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MECHANICAL CHARACTERIZATION OF POLYPROPYLENE REINFORCED WITH WASTE HAZELNUT SHELL

Hazelnut is the fruit of the common hazel (Coryllus avellana L.) bushes. The biggest producers worldwide are Turkey, representing 72% of overall production in 2020/2021, USA, Azerbaijan and Italy [1].

The nut industry produces a large number of by-products. Hazelnut shells, in our region, are only used for combustion. In this regard, one of the highest priority tasks in the field of materials science is the use of hazelnut shell waste as a potential low-cost reinforcing filler for composite materials [2]. In the present study, the possibility of developing a composite based on polypropylene reinforced with hazelnut shell powder and conducting its mechanical characteristics is investigated.

In the present investigation, polypropylene (PP) supplied by SOCAR Polymer LLC (Sumgayit, Azerbaijan) is used as the polymer matrix material. Hazelnut shell (HS) powder was provided by Azhazelnut LLC (Gusarchay, Khachmaz region, Azerbaijan). The chemical composition of the hazelnut shell consists of lignin (30.2%), cellulose (28.9%), hemicellulose (11.3%), tannins (18.2%) and proteins (6.7%).

It can be observed from Figure 1 that average particle size of walnut shell powder is around 98-280 μm. The concentration of hazelnut shells in the composites varied from 1 to 20 wt.%.

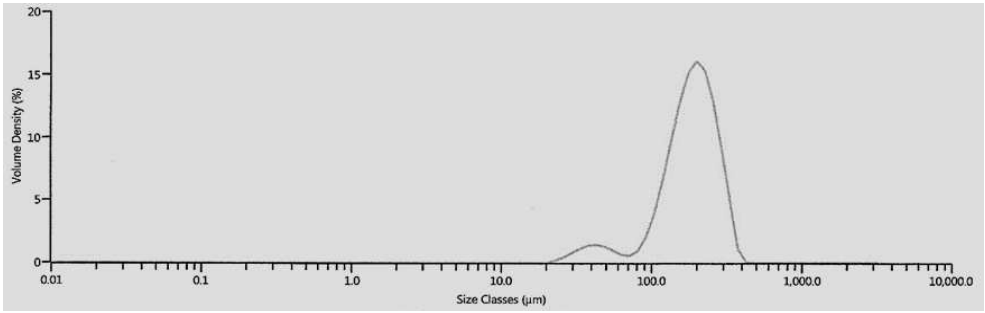

Figure 1 – Particle size distribution of hazelnut shell powder.

The schematic representation of preparation of polymer composite samples based on PP and hazelnut shells is shown in Figure 2. The effect of the concentration of this filler on the mechanical properties of polypropylene is being studied by conducting various characterization tests under controlled laboratory conditions. A study was made of the change in tensile strength of PP-HS composites with different filler content. It can be

said that with the loading of filler particles to polymer matrix, the composite gradually weakens when stretched [3].

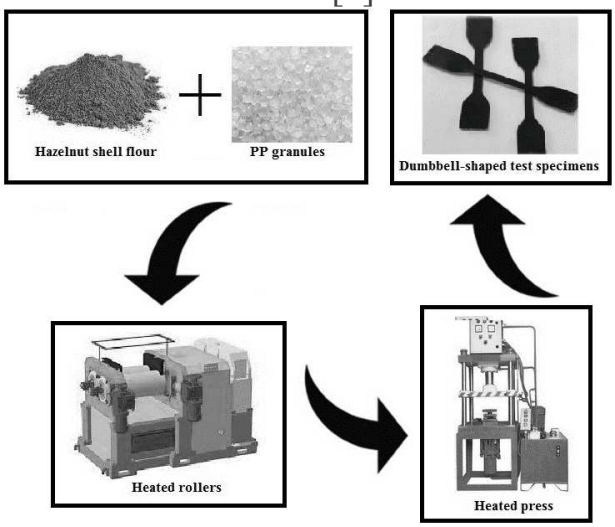

Figure 2 – Schematic representation of HS+PP composite samples preparation

The test results showed that as the filler content in the composite was increased to 10 wt.%, a decrease in the tensile strength was observed. And at 15 wt.% filler loading, a noticeable improvement in tensile strength of the samples by 5% was observed. At 20 wt.% filler loading, the value of this indicator again decreased. HS caused a reduction in elongation at break of the polymer matrix. This is due to the absence of a strong interaction between HS and the matrix, which indicates poor adhesion at the particle-polymer interface [2].

The investigation results showed that presence of natural filler particles in the composite had a noticeable effect on the mechanical properties of the polymer composite materials based on PP+HS. In summary, the results of this study demonstrate that the fabrication of PP-based composites using HS represents potential for its practical use in several industrial applications.

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