلام	1	2			
معمل طابوق صابر التميمي	0.7	3			
معمل طابوق الفرات	1	2			
معمل طابوق الفيجاء	0.65	4			
معمل طابوق المحاويل	0.1	6			
معمل طابوق النيل	0.5	5			
معمل طابوق الهاشمية	1	2			
معمل النورة - كربلاء	0	7			
معمل سممت السدة. كربلاء. النجف الاشرف	0	7			
معمل سممت الكوفة	0.5	5			
الشركة العامة للصناعات الكيماوية / معمل حرير السدة	0	7			
كل معامل الطحين	0	7			
محطة كهرباء المسيب الحرارية	0.5	5			

Table (5.38): Impact of Volatile Organic Compound on the Air Environment for the Factories that Produce Air Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
كل معامل الإسفلت	0	5	معمل طابوق الاعتماد	660	1
معمل طابوق الهاشمية. جبران. الرافدين. السلام. الفرات	0.6	3	معمل طابوق الفيجاء	60	2
معمل طابوق صابر التميمي	1.2	2	معمل طابوق المحاويل	3.2	3
معمل طابوق النيل	0.4	4			
معمل النورة - كربلاء	0	5			
كل معامل السممت	0	5			
كل معامل الطحين	0	5			
الشركة العامة للصناعات الكيماوية / معمل حرير السدة	0	5			
محطة كهرباء المسيب الحرارية	1.6	1			

Table (5.39): Impact of Chloride on the Air Environment for the Factories that Produce Air Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
بقية المعامل	0	1	الشركة العامة للصناعات الكيماوية / معمل حرير السدة	4,4	1

Table (5.40): Impact of Hydrogen Chloride on the Air Environment for the Factories that Produce Air Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
الشركة العامة للصناعات الكيماوية / معمل حرير السدة	0.6	1			
بقية المعامل التي شملتها الدراسة	0	2			

Table (5.41): Impact of Sulfur Trioxide on the Air Environment for the Factories that Produce Air Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
بقية المعامل	0	1	الشركة العامة للصناعات الكيماوية / معمل حرير السدة	4.5	1
			محطة كهرباء المسيب الحرارية	4.2	2

Table (5.42): Impact of Fluoride on the Air Environment for the Factories that Produce Air Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
بقية المعامل	0	1	معمل طابوق الاعتماد	876	1
			معمل طابوق جبران	87.2	8
			معمل طابوق الرافدين	112.8	5
			معمل طابوق السلام	152	3
			معمل طابوق صابر التميمي	262	2
			معمل طابوق الفرات	93.2	7
			معمل طابوق الفجاء	94.4	6
			معمل طابوق المحاويل	18	10
			معمل طابوق النيل	66	9
			معمل طابوق الهاشمية	131.2	4

Table (5.43): Impact of Flow Rate on the Water Environment for the Factories that Produce Water Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
الشركة العامة للصناعات الكيماوية / معمل حرير السدة	1	2	معمل البان بابل	9.2	10
محطة كهرباء المسيب الحرارية	0	5	معمل البان الطيب	7.6	11
معمل ألبان (جمعة عبادي , السهل, الفجاء, الرقق)	1.6	1	معمل نسيج الحلة	103.6	9
معمل البان الوسام	0.8	3	معمل نسيج ابو زيد	772	4
معمل المنتجات المطاطية	0.4	4	معمل نسيج الاخوان	7048	1
معمل بابل للمشروبات الغازية	0.4	4	معمل نسيج الأمل	804	3
معمل نور كربلاء للمشروبات الغازية	0	5	معمل نسيج الحسن	616	6
معمل الكوفة للمشروبات الغازية	0.4	4	معمل نسيج الكوثر	704	5
			معمل نسيج الهادي	524	7
			معمل نسيج الهدى	5036	2
			معمل نسيج الوطن العربي	316	8

Table (5.44): Impact of Biological Oxygen Demand on the Water Environment for the Factories that Produce Water Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
الشركة العامة للصناعات الكيماوية / معمل حرير السدة	0	2	محطة كهرباء المسيب الحرارية	36.5	2
معمل المنتجات المطاطية	0	2	معمل ألبان (جمعة عبادي , السهل, الفجاء)	27	6
معمل نسيج الاخوان , الهدى	1.5	1	معمل البان بابل	29	4
			معمل البان الطيب	5.5	13
			معمل البان الرقق	18	7
			معمل البان الوسام	48.5	1
			معمل بابل للمشروبات الغازية	6	12
			معمل نور كربلاء للمشروبات الغازية	30	3
			معمل الكوفة للمشروبات الغازية	12	11
			معمل نسيج الحلة	27.5	5
			معمل نسيج ابو زيد	16	9
			معمل نسيج الأمل , الحسن , الكوثر, الهادي	15.5	10

			معمل نسيج الوطن العربي	16.5	8
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Table (5.45): Impact of Total Suspended Solids on the Water Environment for the Factories that Produce Water Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
الشركة العامة للصناعات الكيماوية / معمل حرير السدة	3.36	2	محطة كهرباء المسيب الحرارية	5084	1
معمل البان الطيب	1.2	5	معمل ألبان (جمعة عبادي, السهل, الفيحاء)	5.2	11
معمل البان الرفق	3.6	1	معمل البان بابل	6	10
معمل المنتجات المطاطية	0.4	6	معمل البان الوسام	9.6	9
معمل بابل للمشروبات الغازية	1.2	5	معمل نور كربلاء للمشروبات الغازية	10.8	8
معمل نسيج الاخوان	2.8	4	معمل الكوفة للمشروبات الغازية	6	10
معمل نسيج الهدى	3.2	3	معمل نسيج الحلة	13.2	7
			معمل نسيج أبو زيد	31.6	3
			معمل نسيج الأمل, الحسن	30	6
			معمل نسيج الكوثر	31.2	4
			معمل نسيج الهادي	30.4	5
			معمل نسيج الوطن العربي	32	2

Table (5.46): Impact of Tot N (Nitrogen) on the Water Environment for the Factories that Produce Water Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
الشركة العامة للصناعات الكيماوية / معمل حرير السدة	0	2	معمل ألبان (جمعة عبادي, السهل, الفيحاء)	10.4	3
معمل البان الطيب	2	1	معمل البان بابل	12.4	2
محطة كهرباء المسيب الحرارية	0	2	معمل البان الرفق	9.2	4
معمل المنتجات المطاطية	0	2	معمل البان الوسام	18.8	1
كل معامل المشروبات الغازية	0	2			
كل معامل النسيج	0	2			

Table (5.47): Impact of Tot P (Phosphors) on the Water Environment for the Factories that Produce Water Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
الشركة العامة للصناعات الكيماوية / معمل حرير السدة	0	2	معمل ألبان (جمعة عبادي, السهل, الفيحاء)	13.2	4
معمل البان الطيب	2.8	1	معمل البان بابل	15.2	3
معمل المنتجات المطاطية	0	2	معمل البان الرفق	11.2	5
كل معامل المشروبات الغازية	0	2	معمل البان الوسام	24	2
كل معامل النسيج	0	2	محطة كهرباء المسيب الحرارية	1670	1

Table (5.48): Impact of Oil on the Water Environment for the Factories that Produce Water Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
بقية المعامل	0	1	محطة كهرباء المسيب الحرارية	1570	1
			معمل المنتجات المطاطية	20	2

Table (5.49): Impact of Chromium on the Water Environment for the Factories that Produce Water Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
بقية المعامل	0	1	محطة كهرباء المسيب الحرارية	1000	1

Table (5.50): Impact of Copper on the Water Environment for the Factories that Produce Water Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
بقية المعامل	0	1	محطة كهرباء المسيب الحرارية	1275	1

Table (5.51): Impact of Nickel (Ni) on the Water Environment for the Factories that Produce Water Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
بقية المعامل	0	1	محطة كهرباء المسيب الحرارية	4710	1

Table (5.52): Impact of Zinc on the Water Environment for the Factories that Produce Water Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
بقية المعامل	0	1	محطة كهرباء المسيب الحرارية	1612	1

Table (5.53): Impact of Mercury on the Water Environment for the Factories that Produce Water Pollution in the Middle Euphrates Region

b≤1 (accepted impact)			b>1(unaccepted impact)		
Factory Name	Value of c	Rank of Sever Impact	Factory Name	Value of c	Rank of Sever Impact
بقية المعامل	0	1	الشركة العامة للصناعات الكيماوية / معمل حرير السدة	180000	1

5.6 Discussion of the Results

The present work was calculated the pollution loads and concentration of pollutants in air and water environment which results from the industrial activities in the middle Euphrates region. Then compared the concentration of pollutants with Iraqi and WHO limits by using the equations (2.1 to 10) and applying the expert system in the computer program.

5.6.1 Air Environment:

Air pollutants which selected to investigate from the industrial activities in the present work are: TSP, SO₂, NO_x, CO, VOC, F₂, and SO₃. Tables (5.2 to 16) show design and working loads and concentrations of air pollutants calculated.

1. *TSP*: The load of TSP in the middle Euphrates region is high, from table (5.15) the minimum and maximum percent for emitting was (0.2-50) %. The minimum percent emitted from lime factory in Kerbela governorate, while the maximum percent emitted from cement industry in Al-Najaf governorate. The main source of dust is the material handling procedures. From tables (5.14 & 5.16) the load and concentration in design state in the middle Euphrates region are: 813546 tn/y and 2141.2 µg/m³ respectively. The load and concentration in working state in the middle Euphrates region are: 203585 tn/y and 47970 µg/m³ respectively. The working TSP are greater than design TSP because of the electrostatic precipitator was bad and no maintenance for it.
2. *SO₂*: The load of SO₂ in the middle Euphrates region is high, from table (5.15) the lower and upper percent of emitting was (1-63) %. The

minimum percent was emitted from cement industry in Babylon governorate, While the maximum percent was emitted from bricks industry in Babylon governorate. Also SO_2 emission depends on sulfur content in the fuel and the required sulfur content in the lime produced. From tables (5.14 & 5.16) the load and concentration in design state in the middle Euphrates region are: 23214 tn/y and $378.8 \mu\text{g}/\text{m}^3$ respectively. The load and concentration in working state in the middle Euphrates region are: 6906 tn/y and $850.6 \mu\text{g}/\text{m}^3$ respectively.

3. In design and working state the load and concentration of NO_x , CO, VOC, Cl_2 , HCl, SO_3 , and F_2 in the middle Euphrates region, maximum percent and location can be shown in table (5.54).

Table (5.54): Design and working (load, concentration) of NO_x , CO, VOC, Cl_2 , HCl, SO_3 , and F_2 in the middle Euphrates region maximum percent and location.

Parameter	Design*	Design**	Working*	Working**	Location of	Maximum	Location of column (5)
	Load(1)	Concentration(2)	Load(3)	Concentration(4)	(1, 2, 3& 4)	Percent(5)	
NO_x	11156	24.5	2693	77.3	Middle Euphrates Region	58	cement industry in Al-Najaf governorate
CO	362.7	34.35	197.72	64.2	Middle Euphrates Region	74	lime industry in Kerbela governorate
VOC	38	20.45	13.804	1.53	Middle Euphrates Region	83	brick industry in Babylon governorate
Cl_2	54	11	29.3	11.7	Middle Euphrates Region	100	chemical industry in Babylon governorate
HCL	40.5	90	6.6	2.6	Middle Euphrates Region	100	chemical industry in Babylon governorate
SO_3	31.4	16	23.7	9.5	Middle Euphrates Region	100	chemical industry in Babylon governorate
F_2	857.4	8.3	279.7	25.3	Middle Euphrates Region	84	brick industry in Babylon governorate

*Design and Working Load in ton/year. ** Design and Working concentration in $\mu\text{g}/\text{m}^3$

5. By applying an EIA all factories that emitted air pollution in the middle Euphrates region have negative impact in TSP except (Ashur, Babylon, Qasim) asphalt factories and power station. Also all factories of bricks have negative impact in SO₂ except (Al-Mahawil and Al-Nile) bricks factories.

5.6.2 Water Environment:

Water pollutants that result from the industrial activities in the present work are: BOD₅, TSS, TotN, TotP, Oil, Cr, Cu, Ni, Zn and Hg. Tables (5.17 to 31) show Design, Working loads and concentrations which are calculated.

1. The load of BOD₅ in the sewage of middle Euphrates region is high, from table (5.30) the lower and upper percent was (0.1-98) %. The minimum ratio results from dairy products factories and power station in Babylon governorate, while the maximum ratio results from textile industry in Babylon governorate. The source of BOD₅ is the scouring wastes which contribute a large portion of biological oxygen demand (BOD₅) loads from preparation processes. From table (5.29 & 5.31) the load and concentration in design state in the middle Euphrates region are: 273945 tn/y and 12665 mg/l respectively. While the load and concentration in working state are: 64834 tn/y and 62056 mg/l respectively.
2. The load of TSS in the sewage of middle Euphrates region is not small, From table (5.30) the maximum percent 98% results from textile industry in Babylon governorate. The load and concentration in design state in the middle Euphrates region are: 222412 tn/y and 27732 mg/l respectively. From table (5.29 & 5.31) the load and concentration in working state in the middle Euphrates region are: 154319tn/y and 1005198 mg/l respectively.

3. In design and working state the load and concentration of TotN, TotP, Oil, Cr, Cu, Ni, Zn and Hg in the middle Euphrates region, maximum percent and location can be shown in table (5.55).

Table (5.55):Design and working (load, concentration) of TotN, TotP, Oil, Cr, Cu, Ni, Zn and Hg in the middle Euphrates region maximum percent and location.

Parameter	Design*	Design**	Working*	Working**	Location of	Maximum	Location of column (5)
	Load(1)	Concentration(2)	Load(3)	Concentration(4)	(1, 2, 3& 4)	Percent(5)	
TotN	18.9	1022	18.1	11.9	Middle Euphrates Region	66	dairy products in Kerbela governorate
TotP	31.3	432.3	89.2	1589.3	Middle Euphrates Region	72	dairy products in Kerbela governorate
Oil	22.03	3.2	20.62	170.7	Middle Euphrates Region	99	power station in Babylon governorate
Cr	2.8	0.05	2.6	20	Middle Euphrates Region	100	power station in Babylon governorate
Cu	2.3	0.04	2.2	17	Middle Euphrates Region	100	power station in Babylon governorate
Ni	22	0.4	20.6	157	Middle Euphrates Region	100	power station in Babylon governorate
Zn	5.6	0.09	5.3	40.3	Middle Euphrates Region	100	power station in Babylon governorate
Hg	1.32	125	0.39	36	Middle Euphrates Region	100	chemical industry in Babylon governorate

*Design and Working Load in ton/year.

** Design and Working concentration in mg/l.

4. Power station in design state has accepted limits in BOD₅ (17.1), Cr (0.05), Zn (0.09) and unaccepted limits in TSS (2217) and Ni (0.4). In working state unaccepted limits in BOD₅ (7333), TSS (953333), Cr (20), Zn (40.3) and Ni (157). All these numbers in mg/l.
5. Soft drink in design state all factories unaccepted limits in BOD₅ and TSS except Babylon soft drink factory accepted limits in BOD₅ (487.9) mg/l , and TSS (163) mg/l with Iraqi limits. Noor Kerbela and Al-Kufa soft drink factory release waste to the Euphrates river and Babylon soft drink factory release waste to the sewerage system. In working state all factories all factories unaccepted in BOD₅ and TSS except Babylon soft drink factory accepted in TSS (319.6) mg/l with Iraqi limits.
6. All dairy product, rubber product and Babylon soft drink factory accepted with Iraqi standard limits in design state.
7. From tables (5.44 & 5.45) all factories that released liquid wastes in the middle Euphrates region unaccepted impact in BOD₅ except general company for chemical industries, rubber product factory, Al-Ekwan and Al-Huda textile factories and all factories unaccepted impact in TSS except general company for chemical industries, rubber product factory, Al-Ekwan and Al-Huda textile factories, Al-Teeb and Al-Rifiq dairy product factory and Babylon soft drink factory.

CHAPTER SIX

6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

1. Rapid Environmental Assessment (REA) procedure is most useful in making an initial appraisal of the sources and levels of emissions or discharges from an area that has little or no previous pollution load data.
2. The REA of the middle Euphrates region have demonstrated that the region faces significant environmental challenges in relation to future economic and human development. Environmental policies in Babylon, Al-Najaf and Kerbela governorates need further coordinated efforts and joint action for effective implementation and enforcement.
3. The middle Euphrates region must be protected from the harsher impacts caused by unsustainable management practices. These impacts could be minimized with an integrated sustainable development strategy for the middle Euphrates region encompassing integrated water and air management, as well as environmental security issues.
4. The expert system can be considered as a guide to the application of rapid technique in the inventory stage in each tool of the environmental management.
5. In the Leopold matrix method there is no a standardized way of assessing the scores, nor is there a means of assigning weight to different impacts to determine relative importance. For this reason, the scoring values in the matrix present the author's opinion.

6. There is no any control of air pollution in the middle Euphrates region.
7. Exactly 27% of factories in the middle Euphrates region have treatment plant for liquid waste and approximately 13% of them work in a good state.
8. All bricks and cement factories which located in the study area are emitting large quantity of pollutants TSP, NO_x, VOC, CO, SO₂, and F₂ which is out of standard limits.
9. The maximum percent of air pollutants loads that emitted from the industries in the middle Euphrates region were: SO₂ (66%), NO_x (22%), VOC (83%), F₂ (84%), and Cl₂, HCl, SO₃ (100%) all these ratio emitted from Babylon governorate, TSP (54%) which emitted from Al-Najaf governorate and CO (74%) which emitted from Kerbela governorate.
10. The maximum ratio of liquid pollutants loads that discharged from the industries in the middle Euphrates region were: BOD₅ (99.5%) and TSS (100%) and other pollutant like (Oil, Cr, Cu, Ni, Zn, Hg) with percent (100%) all these percents discharged from Babylon governorate, TotN (66%) and Tot P (72%) these ratio discharged from Kerbela governorate.
11. General company for chemical industries has unaccepted limits of mercury (Hg) in design (125 mg/l) and working (36 mg/l) state with Iraqi limits that limit Hg 0.001 mg/l and unaccepted impact.

6.2 Recommendations

6.2.1 Recommendations for factories that studied:

1. Applying ISO 9000 for the quality of products and applying ISO 14000 for quality of environment for factories.
2. Along time, integrated sustainable development strategy for the middle Euphrates region for water and air management, as well as environmental security issues.
3. Physical planning and zoning by:
 - Restricting the location of new industries vicinity to residential zones or other sensitive areas should be prohibited
 - Controlling of emissions in sensitive areas.
4. Promoting pollution control in factories by:
 - Setting priorities by focusing on pollution control devices and construction treatment plant for the most serious polluting factories.
 - Using most suitable techniques.
 - Compulsory notification of accidents and standard limits.
5. Promoting cleaner production (increasing the efficiency of industrial processes and the use of product to prevent the pollution of air and water and reducing wastes at their sources).
6. Increasing environmental awareness throughout society, particularly among policymakers, managers, and citizens.
7. Increasing the green area surrounding the industrial activities.

6.2.2 Recommendations for future studies:

1. Making Environmental Impact Assessment (EIA) for new major industries in order to assess the environmental impact of new activities.
2. Making Rapid Environmental Assessment (REA) for hospitals to reduce solid waste which results from it.
3. Future studies must be done for bricks and cement factories with present pollution control devices to reduce the emission of pollutants.
4. Using Risk Assessment Technique in conjunction with Rapid Environmental Assessment to evaluate and control pollution.

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TABLE OF SYMBOLS

Symbol	Description
AQG	Air Quality Guidelines.
AQS	Air Quality Standard.
BOD ₅	Biochemical Oxygen Demand after 5 days.
CEQ	Council of Environmental Quality.
Cl ₂	Chlorine gas.
CO	Carbon monoxide.
Cr	Chromium.
Cu	Copper.
EIA	Environmental Impact Assessment.
EIS	Environmental Impact statement.
EMP	Environmental Management Plan.
EMS	Environmental Management System.
EPA	Environmental Protection Agency.
ESP	Electrostatic Precipitator.
F ₂	Fluoride.
FWPCA	Federal Water Pollution Control Administration.
HCL	Hydrochloric acid or Hydrogen Chloride.
Hg	Mercury.
ISO	International standard organization.
LCA	Life Cycle Assessment.
MOEF	Ministry of Environment and Forests.
NEPA	National Environmental Protection Agency.
Ni	Nickel.
NO _x	Nitrogen oxides.
PM ₁₀	Particulate Matter with diameter less than 10 micron.
SIC	Standard Industrial Classification.
SO ₂	Sulfur dioxide .
SO ₃	Sulfur trioxide.
Tot N	Total Nitrogen.
Tot P	Phosphors.
TSP	Total Suspended Particle.

TSS	Total Suspended Solids.
U	Unit of Production.
UN	United Nation.
UNEP	United Nation Environmental Program.
U.S	United State.
VOC	Volatile Organic Compound.
WHO	World Health Organization.
Zn	Zinc.
µm	Micro meter.

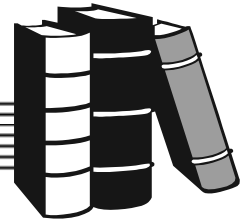
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Appendices

Appendix -B-
WHO Air
Pollutants
Factors

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	(kg/U)
MAJOR DIVISION 0. ACTIVITIES NOT ADEQUATELY DEFINED								
	Consumer Solvent use ¹	(person)*(year)					4.2	
	Surface Coating							
	Paint	tn consumed					560	
	Varnish	tn consumed					500	
	Lacquer	tn consumed					770	
	Enamel	tn consumed					420	
	Primer (zinc Chromate)	tn consumed					660	
MAJOR DIVISION 1. AGRICULTURE, HUNTING, FORESTRY, AND FISHING								
111	Agricultural and livestock							
	Open Burning of Agricultural							
	Field Crop	tn	11.0			58	9.0	
		1000 m ² of land	5.0			26	4.0	
	Vine Crops	tn	3.0			-26	3.0	
		1000m ² of land	1.7			15	17	
	Weeds	tn	8.0			42	4.5	
		1000m ² of land	5.8			30	3.2	
	Orchard Crops	tn	3.0			26	4.0	
		1000m ² of land	1.0			9	1.4	
	Forest Residues	tn	8.0			70	9.0	
		1000m ² of land	2.6			110	14.0	
121	Forestry							
	Charcoal Manufacturing							
	Uncontrolled	tn	133		12	172	157	
	Afterburners	tn	25		12	34	31	
MAJOR DIVISION 2. MINING AND QUARRYING								
210	Coal mining							
	Coal cleaning							
	Coal Drying							
	Fluidized Bed Dryer							
	Uncontrolled	tn of dried coal	10	0.22	0.7		0.05	
	Cyclone	tn of dried coal	6	0.22	0.07	0.05		
	wet scrubber	tn of dried coal	0.05	0.13	0.07		0.05	
	Flash Drier							
	Uncontrolled	tn of dried coal	8					
	Cyclone	tn of dried coal	5					
	wet scrubber	tn of dried coal	0.2					
	Multilouvered Drier							
	Uncontrolled	tn of dried coal	13					
	Cyclone	tn of dried coal	4					
	wet scrubber	tn of dried coal	0.05					
220	Crude petroleum and Natural Gas production							
	Desulphurization of Natural Gas ²	1000 m ³		14.2(1-e) H ₂ S				
		1000 m ³		16.6(1-e) S				
		tn of gas		17.1(1-e) H ₂ S				
		tn of gas		20(1-e) S				
2302	Non-Ferrous ore mining							
	Metallic Mineral processing (low Moisture Ore)							
	Uncontrolled							
	Crushing							
	Primary	tn	0.2					
	Secondary	tn	0.6					
	Tertiary	tn	1.4					
	Dry Grinding							
	Gravity discharge	tn	1.2					
	Air Swept	tn	14.4					
	Drying	tn	9.8					
	Fabric filter or scrubber	tn	1.5					
	Leadbearing Ore Crushing and Grinding							
	Pb Ores	tn	0					Pb 0.15
	Zn Ores	tn	3.0					Pb0.006
	Cu ores	tn	3.2					Pb0.006
	Pb-Zn Ores	tn	3.0					Pb 0.06
	Cu-pb Ores	tn	3.2					Pb 0.06
	Cu-Zn Ores	tn	3.2					Pb0.006
	Cu-pb-Zn Ores	tn	3.2					Pb 0.06
2901	Stone Quarrying. Clay and sand pits							
	Sand and Gravel ⁽³⁾	tn	0.134					

1- The listed factor includes evaporated losses from the use of polishes, waxes, deodorants, etc. And its value is related to the standard of living of people in the study area. A lower value than the listed one may be more appropriate for areas with low standard of living.

