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Studying the effect of irregular crumbling from recycled polymeric materials on selected characteristics of the extrusion process

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ABSTRACT

This work deals with the study of the effect of the irregular crumbling (instability of cutting) for recycled polyethylene terephthalate (PET) bottles on the extrusion process using a twin-screw extruder and as a result its effect on the mechanical properties of the product and the amount of electrical energy consumption. The extrusion process was performed for cutting sizes of PET bottles (4.75, 6.75, 7.15, and 10 mm) in addition to raw material to compare, at temperature ranges between (200–205 °C) at speed of 50 rpm. Results showed that the cutting size has a direct effect on the crystallinity which affects mechanical and thermal properties, such as elongation and tensile strength decreases with increase cutting size but the elastic modulus increase with increase cutting size. The impact and hardness test proved that the impact strength and hardness decrease with increase cutting size, also, it was observed during the extrusion process when placing an equal amount of different sizes in the machine and ensure that the materials enter the machine at once for the sake of comparison, we find that the lower volumes consumed less electrical energy, compared to the rest of the other different sizes, except the raw material from (PET).

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1. Introduction

Polymer (plastic) waste is detrimental to the environment and disposal of this waste is a big problem that can be accomplished by recycling. Current waste plastics disposal methods, particularly as landfills, have produced significant environmental problems that endanger human health [1,2]. A cause of concern was pollution resulting from the accumulation of polymer (plastic) waste, especially in the waterways. Plastic waste is also used as a landfill and it occupies a large area on the earth. It also possible to obtain energy through the recycling process. Since polymer goods are based on petroleum, the increasing price of petroleum as a raw substance for polymer manufacturing may make the recycling of polymer waste a sustainable and profitable enterprise. Six specific phases include the handling of waste polymer for recycling; this involves the collection, sorting, cleaning, cutting, granulation, and forming of the polymer. Research efforts have been made in recent years to mechanize the other steps of the recycling process. Considerable attention was given to the various steps of the recycling process. The sorting method is the sorting of the polymer waste according to its kinds [3–5].

The crumbling appears (cutting) to be the researchers' major focus [6]. The required packaging of shredder waste polymer for foreign trade should promote stand-alone shredding operations to waste plastic management. Polymer shredding is the method of decreasing the waste polymer to small pieces for further handling. Therefore, it is not possible to over-emphasize the improvement of shredding machines for plastic waste management [7]. Improved a polymeric waste shredder. The slicing unit of the device includes the fixed and moving blades arranged regularly into the crumbling machine. As the design of the crumbling machine consists of a conveyor belt to operate the shaft of the rotary blade. The crumbling machine contains cutting blades organized in the manner of auger screws. The crumbling machine was noted to work more than 90% operating performance [8]. Stressed that improving the geometry of the slicer blades will increase the efficiency of the crumbling machine, as discussed in the research, the two edges for the cutting blade were noted to perform efficiently with decreased

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