2 - (a) "e" is fractional efficiency of sulfur recovery plants with typical value as follows:

form uncontrolled 2-stage sulfur recovery plant : from 0.920 to 0.950

form uncontrolled 3-stage sulfur recovery plant : from 0.950 to 0.975

form uncontrolled 4-stage sulfur recovery plant : from 0.960 to 0.990

form uncontrolled sulfur recovery plant : from 0.990 to 0.999

(b) "H₂S" is the mole percent of H₂S in natural gas (1 mole % H₂S =0.966 weight % H₂S or 0.856 weight % sulfur). While "s" is the weight percent of sulfur in the natural gas.

3 - Emission factors apply in cases where granular materials are found in near – surface alluvial deposits and in processing operation involving initial dry screening followed by wet processing for screening and silt removal to produce washed sand and gravel. In situation where silt removed by air blowing, significant portion of the raw material may be blown in the air resulting in very high dust emission

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	(kg/U)
	Stone Quarrying and processing ^{4a}							
	Uncontrolled							
	Wet Quarrying Drilling	tn	0.4					
	Blasting	tn	?					
	Batch Drop							
	Truck Unloaded	tn	0.17					
	Truck loaded							
	Conveyor	tn	0.17					
	Front End loader	tn	29.					
	Conveying	tn	1.7					
	Drying	tn	17.5					
	Crushing							
	Primary + secondary Crushing							
	Dry materials	tn	0.14					
	Wet materials	tn	0.009					
	Tertiary Dry materials	tn	0.93					
2902	Chemical an Fertilizer Mineral Mining							
	Phosphate Rock processing							
	Drying or Calcining							
	Drying							
	Uncontrolled	tn	2.9					
	Low pres Venturi scrubber	tn	0.29					
	High pres Venturi scrubber	tn	0.06					
	Calcining							
	Uncontrolled	tn	7.7					
	Low pres Venturi scrubber	tn	0.77					
	High pres Venturi scrubber	tn	0.16					
	Product Grinding							
	Uncontrolled	tn	1.5					
	Fabric Filter	tn	0.01					
	Transfer and Storage	tn	1					
	Open storage piles	tn	20					
	MAJOR DIVISION 3. MANUFACTURED							
	DIVISION 31. MANUFACTURE OF FOOD , BEVERAGES AND ROBACCO							
3111	Meat Smokehouse							
	Uncontrolled	tn	0.15			0.3	0.18	
	Low Voltage ESP or Afterburner	tn	0.05			0.0	0.075	
3114	Fish processing (canning & manufacture of by – products)							
	Steam tube Dries	tn	2.5					H ₂ S 0.05
	Direct Fired Dries	tn	4.0					H ₂ S 0.05
3116	Grain Mills							
	Feed Mills Uncontrolled	tn	4.9					
	Wheat Milling							
	Uncontrolled	tn	38.0					
	Cyclones & Fabric Filter	tn	0.8					
	Drum Milling Uncontrolled	tn	3.0					
	Rye Milling							
	Uncontrolled	tn	38.0					
	Cyclones & Fabric Filter	tn	0.8					
	Oat Milling Uncontrolled	tn	1.25					
	Rice Milling Uncontrolled	tn	2.97					
	Soybean Milling Uncontrolled	tn	11.73					
	Dry Corn Milling Uncontrolled	tn	6.25					
	Wet Corn Milling Uncontrolled	tn	6.24					
3121	Starch manufacturing							
	Uncontrolled	tn	4.0					
	Controlled ⁵	tn	0.01					
3122	Alfalfa Dehydrating							
	Primary cyclone							
	No secondary controls	tn	5					
	Medium Energy Wet Scrubber	tn	0.5					
	Meal Collector Cyclone							
	No secondary controls	tn	2.6					
	Fabric Filter	tn	0.03					
	Pellet cooler Cyclone							
	No secondary controls	tn	3					
	Fabric Filter	tn	0.03					
3133	Beer brewing	tn of cereal	4.0				1.3	
	m ³ of beer	0.8				0.25		
3133	Wine production	m ³ of wine					0.35	
	DIVISION 32. TEXTLE , WEARING APPAREL & LEATHER INDUSRIES							
321	Textile Fabric printing	tn of fabric					142	
3211	Cotton Ginning							
	Uncontrolled	tn of cotton	7.0					
	Cyclone, in-line filter etc.	tn of cotton	4.48					
	DIVISION 33. MANUFACTURE OF WOOD & WOOD PRODUCE , INCLUDING FURNITURE							
331	Manufacture of wood and wood and Cork Products , Except Furniture							
	Plywood Veneer							
	Fugitive Emission							
	Log Debarking & Sawing	tn of logs	0.187					
	Plywood Cutting & Sanding	M ² of plywood	0.05					

4- Emission from the material hauling are not included as they can computed separately (see factors listed in group 711).

5- Tsp emissions from the various corn cleaning, grinding, and screening operations can be controlled by centrifugal gas scrubber

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
	Sawdust Handling	tn of sawdust	0.5					
	Dryers	1000 m ²					12	
DIVISION 34. MANUFACTURE OF PAPER AND PAPER PRODUCTS, PRINTING AND PUBLISHING								
341	Manufacture of paper products							
	Sulfate (Kraft) Pulping							
	Digester , Brown Stock Washer Multiple Effect Evaporator							
	Uncontrolled	tn						H ₂ S 0.58 Merc 1.15
	Recovery Boiler							
	Recovery Boiler & Direct Contact Evaporator							
	Uncontrolled	tn	90.	3.5		5.5		H ₂ S 6 Merc 1.5
	Venturi Scrubber	tn	24	3.5		5.5		H ₂ S 6 Merc 1.5
	Venturi + Auxilliary Scrubber		7.5	3.5		5.5		H ₂ S 6 Merc 1.5
	ESP		1.5	3.5		5.5		H ₂ S 6 Merc 1.5
	ESP + Auxilliary Scrubber			3.5		5.5		H ₂ S 6 Merc 1.5
	Recovery Boiler without Direct Contact Evaporator							
	Uncontrolled	tn	115.			5.5		H ₂ S 0.05
	ESP	tn	1.			5.5		H ₂ S 0.05
	Smelt Dissolving Tank							
	Uncontrolled	tn	3.5	0.1		5.5		H ₂ S 0.1 Merc
	Mesh Pad	tn	0.5	0.1		5.5		H ₂ S 0.15 Merc
	Scrubber	tn	0.1			5.5		H ₂ S 0.1 Merc0.15
	Lime kiln							
	Uncontrolled	tn	28	0.15		0.05		H ₂ S0.25 Merc0.1
	Scrubber or ESP	tn	0.25			0.05		H ₂ S0.25 Merc0.1
	Miscellaneous Source	tn						Merc0.25
	Sulfite Pulping							
	Digester Blow pit or dump Tank							
	Uncontrolled	tn		3.35				
	Mgo Base System							
	Process Change	tn		2.0				
	Scrubber	tn		0.5				
	Process Change + Scrubber	tn		0.1				
	All Exhausts through							
	Recovery system	tn		0.0				
	NH ₃ Base system							
	Process Change	tn		12.5				
	Process Change + Scrubber	tn		0.2				
	Na Base system							
	Process Change + Scrubber	tn		1				
	Calcium Base system	tn		33.5				
	Recovery system							
	Mgo Base system							
	Multicyclone + Venture scrubber	tn	1.	4.5				
	NH ₃ Base system							
	NH ₃ Absorption + mist Elim	tn	0.35	3.5				
	Na Base system							
	Sodium Carbonate Scrubber	tn	2.	1.				
	Acid Plant ⁽²⁾							
	NH ₃ Base system							
	Scrubber	tn		0.2				
	Na Base system	tn		0.1				
	Calcium Base system							
	Scrubber	tn		4				
342	Printing and publishing And Allied Industries							
	Graphic Arts							
	Small Application ⁷	(Capita)*(year)					0.4	
	Major printing Lines ⁸							
	Web Offset'							
	Publications							
	Printing Line							
	Uncontrolled	tn of ink					240	
	Incineration	tn of ink					12	
	Printed Product	tn of ink					160	
	Newspapers							
	Printed Product	tn of ink					50	
	Web Letterpress							
	Publications							

6 - Necessary in pulp mills with insufficient nonexistent recovery system.

7 - () large sources contribute most of the emission for graphic arts operation.

(b) The listed factor is expressed in kg / year / capita , it provides an overall estimate for the number small source which are difficult separately , and can be used only in the case of developed countries .

8- The VOC emission factor for the plant operation (dryer and other print – line components) are listed separately from these for the printed product, as the former are subject to controls.

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
	Printing Line							
	Uncontrolled	tn of ink					240	
	Web Letterpress							
	Publications							
	Printing Line							
	Uncontrolled	tn of ink					240	
	Incineration	tn of ink					12	
	Printed Product	tn of ink					160	
	Newspapers	tn of ink					0	
	Rotogravure							
	Printing Line							
	Uncontrolled	tn of ink					712	
	Carbon Adsorption	tn of ink					230	
	Incineration	tn of ink					249	
	Printed Product	tn of ink					38	
	Flexography							
	Printing Line							
	Uncontrolled	tn of ink					712	
	Carbon Adsorption	tn of ink					285	
	Incineration	tn of ink					285	
	Printed Product	tn of ink					38	
	Publication Gravure Printing ⁹							
	Uncontrolled	tn of ink					1480	
	Controlled (Old Presses)	tn of ink					370	
	Controlled (New Presses)	tn of ink					220	
DIVISION 35. MANUFACTURE OF CHEMICALS & OF CHEMICAL, PETROLEUM, COAL, RUBBER & PLASTIC PRODUCTS								
351	Manufacture of Industrial Chemical							
3511	Basic Industrial Chemicals Except Fertilizers							
	Phthalic Anhydride							
	Oxidation of o-xylene Process							
	Main Process Stream							
	Uncontrolled	tn	69	4.7		151		
	Scrubber & Incinerator	tn	3	4.7		6		
	Incinerator	tn	4	4.7		8		
	Incinerator + Steam Generator	tn	4	4.7		8		
	Pretreatment							
	Uncontrolled	tn		6.4				
	Scrubber & Incinerator	tn		0.3				
	Incinerator	tn		0.4				
	Distillation							
	Uncontrolled	tn		45.			1.2	
	Scrubber & Incinerator	tn		2.			<0.1	
	Incinerator	tn		2.			<0.1	
	Oxidation of naphthalene							
	Uncontrolled	tn	28.			50		
	Incinerator	tn	6.			10		
	Scrubber	tn	0.3			50		
	Pretreatment							
	Uncontrolled	tn	2.5					
	Incinerator	tn	0.5					
	Scrubber	tn	0.1					
	Distillation							
	Uncontrolled	tn	19.				5	
	Incinerator	tn	2.				1	
	Scrubber	tn	0.2				<0.1	
	Chlor-Alkali Production							
	Mercury Cell Process							
	Air Blowing the Cell Brine	tn						Cl ₂ 2.5
	Blow Gases from Liquefaction							
	Uncontrolled	tn						Cl ₂ 50
	Water Absorber	tn						Cl ₂ 5
	Caustic or Lime Absorber	tn						Cl ₂ 0.5
	Loading of Chlorine							
	Storage & Tank Car Vents	tn						Cl ₂ 8.25
	Diaphragm Cell Process							
	Blow Gases from Liquefaction							
	Uncontrolled	tn						Cl ₂ 30
	Water Absorber	tn						Cl ₂ 3
	Caustic or Lime Absorber.	tn						Cl ₂ 0.5
	Loading of Chlorine							
	Storage & Tank Car Vents	tn						Cl ₂ 8.25
	Hydrochloric Acid (by-product process) ¹⁰							
	Uncontrolled	tn						HCl 3.0
	Final Scrubber	tn						HCl 0.2
	Hydrofluoric Acid from fluorospar & H ₂ SO ₄							
	Spar drying, transfer & silos							
	Uncontrolled	tn	70.5					
	FFs, Covers, Additives	tn	1.3					
	Tail Gas							
	uncontrolled	tn						HF 12 SiF ₄ 15.0
	Caustic Scrubber	tn						HF 0.1 SiF ₄ 0.15

9- (a) Control devices can be of the solvent recovery (carbon adsorption) a-d of the solvent destruction type (thermal or catalytic oxidation) type, the former being more common.

(b) 75% overall control level represents 84% capture efficiency and 90% control efficiency (the U.S. EPA guideline recommendation for old existing presses). The 85% overall control level represents the Best Demonstrated Control «Technology for new plants.

10 - With chlorine added to an organic compound such as benzene, toluene and vinyl chloride.

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
	Sulfuric Acid ¹¹							
	Without Acid Mist Controls							
	From Recovered S	tn of 100% H ₂ SO ₄		7(100-e)				SO ₃ 0.29
	From Bright Virgin S	tn of 100% H ₂ SO ₄		7(100-e)				SO ₃ 0.85
	From Dark Virgin S	tn of 100% H ₂ SO ₄		7(100-e)				SO ₃ 1.66
	Sulfide Ores	tn of 100% H ₂ SO ₄		7(100-e)				SO ₃ 2.15
	Spent Acid	tn of 100% H ₂ SO ₄		7(100-e)				SO ₃ 1.15
	ESP or Mist Eliminator	tn of 100% H ₂ SO ₄		7(100-e)				SO ₃ 0.05
	Nitric Add from Catalytic oxidation of NH ₃							
	Weak Acid Tail Gas							
	Uncontrolled	tn of 100% acid				22.0		
	Catalytic NO _x Reduction							
	with Natural Gas	tn of 100% acid				0.2		
	with Hydrogen	tn of 100% acid				0.4		
	with 25% NG 75% H ₂	tn of 100% acid				0.5		
	Extended Absorption	tn of 100% acid				1.0		
	High Strength Acid Plant	tn of 100% acid				5.0		
	Phosphoric Acid							
	Wet process ¹²							
	uncontrolled	tn of P ₂ O ₅	5.5 ¹³					F ₂ 59.4
	controlled	tn of P ₂ O ₅	3.0					F ₂ 0.6
	Thermal Process							
	Controlled	tn of 100% P ₂ O ₅	1.0					
	Lead Oxide & Inorganic Pigments							
	Lead Oxide Production							
	Barton Pot (After FF)	tn	0.32					Pb 0.22
	Calcining Furnace							
	Uncontrolled	tn	7					Pb 7.0
	Scrubber	tn	1.23					Pb 1.23
	Cyclone + FF	tn	0.07					Pb 0.07
	Pigment Production							
	Red Lead							
	Uncontrolled	tn	0.5					Pb 0.5
	Scrubber	tn	0.088					Pb 0.088
	Cyclone + FF	tn	0.005					Pb 0.005
	White Lead							
	Uncontrolled	tn	0.28					Pb 0.28
	Scrubber	tn	0.05					Pb 0.05
	Cyclone + FF	tn	0.003					Pb 0.003
	Chrome Pigments Production							
	Uncontrolled	tn	0.065					Pb 0.065
	Scrubber	tn	0.011					Pb 0.011
	Cyclone + FF	tn	0.001					Pb 0.001
	White Lead							
	Uncontrolled	tn	0.28					Pb 0.28
	Scrubber	tn	0.05					Pb 0.05
	Cyclone + FF	tn	0.003					Pb 0.003
	Chrome Pigments Production							
	Uncontrolled	tn	0.065					Pb 0.065
	Scrubber	tn	0.011					Pb 0.011
	Cyclone + FF	tn	0.001					Pb 0.001
	Ammonia Production ¹⁴							
	With Natural Gas as Fuel	tn	0.072	0.022	2.7	7.97	4.73	NH ₃ 2.1
	With Distillate Oil as Fuel	tn	0.450	1.319	2.7	8.02	4.94	NH ₃ 2.1
	Sodium Carbonate (Soda Ash) Production							
	Natural Process (Recovery from natural deposits) ¹⁵							
	Predryer - Rotary steam heated							
	Uncontrolled	tn	1.55					
	Venturi Scrubber	tn	0.03					
	Calciner							
	Gas Fired - Uncontrolled	tn	184					
	Coal Fired - Uncontrolled	tn	195	0.007				
	Cyclone & ESP	tn	970-0.08					
	Bleacher - Rotary gas fired							
	Uncontrolled	tn	155					
	Cyclone & ESP	tn	0.02					
	Dryer							
	Rotary steam tube							
	Uncontrolled	tn	33					
	Venturi Scrubber	tn	0.4					
	Fluid bed steam tube							
	Uncontrolled	tn	73					
	Cyclone+Venturi Scrubber	tn	0.09					
	Synthetic (Solvay) Process ¹⁶							
	Uncontrolled	tn	0.25					
	Controlled	tn	0.25					

11 - "e" is the process conversion efficiency of SO₂ into SO₃. Typical values for single absorption plants are 95 to 98% and for double absorption plants about 99.7%. For single absorption plants equipped with alkaline SO₂ absorbers, a value of 99.7% should be also used.

12- The wet process is used predominantly in the production of fertilizers.

13-phosphate rock is assumed to be delivered dried or calcined to the plant .if drying or calcining take place, the added tsp emissions must be computed (use SIC No. 2902)

14 - The natural gas feedstock is assumed to be desulfurized. If natural gas desulfurization takes place , the additional SO₂ emissions need to be considered (see SIC No 2200). Loading of storage tanks and ships may be an additional source of significant NH₃ , emissions if proper controls are not applied.

15 - Significant TSP emissions, which ray arise from crushing and dissolving operations, elevators, conveyor transfer points-, Product loading and storage piles, have not been included.

16 - Significant fugitive TSP emissions from limestone handling and processing operations, product drying operations, and dry solids handling (conveyance and bulk loading) have not been included.

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
	Calcium Carbide Production ¹⁷							
	Coke Dryer							
	Uncontrolled	tn	1.	1.5				
	Controlled	tn	0.13	1.5				
	Electric Furnace							
	Circular Charging Conveyor							
	Controlled	tn	0.17					
	Furnace Main Stack							
	Uncontrolled	tn	12.	1.5				
	Controlled	tn	0.39	1.5				
	Tap fume vents							
	Controlled	tn	0.07					
	Furnace Room vents							
	Uncontrolled	tn	13.					
	Controlled	tn	0.07					
	Primary and Secondary Product Crushing							
	Controlled	tn	0.57					
	Adipic Add (from cyclohexane.or cyclohexanol)							
	Raw Material Storage	tn					3.3	
	Cyclohexane Oxidation							
	Uncontrolled (after scrubber)	tn				58	20	
	Carbon Adsorber	tn				58	1	
	Flaring	tn				2	6	
	CO boiler	tn				0.5	0.0	
	Thermal Incinerator Nitric Acid Reaction	tn				0.0	0.0	
	Nitric acid Reaction							
	Uncontrolled (after NO _x absorber)	tn			27.			
	Scrubber, Flaring or Combustion	tn			8			
	Thermal Reduction ¹⁸	tn			0.5			
	Refining, Drying, Cooling, Storing							
	Controlled (Fabric Filter)	tn	0.5		0.3		0.3	
	Lead Alkyl Manufacture							
	Electrolytic Process	tn						Pb 0.5
	Sodium/Lead Alloy Process							
	Process Vents							
	Tetraethyl Lead Production							
	Uncontrolled	tn						Pb 2.0
	Low Energy Wet Scrubber	tn						Pb 0.25
	High Energy Wet Scrubber	tn						Pb 0.06
	Fabric Filter	tn						Pb 0.02
	Tetramethyl Lead Production							
	Uncontrolled	tn						Pb75.0
	Low Energy Wet Scrubber	tn						Pb 9.4
	High Energy Wet Scrubber	tn						Pb 2.25
	Fabric Filter	tn						Pb 0.75
	Sludge Pits							
	Uncontrolled	tn						Pb 0.6
	Low Energy Wet Scrubber	tn						Pb 0.08
	High Energy Wet Scrubber	tn						Pb0.002
	Fabric Filter	tn						Pb0.001
	Recovery Furnace							
	Uncontrolled	tn						Pb 28.0
	Low Energy Wet Scrubber	tn						Pb 3.5
	High Energy Wet Scrubber	tn						Pb 0.84
	Fabric Filter	tn						Pb 0.28
	Uncontrolled	tn				19	19.8	
	Carbon Adsorption	tn				19	2.0	
	Thermal Oxidation	tn				1.0	1.0	
3512	Manufacture of Fertilizers and pesticides							
	Urea Production [from NH ₃ & CO ₂] ¹⁹							
	Solution Formation's Concentration							
	Uncontrolled	tn	0.0105					NH ₃ 9.12
	Solids Formation							
	Non Fluidized Bed Prilling							
	Uncontrolled	tn	1.85					NH ₃ 0.43
	Wet Scrubber	tn	0.032					NH ₃ 0.43
	Fluidized Bed Prilling							
	Agricultural Grade							
	Uncontrolled	tn	3.1					NH ₃ 1.46
	Wet Scrubber	tn	0.39					NH ₃ 1.46
	Animal Feed Grade							
	Uncontrolled	tn	1.8					NH ₃ 2.07
	Wet Scrubber	tn	0.24					NH ₃ 1.04
	Drum Granulator							
	Uncontrolled	tn	120					NH ₃ 1.07
	Wet Scrubber	tn	0.115					NH ₃ 1.07
	Rotary Drum Cooler ²⁰							
	Uncontrolled	tn	3.72					NH ₃ 0.0256
	Wet Scrubber	tn	0.1					
	Bagging - Uncontrolled	tn	0.095					
	Ammonium Nitrate (from HNO ₃ & NH ₃)							
	High Density Prilling Process							

17 - Controls devices for TSP used are Fabric Filters of Wet Scrubbers. The CO generated from closed furnaces is either used as fuel for other processes or Flared.

18 - In the thermal reduction, the off gases containing the KO⁺ is reacted with excess fuel in a reducing atmosphere.

19 - Emission sources are generally controlled with wet scrubbers due to easy recycling of the dissolved Urea collected. Emissions from the bagging operations are controlled by Fabric Filters. Emissions from the solution synthesis and concentration operations, from the solids screening and coating are small and are generally not controlled.

20- Required only for Pan Granulation and for some agricultural grade prills.

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
	Uncontrolled	tn	5.8					NH ₃ 37.8
	Wet Scrubber	tn	0.74					NH ₃ 0.52
	Low Density Prilling Process							
	Uncontrolled	tn	86.9					NH ₃ 18.8
								NH ₃ 0.52
	Wet Scrubbing	tn	1.2					
	Rotary Drum Granulator Process							
	Uncontrolled	tn	157.5					NH ₃ 48
								NH ₃ 0.52
	Wet Scrubbing	tn	0.43					
	Pan Granulators Process							
	Uncontrolled	tn	23.1					NH ₃ 17.8
	Wet Scrubbing	tn	0.33					
	Ammonium Sulfate ²¹							
	Rotary Driers							
	Uncontrolled	tn	23.00				0.74	
	Wet Scrubbers	tn	0.12				0.11	
	Fluidized Bed Dryers							
	Uncontrolled	tn	109.00				0.74	
	Wet Scrubbers	tn	0.14				0.11	
	Ammonium Phosphates (from H3PO4 & Anhydrous NH3)							
	Controlled	tn	0.5					F ₂ 0.04
	Normal Superphosphates (from Phosphate rock & H ₂ SO ₄)							
	Controlled	tn of product	0.76					F ₂ 0.36
		tn of P ₂ O ₅ content	4.20					F ₂ 2
	Triple Superphosphates (from Phosphate Rock & H ₃ PO ₄) ²²							
	Run-of-the-Pile	tn of product	0.04					F ₂ 0.04
	Controlled	tn of P ₂ O ₅ content	0.10					F ₂ 0.1
	Granular	tn of product	0.10					F ₂ 0.056
	Controlled	tn of P ₂ O ₅ content	0.26					F ₂ 0.14
3513	Manufacture of Synthetic Resins, Plastic Materials and Man-Made Fibbers Except Glass							
	Styrene-Butadiene Copolymer (Rubber)							
	Emulsion Crumb Product							
	Monomer Recovery							
	Monomer Recovery							
	Uncontrolled	tn					2.6	
	Absorber or Flaring	tn					0.26	
	Blend/Coagulation Tank & Dryers	tn					2.93	
	Emulsion Latex Product	tn					3.55	
	Polypropylene & Copolymers							
	Uncontrolled	tn	1.5				0.35	
	Vapor Recovery and/or Flares	tn	0.2				0.03	
	Polyvinyl Chlorides & Copolymers							
	Uncontrolled	tn	17.5				8.5	
	Vapor Recovery and/or Flares	tn	1.7				0.8	
	Rayon Manufacturing - Viscose Process	tn						H ₂ S 50.4 CS ₂ 251
	Cellulose Acetate. Filter Tow	tn					112	
	Cellulose Acetate & Triacetate (yarn)	tn					199	
	Polyesters (e.g. Dacron), Melt Spun							
	Staple	tn					0.6	
	Yarn	tn					0.05	
	Acrylic, Dry Spun							
	Uncontrolled	tn					40	
	Controlled ²³	tn					32	
	Modacrylic, Dry Spun	tn					125	
	Acrylic and Modacrylic, Wet Spun	tn					6.75	
	Acrylic, Inorganic Wet Spun							
	Homopolymer	tn					20.7	
	Copolymer	tn					2.75	
	Nylon 6, Melt Spun							
	Staple	tn					3.93	
	Yarn	tn					0.45	
	Nylon 66, Melt Spun							
	Uncontrolled	tn					2.13	
	Catalytic Incinerators etc	tn					0.31	
	Polyolefin. Melt Spun	tn					5	
	Spandex (polyurethane fiber)							
	Dry Spun	tn					4.23	
	Reaction Spun	tn					138	
	Vinyon Dry Spun	tn					150	
352	Manufacture of Other Chemical Products							
3521	Manufacture of Paints, Varnishes and Lacquers							

21 - Produced as a caprolactam By-product, as a coke oven By-product, or synthetically by reacting

22- (a) Emissions from the reactor, den and granulator are controlled by scrubbers using recycled gypsum pond water.

(b) Emissions from the dryer, cooler, screens, mills, product transfer systems & storage buildings are controlled by cyclones for the removal of dust, before they are sent to wet scrubbers.

(c) ' Fabric Filters are used in the preliminary ground rock handling activities.

23 - Scrubbers and Condensers are used in the spinning cells and in the dryers. Carbon adsorption is used in tank vents and in mixing and filtering operations. Distillation columns are also used to recover solvent from condenser, scrubber and wash water

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
	Paint Manufacture	tn					15	
	Uncontrolled	tn					0.15	
	Afterburners							
	Varnish Manufacture							
	Uncontrolled	tn					182	
	Afterburners	tn					1.9	
3523	Manufacture of Soap and Cleaning Preparations							
	Spray-Dried Detergents							
	Uncontrolled	tn	45.0					
	Cyclones	tn	7.0					
	Cyclones & Spray chamber	tn	3.5					
	Cyclones & Pecked Scrubber	tn	2.5					
	Cyclones & Venturi Scrubber	tn	1.5					
	Cyclones & Wet Scrubber	tn	0.544					
	Cyclones & Wet Scrubber & ESP	tn	0.023					
3529	Manufacture of Chemical Products not Elsewhere Classified							
	Carbon Black							
	Main Process Vent							
	Oil Furnace Process							
	Uncontrolled	tn	3.27	0.0	0.28	1400	75	H ₂ S 30
	Flare	tn	1.35	25.0		122.	1.85	H ₂ S 1.0
	CO Boiler & Incinerator	tn	1.04	17.5	4.65	0.88	0.99	H ₂ S 0.11
	Thermal Process	tn	0.	0.		0.	0.	
	All Other Systems							
	Fabric Filters	tn	0.37	0.27	0.4	0.73		
	Printing Ink							
	Uncontrolled	tn	1.0				235	
	Scrubber/Condenser & Afterburner	tn					< 23.5	
	Trinitrotoluene							
	Batch Process							
	Nitration Reactors							
	With Fume Recovery	tn			12.5			HNO ₃ 0.5
	With Acid Recovery	tn			27.5			HNO ₃ 46.0
	Nitric Acid Concentrators	tn			18.5			SO ₃ 3.7
	Sulfuric Acid Concentrators							
	ESP	tn		7.	20.			SO ₄ 26.5
	ESP & Scrubber	tn		0.	20.			SO ₄ 2
	Red Water Incinerator							
	Uncontrolled	tn	12.5	1.	13.			
	Wet Scrubber	tn	0.5	1.	2.5			
	Sellite Exhaust	tn		29.5				SO ₃ 2.45
	Continuous Process							
	With Fume Recovery	tn	0.13	0.12	7.5			HNO ₃ 0.5
	With Acid Recovery	tn	0.13	0.12	5.0			HNO ₃ 0.01
	Nitrocellulose	tn		34.7	14			HNO ₃ 19.0
								SO ₄ 0.245
353	Petroleum Refineries							
	Petroleum Refining ²⁴						0.4	
	Misc Operations ²⁵	m ³ of Crude						
	Fluid Catalytic Cracking (FCC)							
	Uncontrolled	m ³ of CC feed	0.695	1.413	0.204	39.2	0.63	
	CO Boiler	m ³ of CC feed	0.695	1.413	0.204	0.695		
	ESP & CO Boiler	m ³ of CC feed	0.695	1.413	0.204	0.695		
	Desulfurization of							
	Sour Gas ²⁶	Kg of Sulfur in Gas	2(100-e)/100					
	Rail Tank & Tank Trucks Fining	Kg of Sulfur Recovered	2(100-e)/e					
	Gasoline Loading	m ³ of Gasoline					1.43	
	Splash Loading	tn of Gasoline					1.94	
	Submerged Loading ²⁷							
	Normal Service	m ³ of Gasoline					0.59	
		tn of Gasoline					0.80	
	Vapor Balance Serv	m ³ of Gasoline					0.98	
		tn of Gasoline					1.33	
	Vapor controlled	m ³ of Gasoline					0.05	
		tn of Gasoline					0.07	
	Jet Naphtha Loading							
	Splash loading	m ³ of Gasoline					0.43	
		tn of Gasoline					0.58	
	Submerged Loading							
	Normal Service	m ³ of Gasoline					0.18	
		tn of Gasoline					.24	
	Vapor Balance Serv	m ³ of Gasoline					0.30	
		tn of Gasoline					0.40	

24- Emissions due to fuel burning are not accounted for and should be computed separately (see SIC No 410).

25- VOC emissions from typical sources within a refinery, such as storage tanks ,API separators, blowdowns , fugitive sources etc are included. The listed factor is based on detailed VOC emissions estimates in several refineries.

26 - "e" is the percent efficiency of the sulfur recovery plant. Typical values are for 2-stage plant controlled 92-95%, for 3-stage plant uncontrolled 95-97.5%, 4-stage plant uncontrolled 96-99%, and for controlled plant 99-99.9%.

27- In the Vapor Balance Service the cargo truck retrieves the vapors displaced during the underground tank filling in service stations (see below. SIC 620). This operation increases the VOC concentration in the air within the empty truck and causes higher VOC emissions when the truck is filled. It should be noted in this regard that most of the VOC emissions reduction achieved through the balanced vapor filling of the service stations submerged tanks is offset by the resultant increased emissions in the Truck Filling Station, unless of course a vapor recovery system is used in the latter.

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
	Loading of Barges							
	Gasoline	m ³ of Gasoline					0.41	
	Gasoline	m ³ of Gasoline					0.41	
	Gasoline	tn of Gasoline					0.55	
	Crude Oil	m ³ of Crude oil					0.12	
	Crude Oil	tn of Crude oil					0.137	
	Jet Naphtha	m ³ of Nahtha					0.15	
	Jet Naphtha	tn of Nahtha					0.20	
	Loading of Ships/Ocean Barges							
	Gasoline	m ³ of Gasoline					0.215	
	Gasoline	tn of Gasoline					0.291	
	Crude Oil	m ³ of Crude oil					0.073	
	Crude Oil	tn of Crude oil					0.083	
	Jet Naphtha	m ³ of Nahtha					0.06	
	Jet Naphtha	tn of Nahtha					0.08	
354	Manufacture of Miscellaneous Products of Petroleum and Coal							
	Asphaltic Concrete Plants ²⁸							
	Conventional tiot-Hix (Batch & Continuous mix processes)							
	Uncontrolled	tn	22.5	1465	18	19	14	
	Precleaner	tn	7.5	1465	18	19	14	
	High Efficiency Cyclone	tn	0.85	1465	18	19	14	
	Spray Tower	tn	0.2	735	18	19	14	
	Baffle Spray Tower	tn	0.15	735	18	19	14	
	Multiple Centrifugal Scrubber	tn	0.035	735	18	19	14	
	Orifice Scrubber	tn	0.02	735	18	19	14	
	Venturi Scrubber	tn	0.02	735	18	19	14	
	Baghouse	tn	0.01	1465	18	19	14	
	Dryer Drum Hot Mix							
	Uncontrolled	tn	2.45					
	Cyclone or Multicyclone	tn	0.34					
	Low Energy Scrubber	tn	0.04					
	Venturi Scrubber	tn	0.02					
	Asphalt Roofing ²⁹							
	Asphalt Slowing							
	Saturant							
	UnControlled	tn of Asphalt	3.6			0.14	0.73	
	Controlled	tn of Asphalt	0.25				0.015	
	Coating							
	Uncontrolled	tn of Asphalt	13.4			1.87		
	Controlled	tn of Asphalt				0.1		
	Shingle Saturation							
	Uncontrolled	tn of Asphalt	1.57			0.13	0.13	
	Controlled	tn of Asphalt	0.25			0.01	0.05	
	Controlled	tn of shingle	0.03					
	Coke Production (By-product Method) ³⁰							
	Coal Crushing							
	Cyclone	tn of Coke	0.055					
	Coal Preheating ³¹							
	Uncontrolled	tn of Coke	1.75					
	Scrubber	tn of Coke	0.125					
	Wet ESP	tn of Coke	0.006					
	Wet coal Charging / Larry Car							
	Uncontrolled	tn of Coke	0.24	0.01	0.015	0.3	1.25	NH ₃ 0.01
	Sequential Charging	tn of Coke	0.008					
	Scrubber	tn of Coke	0.007					
	Door Leak	tn of Coke	0.27	0.005	0.005	0.3	0.75	NH ₃ 0.03
	Coke Pushing							
	Uncontrolled	tn of Coke	0.58					NH ₃ 0.05
	ESP	tn of Coke	0.225					
	Venturi Scrubber	tn of Coke	0.09					
	Baghouse	tn of Coke	0.045					
	Mobile Quench-Car Scrubber	tn of Coke	0.036					
	Coke Quenching							
	Quenching with Dirty Water (>5000 ml/l TDS)							
	Uncontrolled	tn of Coke	2.62					
	Baffles	tn of Coke	0.65					
	Quenching with Clean Water(>500 ml/l TDS)							
	Uncontrolled	tn of Coke	0.57					
	Baffles	tn of Coke	0.27					
	Quenching with Clean Water(>500 ml/l TDS)							
	Uncontrolled	tn of Coke	0.57					
	Baffles	tn of Coke	0.27					
	Combustion of Coke Oven Gas							
	Uncontrolled	tn of Coke	0.234	2 ³²				

28 - (a) "S" is the weight percent content of sulfur in the fuel oil used.

(b) Fugitive dust emissions are not included in the listed factors.

(c) Fuel burning emissions are included in Conventional but not in Drum Mix plants.

(d) VOC emission factor for Drum Mix plans is not available.

29- Control devices include afterburners, high velocity air filters, low voltage ESP and wet scrubbers. Blowing operations are controlled by afterburners.

30- One ton of bituminous coal yields approximately 0.7 tn of Coke and 260 to 350 m3 of gas.

31 - Coal preheating is used only in few plants.

32 - Typical SO₂ factor based on the assumptions of 0.8X S content of coal & on 33% of S transfer from coal to coke oven gas.

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
DIVISION 36. MANUFACTURE OF NONMETALLIC MINERAL PRODUCTS EXCEPT PRODUCTS OF PETROLEUM & COKE								
362	Manufacture of Glass and Glass Products							
36201	Glass and Glass Products ³³							
	Melting Furnace							
	Container Glass							
	Uncontrolled	tn	0.7	1.7	3.1	0.1	0.1	
	Low Energy Scrubber	tn	0.4	0.9	3.1	0.1	0.1	
	Venturi Scrubber	tn	0.1	0.1	3.1	0.1	0.1	
	Fabric Filter or ESP	tn	1.7	3.1	3.1	0.1	0.1	
	Flat Glass							
	Uncontrolled	tn	1.0	1.5	4.0	0.1	0.1	
	Low Energy Scrubber	tn	0.5	0.8	4.0	0.1	0.1	
	Venturi Scrubber	tn	0.1	0.1	4.0	0.1	0.1	
	Fabric Filter or ESP	tn	1.5	4.0	4.0	0.1	0.1	
	Pressed or Blown Glass							
	Uncontrolled	tn	8.7	2.8	4.3	0.1	0.2	
	Low Energy Scrubber	tn	4.2	1.3	4.3	0.1	0.2	
	Venturi Scrubber	tn	0.5	0.1	4.3	0.1	0.2	
	Fabric Filter or ESP	tn	0.1	2.8	4.3	0.1	0.2	
	Forming and Finishing							
	Container Glass	tn					4.4	
	Pressed and Blown Glass	tn					4.5	
	Glass Fibber Manufacture ³⁴							
	Wool Glass Fibber (Uncontrolled)							
	Raw Materials Handling	tn	1.9					
	Glass Furnace							
	Electric	tn	0.25	0.02	0.14	0.025		F 0.001
	Gas-Regenerative	tn	11.	5.	2.5	0.13		F 0.06
	Gas-Recuperative	tn	14.	5.	0.85	0.13		F 0.06
	Gas-Unit Melter	tn	4.5	0.3	0.15	0.13		F 0.06
	Forming	tn	1.				0.15	
	Oven Curing (Flame attenuation)	tn	3.		1.	1.8	3.5	
	Textile Glass Fibber (Uncontrolled)							
	Raw Materials Handling	tn	1.9					
	Glass Furnace							
	Gas-Regenerative	tn	1.	1.5	10.	0.25		
	Gas-Recuperative	tn	8.	15.	10	0.5		
	Gas-Unit Melter	tn	3.		10.	0.45		
	Forming	tn	0.5					
	Oven Curing and Cooling	tn	0.6		1.3	0.45		
369	Manufacture of Other Non-Metallic Mineral Products							
3691	Manufacture of Structural Clay Products							
	Bricks and Clay Products)							
	Raw Materials Handling ³⁵							
	Drying							
	Uncontrolled	tn of material dried	35					
	Cyclone	tn of material dried	9.					
	Cyclone + Scrubber	tn of material dried	3.5					
	Grinding ³⁶							
	Uncontrolled	tn of material ground	38.					
	cyclone	tn of material ground	9.5					
	Cyclone + Scrubber	tn of material ground	3.8					
	Storage							
	Uncontrolled	tn of material ground	17.					
	cyclone	tn of material ground	4.					
	Cyclone + Scrubber	tn of material ground	1.7					
	Curing and firing							
	Tunnel kilns							
	Gas fired	tn of bricks	0.012	0.	0.09.	0.030	.0045	F ₂ 0.5
	Oil fired	tn of bricks	0.29	1.98S	0.525	0.060	.0165	F ₂ 0.5
	Coal fired	tn of bricks	0.34A	3.65S	0.73	0.710	.008	F ₂ 0.5
	Sawdust fired	tn of bricks	0.12					F ₂ 0.5
	Periodic kilns							
	Gas fired	tn of bricks	0.033	0.	0.25	0.075	0.015	F ₂ 0.5
	Oil fired	tn of bricks	0.44	2.93S	0.81	0.095	0.025	F ₂ 0.5
	Coal fired	tn of bricks	9.42	6.06S	1.18	1.19	0.015	F ₂ 0.5
3692	Manufacture of Cement, Lime and plaster							
	Lime Manufacturing ³⁷							
	Coal Storage and Processing(if Coal is used as fuel)							
	Coal storage							
	Open piles	tn lime	0.5					
	Semi _ enclosed piles	tn lime	0.25					
	compartments	tn lime	0.1					
	silos	tn lime	0.1					

33 - Emissions from the combustion of fuel are included.

34- (a) Emissions from the combustion of fuel are included.

(b) Control technologies employed include wet ESPs. Low and high pressure drop wet scrubbers. Low and high temperature thermal incinerators.

35- Because of process variations, some raw material handling steps may be partially or completely omitted.

36.(a) "S" is the percent sulfur in the fuel.

(b) "A" is the percent ash in the coal.

(c) Emissions from the combustion of fuel are included. (d) Control of the kiln gases by scrubbers can rebuke fluoride emissions by 95%.

(d) Coal fired kilns are rather rare since coal tends to affect product quality.

37.(a) "S" is the percent sulfur in the fuel.

(b) Emissions from fuel combustion, as well as fugitive dust Emissions are included.

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
	Coal crushing and screening							
	Uncontrolled	tn lime	0.18					
	FF	tn lime	0.002					
	Coal Grinding							
	(semi) Direct Fired system	tn lime	0.0					
	Indirect Fired system							
	Uncontrolled	tn lime	10.					
	Fabric Filter	tn lime	0.1					
	Raw Material storage	tn lime	0.16					
	Crushing & Screening							
	Uncontrolled	tn lime	1.5					
	Fabric Filter	tn lime	0.0005					
	Crushed Material Storage							
	Open Piles	tn Lime	1.0					
	Semi-Enclosed piles	tn Lime	0.5					
	compartments	tn Lime	0.2					
	silos	tn Lime	0.2					
	Raw Material conveying							
	Uncontrolled	tn Lime	1.2					
	Fabric filter	tn Lime	0.01					
	Raw material conveying							
	Vertical Shaft Kiln							
	Uncontrolled	tn Lime	3.0	0.9S	0.1	2.0		
	cyclone	tn Lime	1.0	0.9S	0.1	2.0		
	Multicyclones	tn Lime	0.75	0.9S	0.1	2.0		
	Parallel flow / counterflow Regenerative kilns							
	Uncontrolled	tn Lime	10.5	0.9S	0.1	2.0		
	cyclone	tn Lime	3.6	0.9S	0.1	2.0		
	Multicyclones	tn Lime	2.6	0.9S	0.1	2.0		
	Parallel flow/ Counter flow Regenerative kilns							
	Uncontrolled	tn Lime	8.	0.9S	0.1	2.0		
	cyclone	tn Lime	2.8	0.9S	0.1	2.0		
	Multicyclones	tn Lime	2	0.9S	0.1	2.0		
	Annular kilns							
	Uncontrolled	tn Lime	12.	0.9S	0.1	2.0		
	cyclone	tn Lime	4.2	0.9S	0.1	2.0		
	Multicyclones	tn Lime	3	0.9S	0.1	2.0		
	Rotary short kiln/ Air suspension preheated							
	Uncontrolled	tn Lime	40.	0.365	1.5	1.0		
	cyclone	tn Lime	14.	0.365	1.5	1.0		
	Multicyclones	tn Lime	9.	0.365	1.5	1.0		
	ESP	tn Lime	0.6	0.365	1.5	1.0		
	Fabric Filter	tn Lime	0.2	0.365	1.5	1.0		
	Rotary long kiln							
	Uncontrolled	tn Lime	140.	0.365	1.5	1.0		
	cyclone	tn Lime	49.	0.365	1.5	1.0		
	Multicyclones	tn Lime	35.	0.365	1.5	1.0		
	ESP	tn Lime	2.	0.365	1.5	1.0		
	Fabric Filter	tn Lime	0.4	0.365	1.5	1.0		
	Calcinatic kiln							
	Uncontrolled	tn Lime	25.	0.95	1.0	1.0		
	cyclone	tn Lime	8.7	0.95	1.0	1.0		
	Multicyclones	tn Lime	6.2	0.95	1.0	1.0		
	Lime Cooling							
	Grate Cooler							
	Uncontrolled	tn Lime	20.					
	cyclone	tn Lime	4.					
	Multicyclones	tn Lime	2.					
	Fabric Filter	tn Lime	0.1					
	Planetary, Rotary, or							
	Vertical shaft Coolers	tn Lime	0.0					
	Lime packaging / Shipping	tn of lime	0.12					
	Lime Hydration							
	Uncontrolled	tn of lime	35.00					
	Scrubber	tn of lime	0.04					
	Cement Manufacturing ³⁸							
	Typical Well – Controlled plant	tn of cement	1.9	1.02	2.15			
	Coal storage and processing (if Coal is used as fuel)							
	Coal storage (Only if Coal is used as fuel)							
	Open piles	tn clincker	0.5					
	Semi – Enclosed piles	tn clincker	0.25					
	Compartment	tn clincker	0.1					
	Silos	tn clincker	0.1					
	Coal crushing and Screening (only if Coal is used as fuel							
	Uncontrolled	tn clincker	0.18					
	Fabric Filter	tn clincker	0.002					
	Coal Grinding							
	(semi) Direct fired Syst	tn clincker	0					
	Indirect Fired Syst							
	Uncontrolled	tn clincker	10.					
	Fabric Filter	tn clincker	0.1					
	Raw Materials Storage	tn clincker	0.14					
	Raw Materials Crushing & Screening							
	Primary & Second Crushing							
	Uncontrolled	tn clincker	4.2					
	Cyclone	tn clincker	0.85					

38. Emissions from the combustion of fuel are included .

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT	TSP	SO ₂	NO _x	CO	VOC	Kg/u
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		(U)	(kg/U)	(kg/U)	(kg/U)	(kg/U)	(kg/U)
	Multicyclone	tn clincker	0.63				
	Fabric Filter	tn clincker	0.02				
	Tertiary Crushing ³⁹						
	Uncontrolled	tn clincker	5.1				
	Cyclone	tn clincker	1.0				
	Multicyclone	tn clincker	0.77				
	Fabric Filter	tn clincker	0.026				
	Raw Material Conveying						
	Uncontrolled	tn clincker	1.5				
	Good Control (semi)	tn clincker	0.075				
	Raw Materials grinding & Calcining ⁴⁰						
	Dry process kiln						
	Uncontrolled	tn clincker	128	1.02	2.15		
	Multicyclone	tn clincker	0.34	1.02	2.15		
	Baghouse	tn clincker	0.16	1.02	2.15		
	Wet Process kiln						
	Uncontrolled	tn clincker	120.	1.02	2.15		
	ESP	tn clincker	0.39	1.02	2.15		
	Baghouse	tn clincker	0.57	1.02	2.15		
	Clinker cooler						
	Grate cooler						
	Uncontrolled	tn clincker	10.6				
	Cyclone	tn clincker	2.2				
	Multicyclone	tn clincker	0.530				
	Gravel Bed Filters	tn clincker	0.160				
	ESP	tn clincker	0.048				
	Baghouse	tn clincker	0.010				
	Planetary or Rotary cooler	tn clincker	0.0				
	Clinker storing						
	Open files	tn clincker	5.4				
	Semi – Enclosed piles	tn clincker	2.4				
	Compartment	tn clincker	0.12				
	Silos	tn clincker	0.12				
	Clinker Grinding						
	Tube Mill / Open Cycle						
	Uncontrolled	tn clincker	10.6				
	ESP or ff	tn clincker	0.05				
	Tube Mill / closed Cycle or Roller Mill						
	Uncontrolled	tn clincker	85				
	ESP or ff	tn clincker	0.43				
	Cement Storing in Silos	tn clincker	0.13				
	Cement Shipment						
	Bulk loading	tn clincker	0.1				
	Packing						
	Uncontrolled	tn clincker	2.2				
	FF	tn clincker	0.01				
3699	Manufacture of Non – metallic Mineral products not Elsewhere Classified						
	Gypsum Manufacture						
	Rotary ore Dryers						
	Uncontrolled	tn	5.60				
	Fabric Filter	tn	0.02				
	Raw mills						
	Roller Mills						
	Uncontrolled	tn	1.3				
	Fabric Filter	tn	0.06				
	ESP	tn	0.05				
	Impact mills						
	Uncontrolled	tn	50				
	Fabric Filter	tn	0.01				
	Calciners						
	Flash Calciners						
	Uncontrolled	tn	19				
	Fabric Filter	tn	0.02				
	Continuous Kettle Calciners						
	Uncontrolled	tn	21				
	Fabric Filter	tn	0.003				
	ESP	tn	0.05				
	Concrete Batching						
	Process Emissions Uncontrolled	tn	0.05				
	Wind Erosion						
	Sand & Aggregate storage	(1000m ²)*yr	0.05				
	Vehicle Traffic						
	(Unpaved Road)	Vehicle km Tranelled	4.5				
	Parlite Manufacture						
	Parlite Expansion vertical furnace						
	Uncontrolled	tn	10.5				
	Fabric Filter	tn	0.1				

39- Tertiary crushing of the raw materials to a fairly small size facilitates grinding However plugging or

of the crushing due to the presence of the sticky materials of the prevents tertiary crushing .

40- (a) In typical dry – process installation , a portion of the hot gases from the calcining kilns is fed in the grinding mills for drying the raw meal , gas from grinders – dryers and kilns is thus combined and treated in a common installation .

(b) the listed SO₂ emission factor is based on German studies indication SO₂ removal efficiencies through reactions with alkaline dust from 88% to 100% . High SO₂ emissions are obtained only if the SO₂ exceeds the alkaline content of the raw meal .

(c) The U.S . EPA. On the basis of limited data , reports SO₂ removal from 21% to 45% and suggests the use of the following SO₂ emission factors : for coal fired kilns : 5.4+3.6*5 . for fuel oil fired kilns 5.4+2.2*5 and for Gas fired kilns 5.4. where S is the weight % sulfur in fuel used .

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO (kg/U)	NO (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
DIVISION 37. BASIC METAL INDUSTRIES								

371	Iron and Steel basic Industries							
	Gray Iron foundries ⁴¹							
	Cuppla ^{42,43}							
	Uncontrolled	tn	9.6	0.65		73		Pb 0.32
	Single Wet cap	tn	4.0	0.35		73		Pb 0.19
	Impingement Scrubber	tn	2.5	0.35		73		Pb 0.12
	Scrubber	tn	1.6	0.35		73		Pb 0.07
	High Energy Scrubber	tn	0.4	0.35		73		Pb 0.02
	Baghouse	tn	0.3	0.65		73		Pb 0.01
	Afterburner + ESP	tn	0.7	0.65		7		Pb 0.03
	Electric Arc Furnace							
	Uncontrolled	tn	6.3		0.16	9.75	0.09	
	Baghouse	tn	0.2		0.16	9.75	0.09	
	Electric Induction Furnace							
	Uncontrolled	tn	0.5					
	Baghouse	tn	0.1					
	Reverberatory Furnace							
	Uncontrolled	tn	1.1					
	Baghouse	tn	0.1					
	Iron And steel Mills							
	Sintering ⁴⁴							
	Windbox							
	Uncontrolled	tn of Sinter	4.35					
	Dry ESP	tn of Sinter	0.8					
	Wet ESP	tn of Sinter	0.085					
	Venture Scrubber	tn of Sinter	0.235					
	Cyclone	tn of Sinter	0.5					
	Fabric filter	tn of Sinter	0.1					
	Braker and Hot screens							
	Uncontrolled	tn of Sinter	3.4					
	Venture Scrubber	tn of Sinter	0.295					
	Baghouse	tn of Sinter	0.05					
	Blast Furnace ^{45,46}							
	Uncontrolled Casthouse ⁴⁷	tn	0.3					
	Furnace with local Evolution	tn	0.65					
	Basic Oxygen Furnace							
	Furnace for Melting & Refining							
	Uncontrolled	tn	14.25					
	Open hood with ESP	tn	0.065					
	Open hood with Scrubber	tn	0.045					
	Closed hood with scrubber	tn	0.0034					
	Charging . Tapping . Transfer	tn	0.25					
	Electric Arc Furnace							
	Uncontrolled							
	Carbon Steel	tn	25					
	Alloy steel	tn	5.65					
	Control of primary Emission	tn	0.15					
	Control of primary & Secondary Emission	tn	0.0215					
	Open hearth Furnace							
	Uncontrolled	tn	10.55					
	Fabric Filter of ESP	tn	0.22					
	Ferroalloy production (Electric Furnace) ⁴⁸							
	Fes i (50%)							
	Uncontrolled-open Furnace	tn	35					
	Uncontrolled-Covered Furnace	tn	46					
	Baghouse	tn	0.9					
	High Energy Scrubber	tn	0.24					
	Low Energy Scrubber	tn	4.5					
	Fes i (75%)							
	Uncontrolled-open Furnace	tn	158					
	Uncontrolled-Covered Furnace	tn	103					
	Low Energy Scrubber	tn	4					
	Fes i (90%)							
	Uncontrolled-open Furnace	tn	282					
	Si metal (98%)							
	Uncontrolled-open Furnace	tn	436					
	Baghouse	tn	16					
	FeMn (80%)							
	Uncontrolled-open Furnace	tn	14					
	Baghouse	tn	0.24					
	High Energy Scrubber	tn	0.8					
	FeMn (1% Si)							
	Uncontrolled-Covered Furnace	tn	6					

41 - (a) for one ton of gray iron product .about 143 kg of Coke are required. (b) the Emission factors account also for the fugitive dust source. As well as the emissions Caused by the burning of coke.

42 - "S " is the percent sulfur in the coke.

43 - Co emission factor of 7.0 must be used in cases where afterburners are installed

44- (a) Sintering is used some plants to convert fine size raw materials (iron ore, coke breeze Limestone mill scale & flue dust) into agglomerated product of suitable size to be charged into the blast furnace. (b) About 2.5 tons of raw materials including water & fuel .are required to produce 1 ton of produce sinter.

45- (a) production of one ton of iron requires 1.4 tons of ore, 0.5 to 0.65 tons of coke ,0.25tons of limestone or dolomite . And 1.8 to 2.0 tons of Air. (b) By-product consists of 0.2 to 0.4 tons of slag and 2.5 to 3.5 tons of blast furnace gas containing up to 50kg of dust.

(c) Emission from the use of the blast furnace gas (after dedusting) are not included in the factor listed here and need to be computed separately .

46- (a) Blast furnace gas control typically (setting chamber or cyclone)+(wet scrubber)+(high energy wet scrubber or ESP). are often considered part of the process since cleaning of the Blast furnace gas is required before it can be used as a fuel. (b) The listed Tsp emission factors do not include these from blast furnace slips (39.5) kg/tn of hot metal of slip

47 - Typical of older furnace .

48 - Given Percentages in the alloy refer of the main alloying element in the product.

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
	Uncontrolled-Sealed Furnace	tn	37					
	High Energy Scrubber	tn	0.25					

	FeCr (high carbon)							
	Uncontrolled-open Furnace	tn	78					
	ESP	tn	1.2					
	SiMn							
	Uncontrolled-open Furnace	tn	96					
	Uncontrolled-Sealed Furnace	tn	-					
	High Energy Scrubber	tn	2.1					
	Low Energy Scrubber	tn	0.15					
	Steel Fouderies							
	Electric Arc Furnace							
	Uncontrolled	tn	6.5					
	ESP	tn	0.33					
	Baghouse	tn	0.1					
	Venturi Scrubber	tn	0.226					
	Open Hearth Scrubber							
	Uncontrolled	tn	5.5					
	ESP	tn	0.18					
	Baghouse	tn	0.006					
	Venturi Scrubber	tn	0.14					
	Open Hearth Oxygen Lanced Scrubber							
	Uncontrolled	tn	5					
	ESP	tn	0.175					
	Baghouse	tn	0.05					
	Venturi Scrubber	tn	0.175					
	Electric Induction Furnace							
	Uncontrolled	tn	0.05					
372	Non-Ferrous Metal Basic Industries							
	Primary copper Smelting							
	Uncontrolled	tn of copper Ore	62	530				
		tn of copper	248.0	2120				
	hot ESP (200-340 C)	tn of copper Ore	15.5	530				
		tn of copper	62	2120				
	cold ESP (120 C)	tn of copper Ore	2.5	530				
		tn of copper	10	2120				
	Single Contact H2SO4 plant	tn of copper Ore	2.5	25.2				
		tn of copper	10	100.7				
	Double Contact H2SO4 plant	tn of copper Ore	2.5	8				
		tn of copper	10	32				
	Secondary Copper Smelting and Alloying							
	Copper Scrap							
	Cupola (Uncontrolled)	tn	0.002					
	Reverberatory Furnace							
	Uncontrolled	tn	2.6					
	Fabric Filter	tn	0.2					
	Electric Arc Furnace							
	Uncontrolled	tn	2.5					
	Fabric Filter	tn	0.5					
	Electric Induction Furnace	tn	3.5					
	Uncontrolled	tn	0.25					
	Fabric Filter							
	Copper Insulated Wire Cupola							
	Uncontrolled	tn	120					
	ESP	tn	5.0					
	Copper and Brass Scrap							
	Cupola							
	Uncontrolled	tn	3.5					
	ESP	tn	1.2					
	Brass and Bronze							
	Reverberatory Furnace							
	Uncontrolled	tn	18					
	Fabric Filter	tn	1.3					
	Rotary Furnace							
	Uncontrolled	tn	150					
	ESP	tn	7					
	Crucible or Pot Furnace							
	Uncontrolled	tn	11					
	ESP	tn	0.5					
	Electric Arc Furnace							
	Uncontrolled	tn	5.5					
	Fabric Filter	tn	3.0					
	Electric Induction Furnace							
	Uncontrolled	tn	10					
	Fabric Filter	tn	0.35					
	Alumina Production (Bayer Process from Bauxite) ⁴⁹							
	Bauxite Grinding							

49 - From 1.4 to 3.3 tons of Bauxite Ore processed, one ton of Alumina is produced. One ton of the later yields 526 kg of Aluminum.

50-(a) "S" is the weight percent sulfur in the prebaked anodes.

(b) The listed TSP factors include particulate fluorides.

(c) The listed F~ factors include gaseous, as well as particulate fluorides.

(d) If controls are applied, the fugitive, as well as controlled stack emissions need to be computed.

(e) In older plans cells may not be constructed with covers for the collection of fumes and this may increase drastically the fraction of the uncontrolled fugitive emissions.

(f) For the production of one ton of Aluminum the basic energy and material requirements are as follows:

Electricity 13.2 to 18.7 MVH

Alumina 1.89 to 1.92 tons (2.7 to 6.3 tons of Bauxite)

Carbon Electrodes 0.45 to 0.55 tons

Electrolyte Fluoride 0.03 to 0.10 tons.

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/t
	Uncontrolled	tn of Bauxite	3					
	Spray Tower	tn of Bauxite	0.9					
	Floating bed scrubber	tn of Bauxite	0.85					

	Quench Tower + Spray Screen	tn of Bauxite	0.5					
	Alumina Hydroxide Calcining							
	Uncontrolled	tn of Bauxite	100					
	Spray Tower	tn of Bauxite	30					
	Floating bed scrubber	tn of Bauxite	28					
	Quench Tower	tn of Bauxite	17					
	ESP	tn of Bauxite	2					
	Primary Aluminum Production (from Alumina) ⁵⁰							
	Prebaked Cell Method							
	Anode Baking Furnace							
	Uncontrolled	tn of Aluminum	1.5					F ⁻ 0.5
	Spray Tower	tn of Aluminum	0.375					F ⁻ 0.035
	ESP Dry Alumina Scrubber	tn of Aluminum	0.375					F ⁻ 0.035
	Dry Alumina Scrubber	tn of Aluminum	0.03					F ⁻ 0.0035
	Prebaked Reduction Cells							
	Uncontrolled (total)	tn of Aluminum	47	105				F ⁻ 22
	Fugitive	tn of Aluminum	2.5	0.55				F ⁻ 1.1
	Multiple Cyclones	tn of Aluminum	9.8					F ⁻ 13.5
	Dry Aluminum Scrubber	tn of Aluminum	0.9					F ⁻ 0.3
	Dry ESP + Spray Tower	tn of Aluminum	2.25					F ⁻ 2.4
	Spray Tower	tn of Aluminum	8.9					F ⁻ 2.6
	Floating Bed Scrubber	tn of Aluminum	8.9					F ⁻ 2.15
	Coated FF Dry Scrubber	tn of Aluminum	0.9					F ⁻ 1.9
	Cross Flow Packed Bed	tn of Aluminum	13.15					F ⁻ 6.05
	Dry + Secondary Scrubber	tn of Aluminum	0.35					F ⁻ 0.35
	Vertical Sodeberg Cell Method							
	Vertical Sodeberg Cells							
	Uncontrolled (total)	tn of Aluminum	39	105				F ⁻ 22
	Fugitive	tn of Aluminum	6	0.55				F ⁻ 3.3
	Spray Tower	tn of Aluminum	8.25					F ⁻ 1.3
	Venture Scrubber	tn of Aluminum	1.3					F ⁻ 0.35
	Multiple Cyclones	tn of Aluminum	16.5					F ⁻ 16.4
	Dry Alumina Scrubber	tn of Aluminum	0.65					F ⁻ 0.25
	Scrubber + ESP + Spray							
	Screen and Scrubber	tn of Aluminum	3.85					F ⁻
	Horizontal Sodeberg Cell Method							
	Horizontal Sodeberg Cells							
	Uncontrolled (total)	tn of Aluminum	49	105				F ⁻ 17
	Fugitive	tn of Aluminum	5	0.55				F ⁻ 1.7
	Spray Tower	tn of Aluminum	11.					F ⁻ 5.1
	Floating Bed Scrubber	tn of Aluminum	9.7					F ⁻ 1.4
	Scrubber + Vet ESP	tn of Aluminum	0.9					F ⁻ 0.2
	Pretreatment							
	Sweating Furnace							
	Uncontrolled	tn of Al pretreated	7.25					
	Fabric Filter	tn of Al pretreated	1.65					
	Smelting							
	Crucible Furnace							
	Uncontrolled	tn of Al	0.95					
	Reverberatory Furnace							
	Uncontrolled	tn of Al	2.15					
	Fabric Filter or ESP	tn of Al	0.65					
	Demagging (Chlorination)							
	Uncontrolled	tn of Cl ₂	500					
	Fabric Filter	tn of Cl ₂	25					
	Primary Lead Smelting							
	Fugitive Emissions	tn of pb	16.74					Pb 2.5
	Ore Crushing							
	Uncontrolled	tn of crushed ore	1.0					Pb 0.15
	Fabric Filter	tn of crushed ore	0.01					Pb 0.0015
	Sintering (updraft)							
	Uncontrolled	tn of pb	106.5					Pb 87
	Centrifugal Collector	tn of pb	16.					Pb 13
	ESP	tn of pb	3.2					Pb 2.61
	Fabric Filter	tn of pb	3.2					Pb 2.61
	H ₂ SO ₄ Plant (Single Contact)	tn of pb	0.32					Pb 0.26
	H ₂ SO ₄ Plant (Dual Contact)	tn of pb	0.32					Pb 0.26
	Elemental S Recovery Plant	tn of pb	0.32					Pb 0.26
	Dimethylaniline Absorption	tn of pb	0.32					Pb 0.26
	Ammonia Absorption	tn of pb	0.32					Pb 0.26
	Blast Furnace							
	Uncontrolled	tn of pb	180.5					Pb 29
	Centrifugal Collector	tn of pb	27.1					Pb 4.35
	ESP	tn of pb	5.4					Pb 0.9
	Fabric Filter	tn of pb	5.4					Pb 0.9
	H ₂ SO ₄ Plant (Single Contact)	tn of pb	0.54					Pb 0.1
	H ₂ SO ₄ Plant (Dual Contact)	tn of pb	0.54					Pb 0.1
	Elemental S Recovery Plant	tn of pb	0.54					Pb 0.1
	Dimethylaniline Absorption	tn of pb						Pb 0.1
	Ammonia Absorption	tn of pb	0.54					Pb 0.1

50 - For tangentially fired boilers use 5.0 of kg/1000 Nm³. The load reduction coefficient "f" is computed from Equation $f = 0.3505 - 0.005235 L + 0.0001173 L^2$, where L is the mean boiler load % A typical mean boiler load is 87 %.

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
	Dross Reverberatory Furnace							
	Uncontrolled	tn of pb	10.					Pb 2.4
	Centrifugal Collector	tn of pb	1.5					Pb 0.36
	Fabric Filter	tn of pb	0.3					Pb 0.07

	Materials Handling							
	Uncontrolled	tn of pb	2.4					
	Fabric Filter	tn of pb	0.07					
	Secondary Lead Processing							
	Pretreatment							
	Sweating Furnace							
	Fugitive Emissions	tn of pb	1.3					
	Uncontrolled	tn of pb	25.5					
	Controlled	tn of pb	0.25					
	Smelting							
	Fugitive Emissions	tn of pb	8.2					
	Reverberatory Furnace							
	Uncontrolled	tn of pb	162	40				
	Controlled	tn of pb	0.5	40				
	Blast (Cupola)							
	Uncontrolled	tn of pb	153	27				
	Controlled	tn of pb	1.12	27				
	Refining							
	Kettle Refining							
	Uncontrolled	tn of pb	0.02					
	Controlled	tn of pb						
	Kettle Oxidation							
	Fabric filter	tn of pb	<20.0					
	Storage Battery Production							
	Uncontrolled ⁵¹	1000 Batteries	63.2					
	Controlled	1000 Batteries	3.2					
	Primary Zinc Smelting							
	Pyrometallurgical Process							
	Fugitive Emissions	tn of Zinc	3.85					
	Roasting							
	Multiple Hearth Roaster							
	Uncontrolled	tn of Zinc	113	1100				
	Cyclone + ESP	tn of Zinc	0.5	1100				
	H ₂ SO ₄ Plant	tn of Zinc	0.34	33				
	Suspension Roaster							
	Uncontrolled	tn of Zinc	1000	1100				
	Cyclone + ESP	tn of Zinc	4	1100				
	H ₂ SO ₄ Plant	tn of Zinc	3	33				
	Fluidized Bed Roaster							
	Uncontrolled	tn of Zinc	1083	1100				
	Cyclone + ESP	tn of Zinc	4	1100				
	H ₂ SO ₄ Plant	tn of Zinc	3.2	33				
	Sinter Plant							
	Uncontrolled	tn of Zinc	62.5	110				
	Cyclone	tn of Zinc	24.1	110				
	Cyclone + ESP	tn of Zinc	8.25	110				
	Retorting (Uncontrolled)							
	Vertical Retort	tn of zonc	7.15					
	Electric Retort	tn of zonc	10					
	Electrolytic Process							
	Fugitive Emission	tn of zonc	1.26					
	Roasting							
	Multiple Hearth Roaster							
	Uncontrolled	tn of zonc	113	1100				
	Cyclone + ESP	tn of zonc	0.5	1100				
	H ₂ SO ₄ plant	tn of zonc	0.34	33				
	Suspension Roaster							
	Uncontrolled	tn of zonc	1000	1100				
	Cyclone + ESP	tn of zonc	4	1100				
	H ₂ SO ₄ plant	tn of zonc	3	33				
	Fluidized Bed Roaster							
	Uncontrolled	tn of zonc	1083	1100				
	Cyclone + ESP	tn of zonc	4	1100				
	H ₂ SO ₄ plant	tn of zonc	3.2	33				
	Electrolytic Process							
	Uncontrolled	tn of zonc	3.3					
	Second Zinc Smelting							
	Pretreatment							
	Second Zinc Smelting							
	Pretreatment							
	Sweating							
	Reverberatory Furnace							
	Clean Metallic Scrap	tn of Scrap	0					
	General Metallic Scrap							
	Uncontrolled	tn of Scrap	6.5					
	Fabric Filter	tn of Scrap	0.1					
	Residual Scrap							
	Uncontrolled	tn of Scrap	16					
	Fabric Filter	tn of Scrap	0.24					
	Rotary Furnace							
	Uncontrolled	tn of Scrap	9					

51 - A fabric filter is considered an integral part of the lead oxide mill, if any.

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
	Fabric Filter	tn of Scrap	0.14					
	Muffle Furnace							
	Uncontrolled	tn of Scrap	10.7					
	Fabric Filter	tn of Scrap	0.16					

	Kettle Furnace							
	Clean Metallic Scrap	tn of Scrap	0					
	General Metallic Scrap							
	Uncontrolled	tn of Scrap	5.5					
	Fabric Filter	tn of Scrap	0.08					
	Residual Scrap							
	Uncontrolled	tn of Scrap	12.5					
	Fabric Filter	tn of Scrap	0.2					
	Electric Resistance Furnace							
	Uncontrolled	tn of Scrap	>5					
	Fabric Filter	tn of Scrap	<0.7					
	Crushing & Screening							
	Uncontrolled	tn of scrap	2.2					
	Fabric Filter	tn of scrap	0.02					
	Sodium Carbonate Leaching							
	Crushing & Screening							
	Uncontrolled	tn of scrap	2.2					
	Fabric Filter	tn of scrap	0.02					
	Calcining							
	Uncontrolled	tn of scrap	44.5					
	Fabric Filter	tn of scrap	0.7					
	Melting							
	Kettle (Pot) Melting							
	Uncontrolled	tn of Zn	0.05					
	Refining							
	Retort & Muffle Distillation							
	Uncontrolled	tn of Zn	23					
	Fabric Filter	tn of Zn	0.35					
	Graphite Rod Distillation	tn of Zn	0.0					
	Retort Distillation/Oxidation	tn of Zn	15					
	Muffle Distillation/Oxidation	tn of Zn	15					
	Retort Reduction							
	Uncontrolled	tn of Zn	23.5					
	Fabric Filter	tn of Zn	0.35					
	Galvanizing	tn of Zn	2.5					
MAJOR DIVISION 4. ELECTRICITY GAS AND WATER								
410	Electricity Gas and Steam ⁵²							
	Gaseous Fuels							
	Natural Gas ⁵³							
	utility Boilers	1000 Nm ³	0.048	15.658	8f ⁵⁴	0.64	0.028	
		tn	0.061	20 S	11.3f	0.82	0.036	
	Industrial Boilers	1000 Nm ³	0.048	15.6S	2.24	0.56	0.092	
		tn	0.061	20 S	2.87	0.72	0.118	
	Domestic Furnaces	1000 Nm ³	0.048	15.6S	1.6	0.32	0.127	
		tn	0.061	20 S	2.05	0.41	0.163	
	Stationary Gas turbines	1000 Nm ³	0.224	15.65	6.62	1.84	0.673	
		tn	0.287	20 S	8.91	2.36	0.863	
		MWH	0.138	9.6S	4.08	1.14	0.415	
	Liquefied Petrol Gas (LPG)							
	Industrial Boilers	m3 (Liq)	0.013	0.004	1.51	0.37	0.06	
		tn	0.060	0.007	2.9	0.71	0.12	
	Domestic Furnaces	m3 (Liq)	0.031	0.004	1.07	0.22	0.09	
		tn	0.060	0.007	2.05	0.42	0.17	
	Liquid fuels							
	Distillate Fuel oil							
	Industrial & Commercial Boilers	tn	0.28	20 S	2.84	0.71	0.035	SO ₂ 0.285
	Residential Furnaces	tn	0.36 ⁵⁵	20 S	2.60	0.71	0.354	SO ₂ 0.285
	Heavy Fuel oil ⁵⁶							
	Utility Boilers							
	Uncontrolled	tn	P	20 S	8.5 ⁵⁷	0.64	0.127	SO ₂ 0.255
	ESP – Low Efficiency	tn	0.5p	20 S	8.5	0.64	0.09	SO ₂ 0.255
	ESP – high Efficiency	tn	0.1p	20 S	8.5	0.64	0.09	SO ₂ 0.255
	Scrubber	tn	0.45p	1.5 S	8.5	0.64	0.09	
	Industrial & Commercial Boilers ⁵⁸	tn	p	20S	7.0 ⁵⁹	0.64	0.163	
	Waste Lub oil ⁶⁰							
	Industrial & Commercial Boilers	tn	8.1A	20 S	2.7	0.067	0.13	PB 5.6P
	Domestic Heaters	tn	8.6A	20 S	2.7	0.67	0.13	PB 6.8P
	Solid Fuels							
	Anthracite Coal ⁶¹							
	Pulverized Coal Furnace							

52- (a) "S" is the weight percent of Sulfur in the fuel. (b) "A" is the weight percent of Ash in the solid fuel. (c) "N" is the weight percent of Nitrogen in the fuel.

53- Typical sulfur content of Natural Gas is 0.000615 %.

54 - For tangentially fired boilers use 5.0 of kg/1000 Nm³. The load reduction coefficient "f" is computed from Equation $f = 0.3505 - 0.005235 L + 0.0001173 L^2$, where L is the mean boiler load % A typical mean boiler load is 87 %.

55-In the absence of boiler I/M programs, smoke emission factors may be closer to 1.6 kg/tn.

56 - "P", the uncontrolled TSP emission factor, is function of the sulfur content of fuel oil and is computed from Equation $p = 0.4 + 1.32 S$.

57-Use 5.3 kg/tn for tangentially fired boilers, 13.3 for vertical fired boilers and 8.5 for all other boiler types.

58-- (a) In the absence of boiler I/M program, the average smoke emission factor can exceed that in the table by about 60%, Economopoulos (1987). (b) In case where very effective boiler I/M program are implemented, the average smoke emission factor can be lower by up to 45% of that table, Economopoulos (1991).

59- If the nitrogen content of the fuel is known, the NO_x emission factor can be computed more accurately from the imperial formula $(3.25 + 59.2 N^2)$.

60-(a) typical values of "A" and "S" in lub oils are 0.65% and 0.5% . (b) "p" is the weight percent of lead (pb) in the fuel . The value of P depends on the lead content of the gasoline used . In the U.S.A the average values of P dropped from 1% in 1970

61 - typical ash and sulfur contents are 8.1% & 0.9% for Meta Anthracite , 9.4% & 0.6% for Anthracite and 12.4% & 2% for Semi anthracite respectively (dry basis).

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
	Uncontrolled	tn	5A	19.5 S	9.0	0.3	0.055	
	Cyclone	tn	1.25A	19.5 S	9.0	0.3	0.055	
	ESP - High Efficiency	tn	0.36A	19.5 S	9.0	0.3	0.055	
	Fabric Filter	tn	0.01A	19.5 S	9.0	0.3	0.055	
	Travelling Grate Stoker							

	Uncontrolled	tn	4.6	19.5 S	5.0	0.3	0.055	
	Cyclone	tn	>1.2	19.5 S	5.0	0.3	0.055	
	Hand Fed Units	tn	5.0	19.5 S	1.5	45.0	9.5	
	Bituminous & Subbituminous Coal ⁶²							
	Pulverized Coal / Dry Bottom Furnace							
	Uncontrolled	tn	5A	19.5 S	10.5 ⁶³	0.3	0.055	
	Multiple Cyclones	tn	1.25A	19.5 S	10.5	0.3	0.055	
	ESP - High Efficiency							
	- Low S Coal +No Cond'ning	tn	0.33A	19.5 S	10.5	0.3	0.055	
	- Otherwise	tn	>0.01A	19.5 S	10.5	0.3	0.055	
	Fabric Filter	tn	0.01A	19.5 S	10.5	0.3	0.055	
	Flue Gas Desulfurization	tn	0.01A	19.5 S	10.5	0.3	0.055	
	Pulverized Coal / Wet Bottom Furnace							
	Uncontrolled	tn	3.5A	19.5 S	17.	0.3	0.055	
	Multiple Cyclones	tn	0.88A	19.5 S	17.	0.3	0.055	
	ESP - High Efficiency							
	- Low S Coal +No Cond'ning	tn	0.227A	19.5 S	17.	0.3	0.055	
	- Otherwise	tn	0.007A	19.5 S	17.	0.3	0.055	
	Fabric Filter	tn	0.007A	19.5 S	17.	0.3	0.055	
	Flue Gas Desulfurization	tn	0.35A	19.5 S	17.	0.3	0.055	
	Cyclone Furnace							
	Uncontrolled	tn	A	19.5 S	18.5	0.3	0.055	
	ESP - High Efficiency	tn	0.065A	19.5 S	18.5	0.3	0.055	
	Fabric Filter	tn	0.002A	19.5 S	18.5	0.3	0.055	
	Spreader Stoker Furnace							
	Uncontrolled	tn	30	19.5 S	7.0	0.3	0.055	
	Multiple Cyclones	tn	8.5	19.5 S	7.0	0.3	0.055	
	Overfeed Stoker Furnace							
	Uncontrolled	tn	8.0	19.5 S	3.25	0.3	0.055	
	Multiple Cyclones	tn	4.5	19.5 S	3.25	0.3	0.055	
	Underfeed Stoker Furnace							
	Uncontrolled	tn	7.5	15.5S	4.75	5.5	1.05	
	Multiple Cyclones	tn	5.5	15.5S	4.75	5.5	1.05	
	Hand Fired Furnace	tn	7.5	15.5S	1.5	45.0	9.0	
	Lignite ⁶⁴							
	Pulverized Coal Furnace							
	Uncontrolled	tn	3.1A	15 S ⁶⁵	6. ⁶⁶	0.3	0.055	
	Cyclones	tn	0.93A	15S	6.	0.3	0.055	
	ESP - Older Units	tn	0.16A	15S	6.	0.3	0.055	
	ESP - High Efficiency	tn	0.016A	15S	6.	0.3	0.055	
	Fabric Filter	tn	0.016A	15S	6.	0.3	0.055	
	Flue Gas Desulfurization	tn	0.031A	1.5S	6.	0.3	0.055	
	Cyclone Furnace							
	Uncontrolled	tn	3.3A	15S	8.5	0.3	0.055	
	Cyclones	tn	A	15S	8.5	0.3	0.055	
	ESP - Older Units	tn	0.165A	15S	8.5	0.3	0.055	
	ESP - High Efficiency	tn	0.017A	15S	8.5	0.3	0.055	
	Fabric Filter	tn	0.017A	15S	8.5	0.3	0.055	
	Spreader Stoker Furnace							
	Uncontrolled	tn	3.4A	15S	3.0	0.3	0.055	
	Multiple Cyclones	tn	A	15S	3.0	0.3	0.055	
	Overfeed Stoker							
	Uncontrolled	tn	1.5A	15S	3.0	0.3	0.055	
	Multiple Cyclones	tn	0.84A	15S	3.0	0.3	0.055	
	Overfeed Stoker							
	Uncontrolled	tn	1.5A	15S	3.0	5.5	1.05	
	Multiple Cyclones	tn	1.1A	15S	3.0	5.5	1.05	
	Wood & Bark							
	Wood Boilers	tn	4.4	0.01S	0.34	13.0	0.85	
	Wood-Bark Mixture Boilers							
	Uncontrolled	tn	3.6	0.07S	0.34	13.0	0.85	
	Multicyclone	tn	2.7	0.07S	0.34	13.0	0.85	
	Bark Boilers							
	Uncontrolled	tn	24	0.2	0.34	13.0	0.85	
	Multiple Cyclones	tn	4.5	0.2	0.34	13.0	0.85	
	Wood Stoves							
	Conventional Units	tn	15	0.2	1.4	140.0	46.0	
	Low emitting non-catalytic	tn	9.6	0.2		130.0		
	Low emitting catalytic	tn	6.6	0.2	1.0	39.0	21.6	
	Residential Fireplaces	tn	14.0	0.2	1.7	85.0	43.0	
	Bagasse	tn	8.0	0.0	0.6			
MAJOR DIVISION 6. WHOLESALE AND RETAIL "RADE								
610	Wholesale Trade							
	Bulk Fuel Terminals							

62-(a) In Bituminous coals, typical Ash and Sulfur contents are 4.9% & 0.8 % for Low Volatility coals, 2.9 & 0.6% for Medium Volatility coals, 6.5% & 1.3% for High Volatility A coals, 5.4% & 1.4% for High Volatility B coals, and 9.1% & 2.6% for High Volatility C coals respectively (dry basis).

(b) In Sub bituminous coals typical Ash and Sulfur contents are, 4-.7% & 1% for A type, 2.8% & 0.5% for B type, and 13.2 % & 0.4% for C type respectively (dry basis).

63-For tangentially fired boilers use 7.5 kg/tn.

64 - (a) "A" is the weight percent of Ash in the fuel (wet basis as fired) (b) "S" is the weight percent of Sulfur in the fuel (wet basis as fired)

(c) Typical Ash and Sulfur contents are 8.8 to 9.5 % & 0.8 to 1.1 % (dry basis).

65 -For more accurate estimate compute the SO₂ emission factor from the relation (20 -1.4 * Na₂O)*S Where Na₂O is the Percent content of the ash in alkali constituents.

66 - Use 7.0 kg/tn for front wall fired and horizontally opposed wall fired units. Use 4.0 kg/tn for opposed wall fired units. Lignites with very high humidity and low calorific values may yield significantly lower NO_x emissions.

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
	Storage of Fuels ⁶⁷							
	Floating Roof Tanks							
	Gasoline	(m ³ storage capacity)*year					1.14	
	Crude Oil	(m ³ storage capacity)*year					0.435	
	Jet Naphtha	(m ³ storage capacity)*year					0.415	
	Jet Kero	(m ³ storage capacity)*year					0.019	

	Distillate Oil	(m ³ storage capacity)*year					0.015	
	Fixed Roof Tanks							
	Gasoline	(m ³ storage capacity)*year					13.1	
	Crude Oil	(m ³ storage capacity)*year					2.8	
	Jet Naphtha	(m ³ storage capacity)*year					3.8	
	Jet Kero	(m ³ storage capacity)*year					0.19	
	Distillate oil	(m ³ storage capacity)*year					0.17	
	Truck Fining							
	Truck Fining Stations							
	Gasoline Loading							
	Splash Loading	m ³ of Gasoline					1.43	
		m ³ of Gasoline					1.94	
	Submerged Loading ⁶⁸							
	Normal Service	m ³ of Gasoline					0.59	
		m ³ of Gasoline					0.80	
	Vapor Balance Serv	m ³ of Gasoline					0.98	
		m ³ of Gasoline					1.33	
	Vapor Controlled	m ³ of Gasoline					0.05	
		m ³ of Gasoline					0.07	
	Jet Naphtha Loading							
	Splash Loading	m ³ of Gasoline					1.43	
		m ³ of Gasoline					0.58	
	Submerged Loading							
	Normal Service	m ³ of Gasoline					0.18	
		m ³ of Gasoline					0.24	
	Vapor Balance Serv	m ³ of Gasoline					0.30	
		m ³ of Gasoline					0.40	
620	Retail Trade							
	Service Stations Operation							
	Filling the Underground Tanks							
	Splash Filling	m ³ of Gasoline					1.5	
		tn of Gasoline					2.03	
	Submerged Filling	m ³ of Gasoline					1.0	
		tn of Gasoline					1.353	
	Balanced Vapor Filling	m ³ of Gasoline					0.16	
		tn of Gasoline					0.217	
	Vehicle Refuelling							
	Uncontrolled	m ³ of Gasoline					1.4	
		tn of Gasoline					1.894	
	Balanced Vapor Filling	m ³ of Gasoline					0.212	
		tn of Gasoline					0.287	
MAJOR DIVISION 7. TRANSPORT, STORAGE AND COMMUNICATION								
711	Land Transport ⁶⁹							
	Light Duty Gasoline Powered Cars <3.5 tn							
	Evaporative Emissions ⁷⁰							
	Hot Soak Emission ⁷¹							
	Cars with Carburetors	1000km					9.4/L/Trip	
	Cars with Fuel Injection	1000km					9.4/L/Trip	
	Running Losses	1000km					0.1 to 1.	
	Diurnal Losses							
	Uncontrolled	Car*yr					2.635	
	Evaporative Controls ⁷²	Car*yr					0.0694	
	Exhaust Emissions ⁷³							

67-The listed emission factors yield the VOC emissions in kg/year.

68 - In the Vapor Balance Service the cargo truck retrieves the vapors displaced during the underground tank filling in service stations (see below, SIC 620). This operation increases the VOC concentration in the air within the empty truck and causes higher VOC emissions when the truck is filled. It should be noted in this regard that most of the VOC emissions, reduction, achieved through the balanced vapor fining of the service stations submerged tanks is offset by the resultant increased emissions in the Truck Filling Station, unless & vapor recovery system is used in the latter..

69- (a) "S" is the weight percent of sulfur in the fuel. Typical values for Gasoline are 0.039% to 0.15% & for Diesel 0.2% to 0.5%. (b) "P" Is the average Lead content of the Gasoline's used in .gr / lt. In Unleaded Gasoline Lead concentrations are low (<0.013 gr/lt), while typical values in ,Premium Gasoline's are 0.15 to 0.4 gr /liter.

70- (a) The evaporative emissions can be divided into the Running-Losses (occurring while the vehicle is being driven), the Hot Soak Losses (evaporation of fuel, mainly from the carburetor bowl and tank, each time the vehicle stops with hot engine) and Diurnal Losses (expansion and emission of vapor, mainly from fuel tank, due to the daily diurnal temperature variations).

(b) The relevant emission factors depend on ambient temperature and on gasoline volatility. To account for these effects, the listed factors should be multiplied by appropriate "correction factors". As a guidance for the choice of the latter, the applicable "correction factors" for the EC countries are given below:

	Diurnal Losses	Hot Soak Emissions	Running Losses
Belgium, France, Luxembourg	2.0	0.9	0.9
Portugal, Spain	1.3	0.8	0.8
Greece, Italy		2.1	1.2
Ireland, U.K.		2.5	2.2
Denmark, Germany, Netherlands	1.0	1.0	1.0

(c) Estimates of evaporative emissions based on the listed factors are considered high. An alternative model allowing assessment of evaporative emissions as function of the climatic conditions and Gasoline volatility is given in Section 3.3.3.

71 - "L trip" is the average distance, in km, a car is driven each time its engine starts.

72- Evaporative controls employ canisters filled with activated carbon, to which all fuel system vents are connected. Any diurnal or hot soak VOC emissions will thus be absorbed by the carbon and retained in the canister. The carbon is purged of VOC during driving by drawing air back through the canister and into the engine, where it is burnt.

73 - (a) The emission factors listed are based on a mean ambient temperature of 20 °C & on the following assumptions: For Urban Driving: Av speed = 25 km/h; Av trip length = 8 km; Cold/hot starts: 75/25 For Suburban Driving: Av speed = 60 km/h; Av trip length =12 km; Cold/hot starts: 75/25 For Highway Driving : Av speed=100 km; Av trip length > 20 km; Cold/hot starts: 75/25

(b) Use Model of Section 3.3 for emissions under "local climatic & driving conditions.

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
	Car Production Period up to 1971							
	Urban Driving							
	Engine < 1400 cc	1000km	0.07	1.95	1.64	45.6	3.86	Pb 0.13P
		tn of fuel	0.74	205	17.29	480.6	40.69	Pb 1.35P
	Engine 1400-2000 cc	1000km	0.07	2.225	1.87	45.6	3.86	Pb 0.15P
		tn of fuel	0.63	205	16.87	411.6	34.85	Pb 1.35P
	Engine > 2000 cc	1000km	0.07	2.745	2.25	45.6	3.86	Pb 0.19P
		tn of fuel	0.51	205	16.42	332.8	28.17	Pb .35P

	Suburban Driving							
	Engine < 1400 cc	1000km	0.05	1.155	2.01	25.13	2.03	Pb 0.08P
	Engine 1400-2000 cc	1000km	0.05	1.45	2.51	25.13	2.03	Pb0.09p
		tn of fuel	0.71	205	35.91	359.7	29.05	Pb 1.35p
	Engine > 2000 cc	1000km	0.05	1.665	3.03	25.13	2.03	Pb 0.11p
		tn of fuel	0.60	205	36.50	302.5	24.43	Pb 1.35p
	Highway Driving							
	Engine < 1400 cc	1000km	0.05	1.25	2.02	16.66	1.32	Pb 0.08p
		tn of fuel	0.83	205	33.59	277.0	21.94	Pb 1.35p
	Engine 1400-2000 cc	1000km	0.05	1.495	3.13	16.66	1.32	Pb 0.10p
		tn of fuel	0.67	205	42.06	224.1	17.76	Pb 1.35p
	Engine > 2000 cc	1000km	0.05	1.815	3.59	16.66	1.32	Pb 0.12p
		tn of fuel	0.55	205	39.64	183.7	14.55	Pb 1.35p
	Car Production Period 1972-1977							
	Urban Driving							
	Engine < 1400 cc	1000km	0.07	1.665	1.64	33.42	3.07	Pb 0.11p
		tn of fuel	0.84	205	19.75	402.4	36.95	Pb 1.35p
	Engine 1400-2000 cc	1000km	0.07	1.925	1.87	33.42	3.07	Pb 0.13p
		tn of fuel	0.73	205	19.43	347.5	31.90	Pb 1.35p
	Engine > 2000 cc	1000km	0.07	2.25	2.25	33.42	3.07	Pb 0.15p
		tn of fuel	0.64	205	20.42	303.3	27.85	Pb 1.35p
	Suburban Driving							
	Engine < 1400 cc	1000km	0.05	0.945	2.01	16.96	1.51	Pb 0.06p
		tn of fuel	1.06	205	42.73	360.3	32.0	Pb 1.35p
	Engine 1400-2000 cc	1000km	0.05	1.115	2.51	16.96	1.51	Pb 0.08p
		tn of fuel	0.90	205	45.02	304.4	27.03	Pb 1.35p
	Engine > 2000 cc	1000km	0.05	1.245	3.03	16.96	1.51	Pb 0.08p
		tn of fuel	0.81	205	48.84	273.2	24.26	Pb 1.35p
	Highway Driving							
	Engine < 1400 cc	1000km	0.05	0.985	2.02	19.98	1.19	Pb 0.07p
		tn of fuel	1.02	205	41.10	406.6	24.13	Pb 1.35p
	Engine 1400-2000 cc	1000km	0.05	1.195	3.13	19.98	1.19	Pb 0.08p
		tn of fuel	0.84	205	52.41	335.1	19.89	Pb 1.35p
	Engine > 2000 cc	1000km	0.05	1.345	3.59	19.98	1.19	Pb 1.35p
		tn of fuel	0.75	205	53.73	298.7	17.73	Pb 0.09p
	Car Production Period 1978-1980							
	Urban Driving							
	Engine < 1400 cc	1000km	0.07	1.395	1.50	28.44	2.84	Pb 0.09p
		tn of fuel	1.00	205	21.65	410.0	40.93	Pb 1.35p
	Engine 1400-2000 cc	1000km	0.07	1.685	1.72	28.44	2.84	Pb 0.11p
		tn of fuel	0.83	205	20.47	337.6	33.70	Pb 1.35p
	Engine > 2000 cc	1000km	0.07	2.135	1.97	28.44	2.84	Pb 0.14p
		tn of fuel	0.55	205	18.48	266.5	26.61	Pb 1.35p
	Suburban Driving							
	Engine < 1400 cc	1000km	0.05	0.885	1.90	13.54	1.37	Pb0.06p
		tn of fuel	1.14	205	43.04	307.5	31.11	Pb 1.35p
	Engine 1400-2000 cc	1000km	0.05	1.15	2.18	13.54	1.37	Pb 0.07p
		tn of fuel	0.91	205	39.47	245.4	24.83	Pb 1.35p
	Engine > 2000 cc	1000km	0.05	1.355	2.48	13.54	1.37	Pb 0.09p
		tn of fuel	0.74	205	36.86	201.1	20.34	Pb 1.35p
	Highway Driving							
	Engine < 1400 cc	1000km	0.05	1.035	2.96	10.47	1.00	Pb 0.07p
		tn of fuel	0.97	205	57.25	202.7	19.45	Pb 1.35p
	Engine 1400-2000 cc	1000km	0.05	1.235	3.34	10.47	1.00	Pb 0.08p
		tn of fuel	0.81	205	54.21	170.2	16.33	Pb 1.35p
	Engine > 2000 cc	1000km	0.05	1.475	3.71	10.47	1.00	Pb 0.01p
		tn of fuel	0.68	205	50.44	142.3	13.65	Pb 1.35p
	Car Production Period 1981-1984							
	Urban Driving							
	Engine < 1400 cc	1000km	0.07	1.395	1.58	23.40	2.84	Pb 0.09
		tn of fuel	1.00	205	22.74	337.3	40.93	Pb 1.35p
	Engine 1400-2000 cc	1000km	0.07	1.685	1.92	23.40	2.84	Pb 0.11p
		tn of fuel	0.83	205	22.77	277.8	33.70	Pb 1.35p
	Engine > 2000 cc	1000km	0.07	2.135	2.57	23.40	2.84	Pb 0.14p
		tn of fuel	0.66	205	24.12	219.3	26.61	Pb 1.35p
	Suburban Driving							
	Engine < 1400 cc	1000km	0.05	0.885	1.98	9.26	1.37	Pb 0.06p
		tn of fuel	1.14	2.05	45.01	210.3	31.11	Pb 1.35p
	Engine 1400-2000 cc	1000km	0.05	1.15	2.35	9.26	1.37	Pb 0.07p
		tn of fuel	0.91	205	42.61	167.8	24.83	Pb 1.35p
	Engine > 2000 cc	1000km	0.05	1.355	3.03	9.26	1.37	Pb 0.09p
		tn of fuel	0.74	205	44.98	137.5	20.34	Pb 1.35p
	Highway Driving							
	Engine < 1400 cc	1000km	0.05	1.035	3.26	6.71	1.00	Pb 0.07p
		tn of fuel	0.97	205	63.16	129.8	19.45	Pb 1.35p
	Engine 1400-2000 cc	1000km	0.05	232	3.70	6.71	1.00	Pb 0.08
		tn of fuel	0.81	205	60.04	109.0	16.33	Pb 1.35p
	Engine > 2000 cc	1000km	0.05	1.475	4.47	6.71	1.00	Pb 0.10p
		tn of fuel	0.68	205	60.68	91.11	13.65	Pb 1.35p

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/t
	Car production period 1985-1992							
	Urban Driving							
	Engine < 1400 cc	1000km	0.07	1.27S	1.50	15.73	2.23	Pb 0.09P
		tn of fuel	1.10	20S	23.75	248.3	35.25	Pb 1.35P
	Engine 1400 - 2000 cc	1000km	0.07	1.62S	1.78	15.73	2.23	Pb 0.11P
		tn of fuel	0.86	20S	22.02	194.7	27.65	Pb 1.35P
	Engine > 2000 cc	1000km	0.07	1.85S	2.51	15.73	2.23	Pb 0.13P
		tn of fuel	0.76	20S	27.11	169.7	24.09	Pb 1.35P

	Suburban Driving							
	Engine < 1400 cc	1000km tn of fuel	0.05 1.25	0.80S 20S	2.06 51.26	6.99 173.7	1.05 26.11	Pb 0.05P Pb 1.35P
	Engine 1400 - 2000 cc	1000km tn of fuel	0.05 1.03	0.97S 20S	2.31 47.62	6.99 144.3	1.05 26.68	Pb 0.07P Pb 1.35P
	Engine > 2000 cc	1000km tn of fuel	0.05 0.85	1.17S 20S	3.14 53.81	6.99 119.9	1.05 18.02	Pb 0.08P Pb 1.35P
	Highway Driving							
	Engine < 1400 cc	1000km tn of fuel	0.05 1.04	0.96S 20S	2.85 59.18	3.56 73.9	0.69 14.26	Pb 0.07P Pb 1.35P
	Engine 1400 - 2000 cc	1000km tn of fuel	0.05 0.93	1.08S 20S	3.10 57.21	3.56 65.85	0.69 12.71	Pb 0.07P Pb 1.35P
	Engine > 2000 cc	1000km tn of fuel	0.05 0.74	1.36S 20S	4.09 60.29	3.56 52.5	0.69 10.13	Pb 0.09P Pb 1.35P
	Cars with Uncontrolled 3- way catalytic converters ⁷⁴							
	Urban Driving							
	Engine < 1400 cc	1000km tn of fuel	0.07 0.80	1.74S 20S	1.31 15.13	10.24 118.0	1.29 14.83	
	Engine 1400 - 2000 cc	1000km tn of fuel	0.07 0.68	2.05S 20S	1.13 10.97	6.46 62.9	0.60 5.85	
	Engine > 2000 cc	1000km tn of fuel	0.07 0.60	2.35S 20S	1.13 9.56	6.46 54.9	0.60 5.1	
	Suburban Driving							
	Engine < 1400 cc	1000km tn of fuel	0.05 0.91	1.10S 20S	1.74 31.53	5.15 93.4	0.61 11.10	
	Engine 1400 - 2000 cc	1000km tn of fuel	0.05 0.81	1.23S 20S	1.43 23.19	2.96 48.18	0.28 4.49	
	Engine > 2000 cc	1000km tn of fuel	0.05 0.68	1.48S 20S	1.43 19.27	2.96 40.0	0.28 3.73	
	Highway Driving							
	Engine < 1400 cc	1000km tn of fuel	0.05 0.76	1.32S 20S	2.23 33.80	2.58 39.1	0.40 6.00	
	Engine 1400 - 2000 cc	1000km tn of fuel	0.05 0.73	1.37S 20S	1.83 26.56	1.29 18.8	0.17 2.41	
	Engine > 2000 cc	1000km tn of fuel	0.05 0.53	1.72S 20S	1.83 21.16	1.29 15.0	0.17 1.92	
	Cars with Uncontrolled 3- way catalytic converters ⁷⁵							
	Urban Driving							
	Engine < 1400 cc	1000km tn of fuel	0.07 0.87	1.61S 20S	0.20 2.46	1.71 21.21	0.24 2.95	
	Engine 1400 - 2000 cc	1000km tn of fuel	0.07 0.72	1.94S 20S	0.25 2.57	1.49 15.39	0.19 1.93	
	Engine > 2000 cc	1000km tn of fuel	0.07 0.63	2.23S 20S	0.25 2.24	1.49 13.41	0.19 1.68	
	Suburban Driving							
	Engine < 1400 cc	1000km tn of fuel	0.05 0.98	1.02S 20S	0.33 6.52	1.33 25.96	0.19 3.69	
	Engine 1400 - 2000 cc	1000km tn of fuel	0.05 0.86	1.16S 20S	0.34 5.79	1.04 17.88	0.13 2.19	
	Engine > 2000 cc	1000km tn of fuel	0.05 0.71	1.40S 20S	0.34 4.81	1.04 14.87	0.13 1.82	
	Highway Driving							
	Engine < 1400 cc	1000km tn of fuel	0.05 0.82	1.22S 20S	0.24 3.89	0.90 14.76	0.1 1.76	
	Engine 1400 - 2000 cc	1000km tn of fuel	0.05 0.77	1.30S 20S	0.25 3.91	0.54 8.29	0.06 0.95	
	Engine > 2000 cc	1000km tn of fuel	0.05 0.61	1.63S 20S	0.25 3.12	0.54 6.60	0.06 .76	
	Heavy duty Gasoline powered vehicles 3.5tn							
	Urban Driving	1000km tn of fuel	0.4 3.5	4.5S 20S	4.5 20	70 300	7 30	Pb 0.31P Pb 1.35P
	Suburban Driving	1000km tn of fuel	0.45 2.4	3.7S 20S	7.5 40	55 300	5.5 30	Pb 0.25P Pb 1.35P
	Highway Driving	1000km tn of fuel	0.6 3.6	3.3S 20S	7.5 45	50 300	3.5 20	Pb 0.22P Pb 1.35P
	Light duty Diesel powered vehicles 3.5tn ⁷⁶							
	Urban Driving	1000km tn of fuel	0.2 3.5	1.16S 20S	0.7 12	1 18	0.15 2.6	
	Suburban Driving	1000km tn of fuel	0.15 3.5	0.84S 20S	0.55 13	0.85 20	0.4 9.5	

74. Hot& cold urban Driving cycle and Extra Urban Driving cycle emission and fuel consumption measurements of TNO(TNO,1990), modeled by A. Economopoulos.

75- Hot& cold urban Driving cycle and Extra Urban Driving cycle emission and fuel consumption measurements of TNO(TNO,1990), modeled by A. Economopoulos.

76-(a) in the case of fleet of old vehicles with poor state of maintenance and poor fuel quality , the emission factors listed need to be multiplied as follows :

TSP: 1.6 ,CO: 1.1 ,VOC: 10.0, NOX: 0.9

(B) Based on the contral bureau of statistics , Netherlands , the TSP (smoke) emission from Urban . suburban and Highway driving are 1.1, 0.55 and 0.5 kg/1000km respectively.

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
	Highway Driving	1000km tn of fuel	0.3 4.7	1.3S 20S	1 15	1.25 19.	0.4 6.1	
	Heavy duty Diesel powered vehicles 3.5-16tn ⁷⁷							
	Urban Driving	1000km tn of fuel	0.9 4.3	4.29S 20S	11.8 55.	6.0 28.	2.6 12.	
	Suburban Driving	1000km tn of fuel	0.9 4.3	4.15S 20S	14.4 70.	2.9 14.	0.8 4.	
	Highway Driving	1000km	0.9	4.15S	14.4	2.9	0.8	

		tn of fuel	4.3	20S	70.	14.	4.	
	Heavy duty Diesel powered trucks 16tn ⁷⁸							
	Urban Driving	1000km tn of fuel	1.6 4.3	7.26S 20S	18.2 50	7.3 20	5.8 16.	
	Suburban Driving	1000km tn of fuel	1.6 4.3	7.43S 20S	24.1 65.	3.7 10.	3.0 8.	
	Highway Driving	1000km tn of fuel	1.3 4.3	6.1S 20S	19.8 65.	3.1 10.	2.4 8.	
	Heavy duty Diesel powered buses 16tn ⁷⁹							
	Urban Driving	1000km tn of fuel	1.4 4.3	6.6S 20S	16.5 50.	6.6 20.	5.3 16.	
	Suburban Driving	1000km tn of fuel	1.2 4.3	5.61S 20S	18.2 65	2.8 10.	2.2 8.	
	Highway Driving	1000km tn of fuel	0.9 4.3	6.11S 20S	13.9 65.	2.1 10	1.7 8.	
	Light Duty LPG Powered vehicles<3.5tn ⁸⁰							
	Without catalytic converters							
	Urban Driving	1000km n of fuel			1.24 21	3.3 56	1.35	
	Suburban Driving	1000km tn of fuel			1.3 29	1.76 39	1.15 26	
	Highway Driving	1000km ttn of fuel			2.75 51	1.15 21	1.03 19	
	With 3-way controlled catalytic converters							
	Urban Driving	1000km tn of fuel			0.3 4.4	1.9 28	0.7 10.3	
	Motorcycles							
	Engines < 50 cc 2-stroke	1000km tn of fuel	0.12 6.7	0.36S 20S	0.05 2.8	10 550	6 330	
	Engines < 50 cc 2-stroke	1000km tn of fuel	0.12 4	0.6S 20S	0.08 2.7	22 730	15 500	
	Engines < 50 cc 4-stroke	1000km tn of fuel		0.76S 20S	0.30 8	20 525	3 80	
	Fugitive Dust from vehicle traffic ⁸¹							
	Unpaved Roads ⁸²							
	Plant Roads							
	Copper smelting	1000km	12.5f					
	Iron & steel production	1000km	5.9f					
	Sand& Gravel processing	1000km	3.5f					
	Stone Quarrying / processing	1000km	10.4f					
	Coal Mining / Access Road	1000km	3.8f					
	Coal Mining / Haul Road	1000km	6.2f					
	Coal Mining / scraper Road	1000km	12.5f					
	Rural Roads							
	Gravel	1000km	3.7f					
	Dirt	1000km	21.f					
	Crushed limestone	1000km	7.1f					
	Raved Roads ⁸³							
	City Roads ⁸⁴							
	Local streets (width < 10m)							
	< 500 vehicles / ed	1000km	15					Pb 0.018
	Collector streets (width < 10m)							
	500 – 10000 vehicles / ed	1000km	10					Pb 0.018
	Major streets / highways							
	> 10000 vehicles / ed	1000km	4.4					Pb 0.018
	Freeways / Express ways							
	> 5000 vehicles/d	1000km	0.35					
	Industrial Roads ⁸⁵	1000km	120					
712	Water Transport							

77. Based on the central Bureau of statistics, nether lands (1983) , the TSP(smcke) emissions from Urban . suburban and Highway driving are 5.4, 2.0 and 1.4 kg/1000km respectively.

78. As above

79. Based on the central Bureau of statistics, nether lands (1983) , the TSP(smcke) emissions from Urban . suburban and Highway driving are 5.1, 1.8 and 1.0 kg/1000km respectively

80 The listed emissions factors are valid only for properly converted (into LPG use) and well-adjusted engines . other wise . the emissions factors are in the same order as these for light Duty Gasoline powered vehicles < 3.5 tn.

81-emissions factors account for entrained particles with diameters < 30.

82-(a) $f = s(w^{0.7})(w^{0.5})$, where s is the average vehicle speed in km/hr , is the average vehicle weight in tons. And w is the average number of wheels per vehicle.

(b) The listed emissions factors apply per 1000km driven in dry weather (during days with< 0.25mm of precipitation).

(c) The emissions factors account for PM10 particles are 50% and 36% respectively of the listed emissions factors(PM10 & PM15 are particles with diameters < 10 & < 15 respectively).

(d)Periodic (monthly) applicayion of petroleum resin products over a dust control season (e.g four summer months)yields typical control efficiencies of the order 60%for the TSP and 70% for PM10particles .

83-The emissions factors account for PM15 or PM10 particles are 40% and 36% respectively of the listed emissions factors local and collector streets . 45% & 41% respectively of the listed emissions factors for major streets/ highways and 60% & 54% respectively for free- ways / Expressways (PM10 & PM15 are particles with diameters < 10 & < 15 respectively).

84-limited data suggest control efficiencies of 34% and 37% for PM10 particles from vacuum sweeping and improved vacuum sweeping respectively PM10 are particles with aerodynamic diameter < 10).

85- for pm15 particles , limited data suggest control efficiencies of up 58% for vacuum sweeping

(46% for TSP), (69-0.231*v)% efficiency for water flushing and (96-0.263*v)% efficiency for water flushing by sweeping, where V is the number of vehicle passes since application

Model for Air Emission Inventories and Controls

SIC #	PROCESS	UNIT (U)	TSP (kg/U)	SO ₂ (kg/U)	NO _x (kg/U)	CO (kg/U)	VOC (kg/U)	Kg/u
	Motor ships ^{86,87}	Ship – days in berth	6.8	136S	90.7	0.036	4.1	
	Steamships	Ship – days in berth	7.5	19.5	22.7	20.8	14.9	
713	Air Transport							
	Landing and take off of Aircraft							
	Typical carrier ⁸⁸	Landing + take off	0.99	1.5	14.2		20.4	
	Aircraft Refueling							
	Jet Naphtha	M ³ tn					0.40 0.54	
719	Services Allied to Transport							

7192	Storage and warehousing							
	Grain Elevators							
	Country Elevators	tn	3.7					
	Inland Terminal Elevators	tn	4.8					
	Export Elevators	tn	5.0					
	MAJOR DIVISION 9. COMMUNITY, SOCIAL AND PERSONAL SERVICES							
920	Sanitary and similar Services							
	Municipal/ Domestic type of Wastes							
	Open Burning							
	Municipal Refuse	tn	8	0.5	3.	42.	21.5	
	Automobile components ⁸⁹	tn	50	0.0	2.	62.	21.0	
	Municipal Waste combustion							
	Mass – Burn combustors							
	Uncontrolled	tn	19	0.85	1.8	1.10	0532	Pb 0.09
	ESP or FF	tn	0.19	0.85	1.8	1.10	0532	Pb 0.011
	Modular starved – Air combustors							
	Uncontrolled	tn	0.95	0.85	2.2	0.170.	0532	Pb 0.06
	ESP or FF	tn	0.015	0.85	2.2	0.170.	0532	b 0.001
	Refuse Derived Fuel (RDF) Fired combustors							
	Uncontrolled	tn	40	0.85	2.5	1.80.	0532	Pb 0.065
	ESP or FF	tn	0.04	0.85	2.5	1.80.	0532	Pb 0.014
	Industrial / commercial / Refuse combustion							
	Multiple chamber / Uncontrolled	tn	3.5	1.25	1.5	5.0	1.5	
	Single chamber / Uncontrolled	tn	7.5	1.25	1.0	10.0	7.5	
	Trench/ Uncontrolled							
	Wood	tn	13	0.1	4.0			
	Rubber tires	tn	138					
	Municipal Refuse	tn	37	2.5				
	Pathological Wastes							
	Uncontrolled	tn	8.0	0.	3.0	0.	0.	
	Sewage Sludge Incinerators							
	Multiple Hearth Incinerators							
	Uncontrolled	tn of dried sludge	42	10	5.5	36	3.15	Pb 0.05
	Scrubber ⁹⁰	tn of dried sludge	0.89	2.	2.5	2	3.15	Pb 0.02
	Fluidized Bed Incinerators							
	Uncontrolled	tn of dried sludge	?	10.	4		1.16	Pb ?
	Scrubber	tn of dried sludge	0.33	2.	2.2	2	1.16	Pb 0.03
	Electric Infrared Incinerators							
	Uncontrolled	tn of dried sludge	4	10.		4		
	Scrubber	tn of dried sludge	1	2.		3		
952	Laundries , laundry services , and cleaning and Dyeing plants							
	Dry cleaning	(capita)*(year)					0.6	

86. "S" is the weight percent of sulfur in the fuel used .

87. the number of steamships and motors ships days – in – berth, if not directly known , can computed from the number of ship calls per year and the average mooring time . Typical mooring times in hours are as follows : 6for passenger ships , 45 for freighters and general ships , 24 for container vessels < 40000GRT , 36 for container vessels < 40000GRT, 40 for bulk transport vessels < 40000GRT, 48 for tankers < 40000GRT..

88. Given factors are overall averages for atypical airport , Economopoulos (1980).

89-Upholstery , belts, hoses and tires burned together .

90. Impingement, venture and / or cyclone scrubber.

Appendix -C-
WHO Liquid
Pollutants
Factors



Model for liquid waste Inventories and Controls- Cont'd

PROCESS	UNIT (U)	WASTE VOLUME m³/U	BOD5	Tss	Tot N	Tot P	Other pollutants	
			(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	Name	(kg/U) pntr
MAJOR DIVISION 1. AGRICULTURE HUNTING FORESTRY AHD FISHTNG								
DIVISION 1.AGRICUL TURE AND HUHTIHG								
111 Agricultural and livestock prduction³								
Beef cattle 360 kg aver								
Slotted floor /shallow pit ⁴	Head*yr	8.0	164	1204	43.8	11.3		
Dairy cattle.590 kg aver⁵								
Free stall barn	Head*yr	15.6	228.5	1533	82.1	12.0		
Milking center	Head*yr	5.6	21.5		2.5	3.3		
Swine feed lot ,45kg aver⁶								
Solid floor /water washed	Head*yr	14.6	32.9	73.	7.3	2.3		
Slotted floor / pit manure	Head*yr	2.8	32.9	24.8	7.3	2.3		
Sheep ,68 kg average								
Hosed /solid manure	Head*yr	2.6	58.4		23	6.6		
Hosed/ liquid manure	Head*yr	4.9	33.2	158.4	4	21.5		
Lambs,34.9 kg average⁷								
Housed/solid manure	Head*yr	1.5	33.7		13.5	3.7		
Housed/solid manure	Head*yr	2.9	19.2	169	2.5	1.24		
Chicken⁸								
Broilers on feed,1 kg	Head*yr	21.5	1.61	4.2	3.6			
Layers	(kg of bird)*yr	21.5	1.61	4.2	3.6			
Turkeys⁹								
Breeding birds,11.4 kg	Head*yr	0.25	14.2		3	2.5		
Market birds,6.8 kg	Head*yr	0.15	8.4		1.8	1.5		
Ducks,16 kg average	Head*yr	84	6.4	9.1	N/A	N/A		
Horses/Manure & Bedding	Head*yr	13.6	146		95.3	16.4		
Unaerated lagoon		0.22	0.45	0.44	0.91			
Oxidation Ditch			0.11	0.45	0.25	1.0		
Broilers on feed,1 kg	Head*yr	21.5	1.61	4.2	3.6			
Layers	(kg of bird)*yr	21.5	1.61	4.2	3.6			
Turkeys⁹								
Breeding birds,11.4 kg	Head*yr	0.25	14.2		3	2.5		
Market birds,6.8 kg	Head*yr	0.15	8.4		1.8	1.5		
Ducks,16 kg average	Head*yr	84	6.4	9.1	N/A	N/A		
Horses/Manure & Bedding	Head*yr	13.6	146		95.3	16.4		
Unaerated lagoon		0.22	0.45	0.44	0.91			
Oxidation Ditch			0.11	0.45	0.25	1.0		
MAOOR DIVISION 3.MANUFACTURIHG								
DIVISION 31. HANUFACTURE OF FOOD , BEVERAGES AND TOBCCO								
311 Food Manufacturing								
3111 Slaughtering, preparing &Preserving meat ¹⁰,¹¹,¹²								
Simple slaughterhouses								
With blood recovered	tn lwk	5.3	6	5.6	0.7	0.05	Oil	2.1
Without blood recovered	tn lwk	5.3	10	8.0	0.7	0.05	Oil	4
Complex slaughterhouses	tn lwk	7.4	10.9	9.6	0.84	0.33	Oil	5.9
Packing houses								

1-If a waste load factor does not appear in the appropriate place ,this of then (but not always) means that its value is either small or zero .however, but rather that the value of this factor is not known

2-The listed waste volume factors do not account for cooling water discharges ,which may be very significant the underline assumption here is that ,unless otherwise noted ,the cooling waters are recycled and only a small portion of then ,the blowdown ,is discharged along with the effluents .

3-Low density pasture units represent zero level of waste problems , along with the recovery of full fertilizer value however ,the waste from high density confined operations approaches

4- in beef cattle feedlots calves enter weighing 270 kg and after a period of 130 to 180 days they leave as market animals weighing about 477 kg .

Beef feedlots include shallow and deep pit systems dirt-flat to moderate slope ,dirt-steep slope and paved open slots .the listed factors for shallow bit systems represent the highest loads ,as the manure is collected almost daily in all other systems the manure remains on the floor for a period of time and undergoes decomposition ,loosing some of its original organic load strength for example ,in deep pit systems where the manure may remain for 6 to 12 month ,the BOD can be reduced by about 40% the total nitrogen can be reduced somewhat due to ammonia losses ,but the total phosphorus remains unchanged .

5- In dairy farms each cow produces 9 to 25 kg of milk daily and 1 calve per year .

6- In swine feedlots ,feeder pigs enter weighing 25 kg ,and after a period of 23 to 25 week they leave as 100 kg hogs to be slaughtered.

7- In lamb feedlots, lambs enter weighing 30 to 41 kg , and after a period of 40 to 150 days they leave as market animals weighing about 45 to 59 kg .

8-Both breeding flocks and the growing birds are normally kept on litter (0.9 and 2.7 kg /bird used respectively),where their wastes are absorbed and remain for prolonged periods .the listed factors represent fresh chicken manure with no estimation for the considerable biodegradation or evaporation .they reflect however the loads in newer installations ,where the wastes are regularly washed away .

9- Turkeys ,like chicken ,are growing on litter and the listed factors do not account for the biodegradation

10-Lwk is an abbreviation for the live weight of the animals killed .

11-The average weight of cattle is 430 kg ,of calf 97 kg ,of hog 120 kg ,and of lamb 52 kg

12-The edible meat is about 60% of lwk :



Model for liquid waste Inventories and Controls- Cont'd

PROCESS	UNIT (U)	WASTE VOLUME m ³ /U	BOD5	Tss	Tot N	Tot P	Other pollutants	
			(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	Name	(kg/U) pntr
Low processing	tn lwk	7.8	8.1	5.9	0.53	0.13	Oil	3
High processing	tn lwk	12.5	16.1	10.5	1.3	0.4	Oil	9
Rendering plants	tn lwk	3.3	2.15	1.13	0.48	0.04	Oil	0.72
Poultry processing								
With blood recovery	1000 birds	37.5	11.9	12.7				5.6
Without blood recovery	1000 birds	37.5	17	12.7				5.6
Primary skimming and air floatation		0.45	0.07			Oil	0.13	
Primary skimming and air floatation with coagulant		0.15	0.05			Oil	0.1	
Anaerobic and aerobic lagoon			0.046	0.065	0.67		Oil	0.047
Extended aeration and aerobic lagoon			0.04	0.14	0.72		Oil	0.02
Aerobic lagoon and trickling filter			0.025	0.06	0.7		Oil	0.04
2- stage trickling filter			0.045	0.05	0.7		Oil	0.02
3112 Manufacturing of dairy products ^{13,14}								
Dairies								
Receiving station								
Cans	tn of product	0.68	0.46	0.03	0.49	0.11		
Bulk	tn of product	0.08	0.17	0.03	0.05	0.013		
Fluid products	tn of product	3.1	3.21	1.5	0.31	0.68		
Cultured products	tn of product	3.9	3.21	1.5	0.31	0.68		
Butter	tn of product	2.6	1.1	0.4	1.95	0.42		
Cottage cheese								
With whey recovery	tn of product	7.7	21.7	3.4				
Natural cheese								
With whey recovery	tn of product	2.3	2.2	0.2	1.56	0.34		
Ice cream	tn of product	3	10.9	1.5				
Condensed milk	tn of product	2	6.7	0.83	0.39	0.08		
Powder production	tn of product							
Spray drying	tn of product	0.7	22.4		1.3	0.28		
Roller drying	tn of product	0.8	26.8		1.56	0.34		
Activated sludge			0.071	0.046		0.39		
Trickling filter			0.095	0.43		0.39		
AERATED LAGOON			0.155			0.39		
Stabilization pond			0.05			0.39		
Anaerobic digestion			0.7			0.39		
3113 Canning & preserving of fruits & vegetables								
Fruits processing								
Apricots	tn raw material	29.1	15.4	4.25				
Apple								
All products except juice	tn raw material	3.7	5	0.5				
All prod	tn raw material	5.4	6.4	0.8				
Juice	tn raw material	2.9	2	0.3				
Canberries	tn raw material	5.8	2.8	0.6				
Citrus	tn raw material	10.1	3.2	1.3				
Sweet cherries	tn raw material	7.8	9.6	0.6				
Sour cherries	tn raw material	12	17.2	1				
Brine cherries	tn raw material	19.9	21.7	1.4				
Cranberries	tn raw material	12.3	10	1.4				
Dried fruit	tn raw material	13.3	12.4	1.9				
Grape fruit								
Peaches								
Canned	tn raw material	13	14	2.3				
Frozen	tn raw material	5.4	11.7	1.8				
Pears	tn raw material	11.8	21.2	3.2				

13- The BOD Loads were estimated from the COD loads given in literature using typical for each project COD/BOD ratios

14- The typical distribution of products obtained from 1000 lt of milk is follows : Butter 5 kg ,cheese 10 kg ,condensed milk (45% dry matter) 26 kg , condensate (30% dry- matter)

40 kg skimmed milk powder 9 kg ,and full- milk powder 12 kg.

Model for liquid waste Inventories and Controls- Cont'd



PROCESS	UNIT (U)	WASTE VOLUME m ³ /U	BOD5	Tss	Tot N	Tot P	Other pollutants	
			(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	Name	(kg/U) pntr
Pickles								
Fresh –packed	tn raw material	8.5	9.5	1.9				
Process–packed	tn raw material	9.6	18.3	3.3				
Salting stations	tn raw material	1.1	8.0	0.4				
Pineapples	tn raw material	13	10.3	2.7				
Plums	tn raw material	5	4.1	0.3				
Raisins	tn raw material	2.8	6	1.6				
Strawberries	tn raw material	13.1	5.3	1.4				
Tomatoes								
Peeled	tn raw material	8.9	4.1	6.1				
Products	tn raw material	4.7	1.3	2.7				
Vegetable processing								
Asparagus	tn raw material	68.8	2.1	3.4				
Beets	tn raw material	5	19.7	3.9				
Broccoli	tn raw material	45.6	9.8	5.6				
Brussels sprouts	tn raw material	36.3	3.4	10.8				
Carrots	tn raw material	12.1	19.5	12				
Cauliflower	tn raw material	89.4	5.2	2.7				
Corn								
Canned	tn raw material	4.5	14.4	6.7				
Frozen	tn raw material	13.3	20.2	5.6				
Dehydrated								
Onion & garlic	tn raw material	19.9	6.5	5.9				
Vegetables	tn raw material	22.1	7.9	5.6				
Dry beans	tn raw material	18	15.3	4.4				
Lima beans	tn raw material	27.1	13.9	10.3				
Mushrooms	tn raw material	22.4	8.7	4.8				
Onions Canned	tn raw material	23	22.6	9.3				
Peas								
Canned	tn raw material	19.7	22.1	5.4				
Frozen	tn raw material	14.5	18.3	4.9				
Pimentos	tn raw material	28.8	27.2	2.9				
Potatoes								
All products	tn raw material	10.3	18.1	15.9				
Frozen Prod	tn raw material	11.3	22.9	19.4				
Dehydrated Prod	tn raw material	8.8	11	8.6				
Sauerkraut								
Canning	tn raw material	3.5	3.5	0.6				
Cutting	tn raw material	0.43	1.2	0.2				
Snap beans								
Canned	tn raw material	15.4	3.1	2				
Frozen	tn raw material	19.9	6	3				
Spinach								
Canned	tn raw material	37.6	8.2	6.5				
Frozen	tn raw material	29.2	4.8	2				
Squash	tn raw material	5.6	16.8	2.3				
Sweet potatoes	tn raw material	4.1	30.1	11.5				
Settling or floatation			0.3	0.73				
Chemical coagulation			0.2	0.3				
Trickling filters			0.12	0.1				
Activated sludge			0.07	0.1				
Stabilization pond			0.1	0.05				
3114 Canning , preserving & processing of fish , crustacean &similar foods								
Fish and seafood processing industry								
Catfish processing	tn of product	24	7.3	9.4	0.55		Oil	4.7
Blue crab								
Convent, l processing	tn of product	1.2	5.2	0.74	1		Oil	0.25



PROCESS	UNIT (U)	WASTE VOLUME m ³ /U	BOD5	Tss	Tot N	Tot P	Other pollutants	
			(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	Name	(kg/U) pntr
Mechanized processing	tn of product	38	22.5	12	3.7		Oil	5.6
Shrimp								
Breaded	tn of product	116	84	93	5.9		Oil	20
Canned	tn of product	52	82	43	9.5		Oil	31
Frozen	tn of product	115	120	220	10		Oil	29
Tuna	tn of product	25	13.4	10.4	2.1		Oil	
Clam								
H and shucked	tn of product	4.6	5.1	10.2			Oil	0.14
Mechanized	tn of product	19.5	18.7	6.3			Oil	0.46
Fish meal								
With solubles	tn of product	35	3	0.9			Oil	0.56
Without solubles	tn of product	1.9	62.2	34.8			Oil	22.8
Salmon								
Mechanical butchering	tn of product	18.5	50.8	20.3			Oil	6.5
Hand butchering	tn of product	4	2.1	1.2			Oil	1.5
Sardine	tn of product	8.7	9.2	5.4				
Herring	tn of product	7	32.2	20.9			Oil	6.5
Oyster /steam cleaned	tn of product	98	61.2	155			Oil	1.5
Screening , floatation and extended aeration			0.05	0.05			Oil	0.05
Screening , floatation and aerated lagoon			0.05	0.05			Oil	0.05
3115 Manufacture of vegetable and animal oil and fats								
Olive oil expression								
Pressing	tn of Oil product	5	210	325				
	tn of olives	1	42	65				
Centrifuging	tn of Oil product	7	95	455				
	tn of olives	104	19	91				
Sedimentation with lime								
Anaerobic digestion	0.3							
Edible oil refining								
Edible fats and oils								
General	tn of product	6.8	24.9	24.9			Oil	28.1
Corn Oil	tn of product	1.85	0.3	0.35				
olive Oil	tn of product	27.5	12.9	16.4			Oil	6.5
Dissolved air floatation with chemicals			0.08	0.32			Oil	0.22
Gravity clarifier & oil collection filter			0.08	0.32			Oil	0.22
Biological secondary treatment			0.01	0.01			Oil	0.01
3116 Grain mill products								
Corn								
Wet milling	tn of product	22.4	7.3	5.2				
Dry milling	tn of product	0.7	1.1	1.6				
Wheat								
Normal milling	tn of product		No effluents					
Bulgur milling	tn of product	0.29	0.11	0.1				
Rice								
Normal milling	tn of product		No effluents					
Parboiled milling	tn of product	1.5	1.8	0.07				
Activated sludge			0.21	0.41				
Flow equalization & activated sludge			0.1	0.2				
Flow equalization & activated sludge & stabilization lagoon			0.04	0.09				
Tertiary treatment			0.005	0.01				
3117 Manufacture of bakery products								
Bread	tn of product		0.11		0.004			
Rusk	tn of product		0.11		0.004			
Dry pastry	tn of product		0.7		0.005			
Wet pastry	tn of product		9		0.05			
3118 Sugar factories and refineries								
Beet sugar production	tn of product	23	20					

PROCESS	UNIT (U)	WASTE VOLUME m³/U	BOD5	Tss	Tot N	Tot P	Other pollutants	
			(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	Name	(kg/U) pntr
Water conservation & activated sludge			0.09	0.02				
Ove & recycling of condenser water			0.004	0.003				
Cane sugar production	tn of product	3-48	2.9	6.3				
Water conservation & activated sludge			0.23	0.05				
Tertiary treatment			0.05	0.004				
3121 Manufacture of food products not elsewhere classified specialty food Industry								
Prepared dinners	tn of product	12	17	14	0.44	0.19	Oil	15
Frozen bakery products	tn of product	11	23	14	0.3	0.08	Oil	11
Dressing , sauces and								
Spreads	tn of product	2.8	7.5	3.5	0.04	0.03	Oil	5.7
Meat specialties	tn of product	10	10	6.1	0.57	0.1	Oil	4
Canned soups & baby foods	tn of product	22	12	7.6	0.47	0.18	Oil	2.4
Tomato –cheese – starch								
Combinations	tn of product	2.9	7.2	6	0.23	0.23	Oil	4.7
Sauced vegetables	tn of product	85	25	21	1.1	0.33		
Sweet syrups , jams & jellies	tn of product	2.4	5.1	1	0.04	0.05	Oil	0.6
Chinese & Mexican foods	tn of product	14	6.9	2.8	0.28	0.14	Oil	3
Breaded frozen products	tn of product	48	26	26	2.6	0.35		
stabilization lagoons			0.03	0.05			Oil	0.05
Activated sludge			0.05	0.08			Oil	0.05
Egg breaking								
Us facilities	tn of product	10.3	33					
Dutch facilities	tn of eggs	7.9	12.4					
	Dozen eggs	0.0039	0.006					
Activated sludge			0.1					
Rotating disks			0.077					
Wheat , starch gluten	tn of product	9.9	94	81	3.7	1		
Starch and glucose	tn of product	33	13.4	9.7				
Yeast manufacturing	tn of product	150	1125	18.7	127		SO ₄	337
Activated sludge			0.02	0.03				
313 Beverage Industries								
3131 Distillery , rectifying and blending spirits								
Grain distilleries ¹⁵	tn anhydrous alcohol	63	216	257				
Aerated lagoon		0.043	0.077					
Activated sludge		0.043	0.077					
Molasses distilleries ¹⁶	tn anhydrous alcohol	63	220	300				
Sugar cane distilleries	tn anhydrous alcohol	113	426					
Wine distilleries	tn anhydrous alcohol	36	210	75				
	tn of grapes		3.6	2.1				
Aerated lagoon	0.001	0.002						
Activated sludge	0.001	0.004						
3132 Wine production								
Wine production	tn of grapes	2	1.6	0.3				
Rotating biological contactor & sand filter	0.065	0.01						
Activated sludge /Extended aeration								
Activated sludge /Conventional								
3133 malt liquors and malt								
Beer manufacturing								
Malting	tn of barley	7.3	5	0.85				
Malting and brewing								
New large plant	M³ of beer	5.4	10.5	3.9				
Old large plant	M³ of beer	11	18.8	7.3				
Primary treatment			0.84	0.37				
Trickling filter / low loading			0.03	0.1				
2 stage Trickling filter / high loading			0.1	0.1				

15-One bushel (35.2 lt or 27.2 kg) of grain yields 17.8 lt of anhydrous alcohol .

16- 2.4 lt of molasses yield 1. lt of anhydrous alcohol

Model for liquid waste Inventories and Controls- Cont'd

PROCESS	UNIT	WASTE	BOD5	Tss	Tot N	Tot P	Other pollutants
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	(U)	VOLUME m³/U	(kg/U)	(kg/U)	(kg/U)	(kg/U)	Name	(kg/U)
			pntnr	pntnr	pntnr	pntnr		pntnr
Activated sludge			0.1	0.1				
3134 Soft drinks								
Major plant								
With syrup preparation	m³ of product	12.8	3.1.	4.3				
Franchise plant								
With no syrup preparation								
Bottled	m³ of product	4.3	2.1	0.7				
Canned	m³ of product	2	0.8	0.3				
Aerated lagoon								
Activated sludge								
Division 32 . textile ,wearih6 apparel & leather industries								
321 Manufacture of textiles								
Wool processing ¹⁷								
Ave unsoured stock ¹⁸	tn of Wool	544	314	196			Oil Cr Phenol	191 1.33 0.22
Ave scoured stock	tn of Wool	537	87	43			Cr Phenol	1.33 0.17
Process –specific								
Scouring	tn of wool	17	227	153			Oil	191
Dyeing	tn of wool	25	22				Cr Phenol	1.33 0.17
Washing	tn of wool	362	63					
Carbonizing	tn of wool	138	2	44				
Bleaching	tn of wool	12.5	1.4					
Cotton processing								
Ave compounded ¹⁹	tn of cotton	265	155	70				
Process –specific								
Yarn sizing	tn of cotton	4.2	2.8					
Desizing	tn of cotton	22	58	30				
Kiering	tn of cotton	100	53	22				
Bleaching	tn of cotton	100	8	5				
Mercerizing	tn of cotton	35	8	2.5				
Dyeing	tn of cotton	50	60	25				
Printing	tn of cotton	14	54	12				
Rayon processing	tn of rayon	42	30	55				
Acetate process	tn of acetate	75	45	40				
Nylon process	tn of nylon	125	45	30				
Acrylic process	tn of acrylic	210	125	87				
Polyester process	tn of polyester	100	185	95				
Sedimentation			0.6	0.4				
Coagulation / Sedimentation			0.6	0.15				
Anaerobic lagoon			0.2	0.3				
Aerobic lagoon			0.05	0.05				
Activated sludge			0.1	0.05				
323 Manufacture of leather & products of leather								
3231 Tanneries and leather finish ²⁰								
1. Hair pulp , chrome ten ,retan ,wet finish	tn of hides	57	63.5	104.	12		Oil Sulfide Cr Phenol	57.8 3.35 4.76 0.11
2. Hair save , chrome ten ,retan ,wet finish	tn of hides	44	67.3	199.	12.8		Oil Sulfide Cr Phenol	13.1 1.94 0.24
3. Hair pulp or save non , chrome ten ,retan ,wet finish	tn of hides	45	73.1	96.7	13.6		Oil Sulfide Cr Phenol	17.3 3.43 0.06 0.39

17- The pH varies widely ,from 1.9 to 10.4.

18- The average compounded load factors listed are based on the assumption that only 20 % of the product is mercerized and 10% is bleached .

19- The average compounded load factors listed are based on the assumption that only 35 % of the product is mercerized , 50 % of the product is dyed and 14 % of the product is printed.

20. Typical weight of big hides (from cattle or horse) is 25-26 kg , while that of small hides (from sheep or goat) 3 kg .

Model for liquid waste Inventories and Controls- Cont'd

PROCESS	UNIT (U)	WASTE	BOD5	Tss	Tot N	Tot P	Other pollutants
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		VOLUME m ³ /U	(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	Name	(kg/U) pntr
4. Retan & wet finish (sides)	tn of hides	43	29.2	51	3.8		Oil Sulfide Cr Phenol	6.8 0.11 1.86 0.24
5. No beamhouse tanneries (ten ,retan & wet finish)	tn of hides	56	39.2	49.2	5		Oil Sulfide Cr Phenol	86.3 0.01 2.21
6. Through –the –blue (ten & removal & chrome ten of cattlehides	tn of hides	17	130	200	20.3		Oil Sulfide Cr Phenol	17.37.6 6.3 0.11
7. Shearling tanneries(ten & finish sheepskins with wool intact)	tn of hides	78	57	77.7	4		Oil Sulfide Cr Phenol	15.3 0.54 7.4
8. Pigskin tanneries (same process as that of category 1)	tn of hides	42	115	181	5.7		Oil Sulfide Cr Phenol	64 12.1 4.4 0.03
9. . Retan & wet finish (splits)	tn of hides	27	16.9	23.8	3.9		Oil Sulfide Cr Phenol	19.3 0.03 1.07 0.01
Primary Sedimentation			0.6	0.42	0.74		Oil Sulfide Cr	0.34 1 0.62
Sulfide oxidation / Sedimentation			0.56	0.32	0.74		Oil Sulfide Cr	0.39 0.0 0.2
Coagulation with chemical addition and Sedimentation			0.52	0.09	0.58		Oil Sulfide Cr	0.22 0.125
Activated sludge (extended aeration)			0.02	0.1	0.66		Oil Sulfide Cr	0.02 0.01
331 Manufacture of wood & wood &cork products, except furniture								
Plywood manufacturing	1000 m ²	4.1	4	1.1	0.24	Phenol	5	
Fiberboardmanufacturing	tn of product	20	12.5	20				
Division 34. manufacture of paper & paper products , printing &publishing								
341 Manufacture of paper and paper products								
3411 Manufacture of pulp ,paper and paperboard								
Pulp mills								
Wood Pulp								
Mechanical	tn of product							
Sulfate (kraft) ²¹	tn of product	61.3	31	18				
Sulfite	tn of product	92.4	130	26				
Semi chemical	tn of product	47	27	12.5				
Paper mills								
Newsprint Paper	tn of product	190	7.5	2				
Kraft coarse paper	tn of product	152	5.5	10.5				
Cigarette paper	tn of product	100	11.5	37.5				
Paperboard / simple finish	tn of product	200	15	30				
Graphic paper	tn of product		10.5	6.5				
Sedimentation			0.75	0.75				
Dissolved air floatation			0.65	0.15				
Activated sludge			0.05	0.1				
Aerated lagoon			0.3	0.1				
stabilization lagooning			0.6	0.1				
Division 35. Manufacture of chemicals & of chemicals , Petroleum , coal ,rubber & plastic products								
351 Manufacture of industrial chemicals								
3511 Manufacture of basic industrial chemicals except fertilizers ²²								
Primary petrochemicals								
Ethylene	tn of product	3.2	1.8					
Propylene	tn of product	4.4	2.4					
Primary Intermediates								
Ammonia	tn of product	6.9	0.4		0.1	Oil	11	
Butanol (Butyl Alcohol)	tn of product	4.6	10.3					

21- The processes considered are pulping , pulp screening ,pulp washing and thickening.

22. Wast volumes and bod loads vary widely In most cases other pollutants (ss, nitrogen , phenol ,oil ,heavy metals and cyanide) , as well as pH and color , are present ,but factors are not available when these products are Manufactured by petrochemical refineries ,rather than from smaller installations , use the compounded factors applicable for refineries (SIC3530).



PROCESS	UNIT (U)	WASTE VOLUME m ³ /U	BOD5	Tss	Tot N	Tot P	Other pollutants	
			(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	Name	(kg/U) pntr
Chlorinate hydrocarbons	tn of product	2.2	0.22					
Ethanol (Ethyl Alcohol)	tn of product	9	14.9					
Ethy benzene	tn of product	6.9	12					
Methanol (methyl Alcohol)	tn of product	6.9	4.4			Oil	1.2	
Toluene	tn of product	6.9	9.7					
Xylene	tn of product	6.9	15.5					
Secondary Intermediates								
Acetic anhydride	tn of product	18.7	50					
Acetone	tn of product	4.2	12.6					
Acetylates	tn of product	8.3	23					
Acrylonitrile	tn of product	22.9	10					
Butylenes , Butadiene	tn of product	4.4	0.5					
Ethylene glycol								
Ethanediol	tn of product	14.6	29					
Formal ldehyde (Methnal	tn of product					Oil		
Glycerine , glycols	tn of product	14.6	29					
Phenol,Cumene	tn of product	6.2	34.7					
Styrene	tn of product	23.1	38					
Terephthalic acid	tn of product	8.3	16					
Vinyl chloride	tn of product	0.4	0.5					
Primary polymers								
Butyl rubber	tn of product	16.7	23.4					
Polyvinyl chloride	tn of product	9.3	2.6					
Dyes and pigments	tn of product	624	187					
Miscellaneous Organics								
Isocyanate	tn of product	31	54					
Parathion	tn of product	22.9	57					
Phenyl glycine	tn of product	31	54					
Tributyl phosphate	tn of product	10.4	13					
Activated sludge treatment			0.01					
Chlor -alkali ²³								
Memory cell								
Untreated		tn of cl...		5.6			Hg	0.15
Treated			0.32	0.23			Hg	0001
Diaphragm cell (Metal or graphic anodes								
Untreated				3.2			pb	046
Treated				0.32			Pb	0025
3512 Manufacture of fertilizers and pesticides								
Nitrogenous fertilizers								
Ammonium nitrate								
Untreated	tn of product				2.9			
Treated	tn of product				0.1			
Ammonium sulphate								
Untreated	tn of product		0.4		10			
Treated	tn of product				0.1			
Urea								
Untreated	tn of product		0.24		10			
Treated	tn of product				0.1			
Phosphatic fertilizers								
Phosphoric acid (wet process)		670		3900	5	17 ²⁴	Fluor pb ,As Cr , Hg	246 ²⁵
Normal super phosphates(phosphate rock +h2s04)				1.25		0.65	Fluoride	1.1
Triple super phosphates(phosphate rock +h3p04)			0.55			0.32	Flu oride	7.8
N.p.p. fertilizers	tn of product			0.4	0.4		F	0.06

23.Controls in both ,the mercury and the Diaphragm cell process, comprise sulfide precipitation and possibly activated carbon treatment .

24. If the henihydrate ,rather than dehydrate ,process is used ,the applicable factor is 8.7.

25. If fluorosilicic acid is recovered from the exhaust gases , the applicable factor is 24.6.

Model for liquid waste Inventories and Controls- Cont'd



PROCESS	UNIT (U)	WASTE VOLUME m³/U	BOD5	Tss	Tot N	Tot P	Other pollutants	
			(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	Name	(kg/U) pntr
Total water recycle & treatment of excess effluents ²⁶				0.0		0.0	Fluoride Pb ,As ,Cr ,Hg	0 0
Insecticides ,fungicides ,disinfectants etc								
DDT	tn of product	5.3					Oil Chlorobenzene	76 38
Chlorinated hydrocarbon herbicides	tn of product	3.6	22.7	9			Phenol	4.9
3513 Manufacture of synthetic resins ,plastic and man – made fibers ²⁷								
Butadiene –styrene								
Untreated	tn of product		14					
Butadiene – nitrile rubber								
Untreated	tn of product		11					
Phenolic resins								
Untreated	tn of product	4.1	33	3.7			Phenol	6.6
Good control	tn of product		3.7	1.5				
Polyethylene								
Low density								
Untreated	tn of product		2.3	2.1				
Good control	tn of product		0.2	0.55				
High density								
Untreated	tn of product		0.5	1.7				
High density - solvent								
Good control	tn of product		0.3	0.83				
High density – polyfrom								
Good control	tn of product		0.05	0.14				
Polypropylene								
Untreated	tn of product		5	0.16				
Good control	tn of product		0.42	1.16				
Polystyrene								
Untreated	tn of product		1.1	4.2				
Polystyrene -suspension								
Good control	tn of product		0.22	0.61				
Polystyrene bulk								
Good control	tn of product		0.04	0.11				
PVC –emulsion								
Untreated	tn of product		0.1	15.5				
Good control	tn of product		0.1	0.36				
PVC – suspension								
Good control	tn of product		0.36	0.99				
PVC – bulk								
Good control	tn of product		0.05	0.16				
Rayon								
Untreated	tn of product		44	N/A			Sulfide	3.5
							Zn	12
							Mg	2
							CS2	1.5
							H2SO	45
							SO4	540
Good control	tn of product		4.8	8.8				
Nylon (polyamide)								
6+66 resin / Untreated	tn of product		68	4				
6 resin / Good control	tn of product		3.7	2.5				
66 resin / Good control	tn of product		0.66	0.44				

26. The magor effluents are from the gypsum filter , as well as from the gypsum by – product (4.75tn of gypsum per tn of p205)from the phosphoric acid solution .

The washed gypsum can be can carried away as solid cake (with about 25%water) and dry-stacked on land as asolid waste.the remaining scrubber / condenser wastes can be recycled through acooling pond with an area of about 400 m 2 per daily tn of p205 production ,or through acooling tower . the latter reduces drastically the area requirements and is especially suited when fluoride is recovered from the off gas as hydro fluorosilicic acid . Alternatively,the washed gypsum can be slurried and ,mixed with scrubber / condenser waters ,can be discharged either directly into the sea, or into a gypsum pond .In the latter case , the settled gypsum is continuously worked with drag lines and transferred to near-by gypsum piles ,while the cooled water is recycled back to the process.Depending on the rain –this can be treated so as to have very low loads.

27. The pollutant load factors vary widely.

Model for liquid waste Inventories and Controls- Cont'd



PROCESS	UNIT (U)	WASTE VOLUME m ³ /U	BOD5	Tss	Tot N	Tot P	Other pollutants	
			(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	Name	(kg/U) pntr
6+66 fibers / Untreated	tn of product		30	3				
6 fibers/ Good control	tn of product		1.9	1.3				
66 fibers / Good control	tn of product		0.58	0.39				
Polyesters (e.g. Dacron)								
Untreated	tn of product		11.5	6				
Resin / Good control	tn of product		0.78	0.52				
Fibers / Good control	tn of product		0.78	0.52				
Resin + Fibers continuous								
Good control	tn of product		0.78	0.52				
Resin + Fibers batch								
Good control	tn of product		1.65	1.04				
ABS/SAN								
Untreated	tn of product		11.3	15			H2SO	22
							C2H3CN	2
Good control	tn of product		0.63	1.2				
Cellophane								
Untreated	tn of product		76.5	38				
Good control	tn of product		8.7.	16				
Cellulose acetate								
Untreated	tn of product		38	11				
Resin or Fibers								
Good control	tn of product		4.1	2.7				
Resin and Fibers								
Good control	tn of product		8.3	5.5				
Acrylic Resin								
Untreated	tn of product		25	1.1				
Good control	tn of product		2.75	1.1				
Epoxy resins								
Untreated	tn of product		70	14.5				
Batch & continuous	tn of product		2.1	1.4				
Batch fusion	tn of product		0.25	0.17				
Urea and melamine resins								
Good control	tn of product		0.2	0.13				
352 Manufacture of other chemical products								
3522 Manufacture of drugs and medicines								
Fermentation products	tn of product		2050	834	279	40	Oil	104
Biological & natural exaction								
Blood fractionation	tn of product		210	64	6	4	Oil	0.3
Vaccine production	tn of product		210	64	6	4	Oil	0.3
Chemical synthesis products	tn of product		270	27	54.5	7.4	Oil	4.5
Mixing ,compounding & Formulation	tn of product		8.3	1	0.2	0.14	Oil	0.4
Secondary biological treatment			0.1	0.4				
3523 Manufacture of soap cleaning preparations								
Soap production								
Soap from kettle boiling	tn product	4.5	6	4			Oil	0.9
Soap from fatty acids								
Fatty acids:								
Production	tn product	13.5 ²⁸	12	23			Oil	2.5
Hydrogenation	tn product		1.5	1			Oil	1
Neutralization	tn product		0.1	0.2			Oil	0.05
Glycerine concentration								
(1st step)	tn product		15	2			Oil	1
Glycerine distillation								
(2 nd step)	tn product		5	2			Oil	1
Soap processing								
Soap flakes and powders	tn product		0.1	0.1			Oil	0.1
Bar Soaps	tn product		3.4	5.8			Oil	0.4

28- The listed factor accounts also for the waste volumes from the fattyb acids hydrogenation and neuylralization.

Model for liquid waste Inventories and Controls- Cont'd

PROCESS	UNIT	WASTE	BOD5	Tss	Tot N	Tot P	Other pollutants
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34. Integrated Refineries are most complex type of refinery comprising all major operations, including cracking , lub oil petrochemicals production units.



	(U)	VOLUME m³/U	(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	Name	(kg/U) pntr
Trickling filter			0.3	0.25			Oil Phenol Sulfide	0.04 0.1 0.1
Aerated lagoon			0.3	0.8			Oil Phenol Sulfide	0.04 0.1 0.04
Oxisation pond			0.4	0.55			Oil Phenol Sulfide	0.04 0.1 0.2
Tertiary treatment			0.03	0.0			Oil	0.0
354 Manufacture of Miscellaneous products of petroleum and coal								
Building felt and tarpaper	tn of product	50	8	40				
Coke plant								
Untreated	tn of coke	14.7	3.9		3.5		Phenol CN Thioc/ te	0.28 0.61 2.1
Old plants	tn of coke	9.9	0.7		3.5		Phenol CN Thioc/ te	0.28 0.03 0.13
Basae level treatment ³⁵	tn of coke	9.9	0.3		3.5		Phenol CN Thioc/ te	0.54 0.15 0.06
Biological treatment	tn of coke	1.6	0.3		3.5		Phenol CN Thioc/ te	0.07 0.02 0.08
355 Manufacture of Rubber products								
355 tire and tube industries	tn of product	37	0.4	1			oil	0.12
DIVISION 36. MANUFACTURE OF NONMETLLI MINERAL PRODUCTS EXCEPT PRODUCTS OF AND								
362 Manufacture of Glass and Glass products								
Plate glass								
Untreated	tn of product	45.9	2.3	690				
Chemical sedimentation	tn of product	45.9		2.76				
2ary sediment 'n+ filtr'n	tn of product			.045				
Float glass								
Untreated	tn of product	.14	.001	.002			Oil	.001
Chemical sedimentation	tn of product	0.14		.001			Oil	.001
2ary sediment 'n+ filtr'n	tn of product	0.14		.001			Oil	.001
Windshield glass								
Untreated	1000m²of glass	4.9	0.73	4.90			Oil	0.64
Chemical sedimentation	1000m²of glass	4.9		1.95			Oil	0.64
2ary sediment 'n+ filtr'n	tn of product	4.9		0.24			Oil	0.49
Sheet glass		Only cooling waters						
Rolled glass		Only cooling waters						
DIVISION 37. BASIC METAL INDUSTRIES								
371Iron and steel Basic Industries								
Iron and steel mills								
Blast furnace (scrubber waster)								
Untreated	tn of product	12.3		29.3	0.27		Phenol F Cn	0.01 0.23 .039
sedimentation	tn of product	12.3		1.5	0.27		Phenol F Cn	0.01 0.23 .039
Chemical coagulation	tn of product	12.3		.13	.018		Phenol F Cn	0.01 0.23 .0001
Recycling 15% blowdown & alikine chloination	tn of product	0.55		.006	.001		Phenol F Cn	0.0 0.005 0.0
Basic oxygen furnace								
Precipitator / quencher								
Untreated	tn of product	0.6		.049				
Floc ' tion / sedim'tion	tn of product	0.6		.011				
Venture / quencher								
Untreated	tn of product	1.9		.146				
Floc ' tion / sedim'tion	tn of product	1.9		.034				
Off – gas system								
Untreated	tn of product	0.5		.036				
Floc ' tion / sedim'tion	tn of product	0.5		.009				

35. The base level treatment comprises the use of free and fixed stills, dephenolizers. And recirculated final coolers with cooling tower blowdown.



PROCESS	UNIT (U)	WASTE VOLUME m³/U	BOD5	Tss	Tot N	Tot P	Other pollutants	
			(kg/U) pnt	(kg/U) pnt	(kg/U) pnt	(kg/U) pnt	Name	(kg/U) pnt
Electric arc furnace Venture / quencher								
Untreated	tn of product	4.6		0.36				
Floc 'tion / sedim'tion	tn of product	4.6		0.09				
Open hearth furnace Venture / quencher								
Untreated	tn of product	3.5		0.27				
Floc 'tion / sedim'tion	tn of product	3.5		.065				
Hot – rolling mills								
Untreated	tn of product	42		33.9			Oil	1.87
Scale pits	tn of product	42		10.8			Oil	1.87
Deep bed filters	tn of product	42		0.76			Oil	0.25
Settling &ww recycling	tn of product	2.3		0.04			Oil	.015
Cold rolling								
Untreated	tn of product	6.7		2.2			Oil	2.05
H2SO4 pickling								
Carbon steel	tn of product	1.8					Fe SO4	6.4 22.1
Stainless steel	tn of product	1.4					Fe SO4	2.6 9.1
Alloys	tn of product	1.2					Fe SO4	2.6 9.8
Hcl pickling								
Carbon steel	tn of product	1.2					Fe Cl	18.4 24.8
Stainless steel	tn of product	1.6					Fe Cl	57.8 76.2
Alloys	tn of product	1.1					Fe Cl	33.7 44.5
Galvanize								
Untreated								
Hot dip	tn of product	9.4		2.32		0.02	Fe Zn Cr	0.19 007. .015
Electrogranizing	tn of product	6.9		N/A			Zn	405.
Treated	tn of product			.125			Oil Fe Zn Cr	0.06 007. 009. .004
372 Non – Ferrous metal Basic Industries								
Primary Aluminum production								
Alumina from bauxite ^{36,37}	tn of Alumina			2.4				
	tn of Alumina			4.5				
Aluminum from Alumina								
Anode pre-baking	tn of product			5.0				
Reduction cells	tn of product		2.0	14.5	0.04			
Secondary Aluminum								
Smelting	tn of product	0.008		1.5				
Casting and Foundry	tn of product	0.02						
Primary lead								
Untreated	tn of product			350				
Primary zing								
Untreated	tn of product			0.9				
381 manufacture of fabricated metal products , Except machinery & Equipment								
Electroplating ^{38,39}								
Degreasing baths	1000m²						Oil	5
Pickling baths								
steel	1000m²						Fe cl-	25 0.12
Brass	1000m²						Cu Zn	23 15

36.from 1.4 to 3.3 tons of Bauxite Ore processed , 1.0 ton alumina is produced the latter yields 526 kg of Aluminum .

37.Red mud 675 kg /tn of alumina . may be discharged as suspended solids if they are not removed from the effluents .

36. the base treatment comprises neutralization and segregated chemical treatment of organic and chromium vl .

37. the stage I treatment comprises recycling f cooling water , multi – tank rinsing , reclamation of drag – out , neutralization , and segregated chemical treatment of organic and chromium vl .

Model for liquid waste Inventories and Controls- Cont'd

PROCESS	UNIT	WASTE	BOD5	Tss	Tot N	Tot P	Other pollutants
---------	------	-------	------	-----	-------	-------	------------------



	(U)	VOLUME m ³ /U	(kg/U)	(kg/U)	(kg/U)	(kg/U)	Name	(kg/U) pntr
			pntr	pntr	pntr	pntr		
Alkaline pickling for Al	1000m ²						Al Na OH	55 430
Nickel bright	1000m ²						Ni So4	25 33
Base treatment							Ni	0.06
Stage I treatment							Ni	0.009
Chromium ornamental	1000m ³						Cr ⁶	37
Base treatment							Cr ⁶	0.06
Stage I treatment							Cr ⁶	0.009
Zinc bright								
Cyanide bath	1000m ³						Oil Zn Cn NaOH	0.5 6.9 15 50
Non- Cyanide bath	1000m ³						Oil Zn NaOH	0.5 3 47
Acid bath	1000m ²				0.7		Oil Zn	0.5 8.0
Base treatment							Zn NaOH	0.02 0.0
Stage I treatment							Zn NaOH	0.003 0.0
Copper								
Cyanide bath	1000m ³						Oil Cu Cn	2 10 20
Acid bath	1000m ³						Cu So4	12 75
Pyrophosphate bath	1000m ²						Cu	4.5
Base treatment							Cu	0.03
Stage I treatment							Cu Cn	0.004 0.002
Cadmium								
Cyanide bath	1000m ³						Cd Cn NaOH	4 10 6
Base treatment							Cd	0.02
Stage I treatment							Cd Cn	0.002 0.002
Silver	1000m ²						Ag Cn	7 10
Stage I treatment							Ag Cn	0.001 0.002
Tip								
Alkaling bath	1000m ²						Sn Naoh	4 4
Bright acid bath	1000m ³						Sn	5
Tin flucroborate bath	1000m ³						Sn F / borate	16 50
Stage I treatment							Sn naOH	0.01 0.0
Lead flucroborate bath	1000m ²						Oil Pb F / borate	1 21 48
Stage I treatment							Pb	0.004
Gold								
Ornamental	1000m ²						Au Cn	0.3 0.4
Technical	1000m ²						Au Cn	2.5 1.4
Stage I treatment							Au Cn	0.01 0.002
Brass Cyanide bath	1000m ³						Zn Cn	3.2 1.2
Base treatment							Zn	0.02
Stage I treatment							Zn Cn	0.003 0.002
Lead – tin								
Flucroborate bath	1000m ³						Oil Pb Sn F / borate	1 3.5 7 55
Stage I treatment							Pb Zn	0.022 0.022

Model for liquid waste Inventories and Controls- Cont'd

PROCESS	UNIT (U)	WASTE	BOD5	Tss	Tot N	Tot P	Other pollutants
---------	-------------	-------	------	-----	-------	-------	------------------



		VOLUME m³/U	(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	(kg/U) pntr	Name	(kg/U) pntr
Electroless metal bath								
Nickel bath	1000m²						Oil Ni Phosph	4 1.1 4
Copper bath	1000m²						Oil Cu	15 1.6
Anodizing sulfuric bath	1000m²						Al So4	7.5 235
Phosphating baths								
Zinc Phosphating	1000m²						Zn Fe Phosph	3 1.8 12
Iron Phosphating	1000m²						Oil Phosph	5 4
Chromating bath								
For aluminum	1000m²						Cr F	0.8 0.4
For Zinc(yellow passivating bath)	1000m²						Cr Zn	1.4 0.3
For Zinc (blue passivating bath)	1000m²						Cr Zn F	3.3 16 7.5
MAJOR DIVISION 4. ELECTRICITY GAS AND WATER								
410 Electricity Gas and steam								
4101 Steam turbines	GWH		2.2	286		0.05	Oil Cr Cu Ni Zn	047. 006. 005. 047. .012
4102 Manufacture of city Gas by Coke Ovens	Use effluent model for Coke , See SIC 3540							
MAJOR DIVISION 6. WHOLESALE & RETAIL TRADE & HOTELS & RESTAURANTS								
620 Retail Trade								
Shopping centers	employee*yr	21.9	7.3					
631 Restaurants , Cafes , and Other Eating & Drinking								
Restaurants	employee*yr	7.3	3.7					
632 Hotels , Rooming Houses , Comps and other lodging								
Motels with restaurant	Bed*yr	.70	21.9					
Compgrounds	(Trailer site)*yr	.70	21.9					
	Trailer*yr	108	58.4					
Camps								
No meals served	Person*yr	22	7.3					
Luxury	Person*yr	140	36.					
Dwellings (seasonal occup)	Person*yr	70	21.9					
parks	Person*yr	7.3	3.7					
MAJOR DIVISION 7. TRANSPORT, STORAGE AND COMMUNICATION								
713 Air Transport								
Airports	Passenger*yr	7.3	3.7					
MAJOR DIVISION 9. COMMUNITY, SOCIAL AND PERSONAL SERVICES								
920 sanitary and similar services								
9200 community , social and personal services								
Population served by								
Sewers ⁴⁰	Person*yr	55	18.1	39.2	3.3	0.93	oil	7.3
Septic tanks ⁴¹	Person*yr	7.3	6.9	16				
Primary sedimentation			0.67	0.4	0.925	0.90		
Chemical coagulation			0.25	0.15	0.75	0.15		
High rate trickling filter			0.25	0.21			Bacteria	0.12
Low rate trickling filter			.075	0.19			Bacteria	0.12

40. the waste volume and loads exhibit the following typical ranges :

Waste volume: 30. to 110. m³/ capita/yr,
 BOD5: 16.4 to 19.7 m³/ capita/yr
 TSS: 25.5 to 53 m³/ capita/yr
 Total N: 2.2 to 4.4 m³/ capita/yr
 Total P: 0.22 to 1.64 m³/ capita/yr
 Oil: 3.6 to 11. m³/ capita/yr .For additional parameters see Table 4.2.2-141.

41. When septage is treated along with domestic wastes, the proportions should be kept low enough so as not to affect the operation of the treatment plant, other wise pre-aeration may be required to avert anoxic conditions

Model for liquid waste Inventories and Controls- Cont'd

PROCESS	UNIT (U)	WASTE VOLUME m ³ /U	BOD5	Tss	Tot N	Tot P	Other pollutants	
			(kg/U)	(kg/U)	(kg/U)	(kg/U) pntr	Name	(kg/U) pntr

			pntr	pntr	pntr			
Activated sludge / conventional			0.1	0.12	0.65	0.62	Bacteria	0.25
Activated sludge / Extended aeration			.035	0.12	0.77	0.85	Bacteria	0.25
Waste stabilization ponds			0.2	0.15	0.55	0.60	Bacteria	0.10
Biological treatment & chemical coagulation			0.06	0.13	0.86	-0.06		
931 Education services								
Schools								
No boarding	Student*yr	27	7.3					
Boarding	Student*yr	139	29.2					
940 Recreational and cultural services								
Theaters								
Drive -in	Stall*yr	7.3	3.7					
Indoor	Seat*yr	7.3	3.7					
Swimming pools	Swimmer*yr	14.6	3.7					

Appendix -A-
Industrial
Activities
Classification

Table (A-1): List Of Activates Included in the Air, Water, And Solid Waste Inventory and Control Models, Classified under the SIC System, UN (1989). (Economopoulos; 1993).

	Emission ^a	Effluents ^a	Solid Wastes ^a
0 Activities not Adequately Defined			
Consumer Solvent Use	#		
Surface Coating	#		
1 Agricultural, Hunting, Forestry & Fishing			
11 Agricultural & Hunting			
111 Agricultural & Livestock Production	#	#	#
12 Forestry & Logging			
121 Forestry	#		
2 Mining & Quarrying			
21 Coal Mining	#		#
22 Crude Petroleum & Natural Gas Prod.	#		
23 Metal Ore Mining	#		#
29 Other Mining	#		#
3 Manufacturing			
31 Manufacture of Food, Beverages & Tobacco			
311/2 Food Manufacturing			
3111 Slaughtering, preparing & Preserving Meat	#	#	#
3112 Manufacture of dairy Products		#	#
3113 Canning & preserving fruits & vegetables		#	#
3114 Canning, preserving & Processing of fish	#	#	#
3115 Manufacture of vegetable &		#	

animal Oils & Fats			
3116 Grain mill products	#	#	
3117 Bakery products		#	
3118 Sugar factories & refineries		#	#
3121 Food products not elsewhere Classified	#	#	
3122 Alfalfa dehydrating	#		
313 Beverage Industries			#
3131 Distilling, rectifying & Blending Spirits		#	
3132 Wine industries		#	
3133 Malt liquors & malt	#	#	
3134 Soft drinks		#	
32 Textile, Wearing Apparel & Leather			
321 Manufacture of Textiles			
3210 Manufacture of Textiles		#	
322 Manufacture of Wearing Apparel, Except Footwear			
3211 Spinning, weaving & finishing Textiles	#		#
3214 Carpet & rug manufacture			#
323 Manufacture of Leather & Products of Leather			
3231 Tanneries & leather finishing		#	#
33 Manufacture of Wood & Products Including Furniture			
331 Manufacture of Wood & Products Except Furniture	#	#	
34 Paper & Paper Products, Printing & Publishing			
341 Manufacture of Paper & paper Products	#	#	#

342 Printing, Publishing & Allied Industries	#		#
35 Manufacture of Chemicals, Chemical Petroleum, Coal, Rubber & Plastic			
351 Manufacture of Industrial Chemicals			
3511 Basic industrial chemicals except Fertilizer	#	#	#
3512 Manufacture of fertilizers & pesticides		#	
3513 Resins, plastics & fibers except Glass		#	
352 Manufacture of Other Chemical Products			
3521 Manufacture of paints, varnishes & Lacquers	#		
3522 Manufacture of drugs & medicines		#	
3523 Manufacture of soap & Cleaning Preparations	#	#	
3529 Chemicals products not Classified	#		
353 Petroleum Refineries	#	#	#
354 Manufacture of Misc. Products of Petroleum & Coal	#	#	#
355 Manufacture of Rubber Products			
3551 Tyre & tube industries		#	#
36 Manufacture of Non-metallic Mineral, Except Products of Petroleum & Coke			
361 Manufacture of Pottery, China & Earthenware			

362 Manufacture of Glass & Glass Products	#	#	
369 Manufacture of Non-metallic Mineral Products			
3691 Manufacture of structural clay Products	#		
3692 Cement, lime & plaster	#		
3699 Products not elsewhere classifies	#		
37 Basic Metal Industries			
371 Iron & Steel Basic Industries	#	#	#
372 Non-ferrous Metal basic Industries	#	#	#
38 Fabricated Metal Products, Machinery & Equipments			
381 Fabricated Metal Products, Except Machinery		#	#
384 Manufacture of Transport Equipment			
3841 Ship building & repairing			#
4 Electricity Gas & Water			
41 Electricity, Gas & Steam			
4101 Electricity light & power	#		#
6 Wholesale & Retail Trade			
61 Wholesale Trade	#		
62 Retail Trade	#	#	
63 Restaurants & Hotels			
631 Restaurants, Cafes & Other Eating & Drinking		#	
632 Hotels, Rooming Houses, Camps & Other Lodging		#	
7 Transport, Storage & Communication			

71 Transport & Storage			
711 Land Transport	#		
712 Water Transport	#		
713 Air Transport	#	#	
719 Services Allied to Transport			
7192 Storage & Warehousing	#		#
9 Community, Social & Personal Services			
92 Sanitary & Similar Services	#	#	#
93 Social & Related Community Service			
931 Education Services		#	
932 Medical, Dental & Other Health Services			
94 Recreational & Cultural Services		#	
95 Personal & Household Services			
952 Laundries, Laundry Services & Cleaning	#		

^a An asterisk in the column below indicates that the relevant industry or process is included in the appropriate air, water, or solid waste inventory and control models of appendix C, & D respectively .

Appendix -D-
Iraqi Effluent
Standards

Table (D.1): Iraqi Effluent Standards. ^[60]

Pollutant	A	B
Temperature(C)	<35	45
SS	60	750
pH	6.0-9.5	6.0-9.5
BOD ₅	<40	<1000
COD (using Cr ₂ O ₇ method)	<100	---
Cyanide (CN ⁻)	0.05	0.5
Flouride(F ⁻)	5.0	10.0
Free chloride	Trace	100
Chloride (Cl ⁻)	<600	---
Phenol	0.01-0.05	5.0-10.0
Sulfates(SO ⁻²)	<300	---
Nitrates(NO ⁻²)	50	---
Phosphates(PO ⁻²)	3.0	---
DDt	Nil	---
Pb	0.1	0.1
Arsenic	0.05	---
Cu	0.2	---
Ni	0.2	0.1
Selenium (Se)	0.05	---
Hg	0.005	0.001
Cd	0.1	0.1
Zn	2.0	0.1
Cr	0.1	0.1
Al	5.0	20.0
Barium(Ba)	4.0	0.1
Boron	1.0	1.0
Cobalt(Co)	0.5	0.5
Fe	2.0	15.0
Mn	0.5	---
Ag	0.05	0.1
Hydrocarbons(HC)	10.0	---
A: River& their tributaries, B: Stream, channel &their branches		
All concentration are in mg/l		



Appendix -E-
WHO
Guidelines
and
Standards

Table (E.1): Revised WHO Air Quality Guidelines For Europe. ^[47]

Substance	Guideline value	Unit	Average time
Classical Air Pollutants			
Carbon monoxide	100	mg/m ³	15 min
	60	mg/m ³	30 min
	30	mg/m ³	1 hour
	10	mg/m ³	8 hour
Ozone	120	µg/m ³	8 hour
Nitrogen dioxide	200	µg/m ³	1 hour
	150	µg/m ³	24 hour
	40	µg/m ³	Annual
Sulfur dioxide	500	µg/m ³	10 min
	125	µg/m ³	24 hour
	50	µg/m ³	annual
Particulate matter	120	µg/m ³	24 hour
Indoor Air			
MMVF(RCF)	1*10 ⁻⁶	(fiber/liter) ⁻¹	UR/lifetime
Radon	(3-6)* 10 ⁻⁵	/Bq/m ³	UR/lifetime
ETS	No guideline		
Organic Pollutants			
Benzene	6*10 ⁻⁶	(µg/m ³) ⁻¹	UR/lifetime
1,3 Butadiene	No guideline		
Dichloromethane	3	mg/m ³	24 hour
Formaldehyde	0.1	mg/m ³	30 min
PAH(BAP)	8.7* 10 ⁻⁵	(mg/m ³) ⁻¹	UR/lifetime
Styrene	0.26	mg/m ³	1 week
Tetrachloroethylene	0.25	mg/m ³	annual
Toluene	0.26	mg/m ³	1 week
Trichloroethylene	4.3*10 ⁻⁷	(µg/m ³) ⁻¹	UR/lifetime
PCBs, PCDDs, PCDFs	No guideline		

Inorganic Pollutants			
Arsenic	1.5×10^{-3}	$(\mu\text{g}/\text{m}^3)^{-1}$	UR/lifetime
Cadmium	5	mg/m^3	Annual
Chromium(Cr^{+6})	4×10^{-2}	$(\mu\text{g}/\text{m}^3)^{-1}$	UR/lifetime
Fluoride	No guideline		
Lead	0.5	$\mu\text{g}/\text{m}^3$	Annual
Manganese	0.15	$\mu\text{g}/\text{m}^3$	Annual
Mercury	1.0	$\mu\text{g}/\text{m}^3$	Annual
Nickel	3.8×10^{-4}	$(\mu\text{g}/\text{m}^3)^{-1}$	UR/lifetime
Platinum	No guideline		
Ecotoxic Effects			
SO critical level	10 – 30 ^{a)}	$\mu\text{g}/\text{m}^3$	Annual
critical load	250 – 1500 ^{b)}	eq/ha/yr	
NO critical level	30	$\mu\text{g}/\text{m}^3$	Annual
critical load	5 – 35 ^{b)}	KgN/ha/yr	
ozone critical level	0.2 – 10 ^{a, c)}	Ppm.h	5 days to 6 months

a) depending on type of vegetation

b) depending on type of soil and ecosystem

c) AOT: Accumulate exposure over threshold of 40 ppb.

UR is the excess risk of dying from cancer following lifetime exposure. This means for instance that for benzene 6 person in population of 1 million will die when they are exposure for their lifetime to a concentration of $1 \text{ mg}/\text{m}^3$, for PAHs the unit risk tells you that 87 person in population of 1 million will die from cancer following lifetime exposure to $1 \text{ mg}/\text{m}^3$.

Appendix -F-
Forms of the
Surveying
Data Sheet

استمارة المعلومات العامة

- اسم النشاط: {
- نوع النشاط: حكومي
- خاص
- مختلط
- اسم صاحب النشاط: {
- نوع الإنتاج: {
- موقع النشاط: محافظة {
- مدينة {
- قضاء أو ناحية {
- النشاط يقع ضمن: منطقة سكنية {
- منطقة صناعية {
- منطقة تجارية {
- منطقة زراعية {
- بعد اقرب وحدة سكنية عن النشاط: { كم
- رقم الترميز في الأمم المتحدة: {
- تاريخ الإنشاء: {
- الطاقة الإنتاجية التصميمية للمعمل: { تذكر الوحدات
- الطاقة الإنتاجية الحالية للمعمل: { تذكر الوحدات
- هل هناك نية زيادة في الطاقة الإنتاجية للمعمل ؟ نعم لا
- تذكر الطاقة الإنتاجية المقترحة: {

☐
☐

■ المواد الأولية الداخلة في الإنتاج غير الماء والوقود :

المصدر		الكمية (وحدة وزن أو حجم /اليوم)	المادة الأولية	التسلسل
حاليا	سابقا			

- المواد المضافة في الإنتاج (أحماض، قواعد، مواد كيميائية، أصباغ وغيرها): {
- (وحدة وزن أو حجم /اليوم)
- مرتسم على شكل مربعات واسهم لتوضيح تفاصيل العملية الإنتاجية :

■ الإنتاج : يصدر
يسوق داخل القطر

- عدد وجبات العمل في اليوم : {
- عدد ساعات العمل في الوجبة : {
- عدد العاملين في النشاط : {

استمارة الملوثات السائلة

- كمية المخلفات السائلة: { (م³/اليوم) }
- اسم المصدر الذي يأخذ منه النشاط المياه: مياه إسالة

☐ نهر
☐ غير ها
☐ (م³/اليوم)

☐ بئر
☐
- كمية المياه المستخدمة في الصناعة: { (م³/اليوم) }
- هل هناك محطة لمعالجة المياه المتخلفة من الصناعة؟ نعم
وحدات محطة المعالجة: {
☐ ☐ {
تاريخ التشغيل: {
☐ ☐
- خصائص المياه الداخلة والخارجة من محطة المعالجة (تذكر نتائج فحص المياه برفقة هذه الاستمارة): {
هل هناك فحوصات لمياه المخلفات قبل التصريف؟ نعم
(تدرج الفحوصات ونوعها): {
الفحوصات تتم: يدويا ميكانيكيا
بصورة متقطعة بصورة مستمرة
☐ ☐
- نوع الفحوصات: BOD ☐
COD ☐
Heavy Metal ☐
أخرى تذكر ☐
من المسؤول عن عملية الفحص؟ { ☐ ☐
- الموقع النهائي لرمي المخلفات: ارض زراعية ☐
إلى بئر ☐
إلى نهر ☐
إلى مبزل ☐
ارض متروكة شبكة مجاري ☐

☐
☐
☐
☐
☐
☐

استمارة ملوثات الهواء

- نوع الوقود المستعمل في الصناعة: نفط اسود ☐ نفط ابيض ☐ أخرى تذكر ☐ {
- كمية الوقود المستخدم: { (تذكر الوحدات)
- المراحل الإنتاجية التي تتبع منها ملوثات الهواء: {
- ملوثات الهواء غازات أبخرة دقائق عالقة
- هل هناك أجهزة لمراقبة ملوثات الهواء ؟ نعم ☐ لا ☐
- تاريخ صناعة الأجهزة: { ☐ كفاءتها { ☐ مدة التشغيل { ☐ {
- هل هناك صيانة لتلك الأجهزة ؟ نعم ☐ لا ☐
- هل هناك أجهزة (وسائل سيطرة) لتقليل الملوثات المنبعثة ؟ نعم ☐ لا ☐
- نوع وسائل السيطرة: مرسبات غبار ☐ فلاتر بأنواعها ☐
- سايكلون ☐ غسالات الغاز ☐ ☐
- العدد: { الكفاءة: { ☐ التشغيل: { ☐ {
- هل هناك محرقة ؟ نعم ☐ لا ☐
- نوعها: { العدد: { الكفاءة: { ☐ {
- نوع الوقود المستعمل: { كمية الوقود المستعملة: {
- تاريخ التشغيل: { ☐ السعة: { ☐ {
- عدد المداخل: { القطر الداخلي: { م القطر الخارجي: { م الارتفاع: { م
- مادة البناء: { اتجاه الرياح السائدة: {
- هل هناك انبعاث لروائح غير مرغوبة؟ نعم ☐ لا ☐
- هل هناك غيوم كثيفة سوداء ؟ نعم ☐ لا ☐

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الموقع			اسم النشاط	الخصائص الأنشطة الصناعية
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