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Development and Characterization of Expandable TPEs Compounds for Footwear Applications

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Abstract : Elastomeric thermoplastics (TPEs) have been widely used in the footwear industry over the years. Recently this industry has been requesting materials that can combine lightweight and high abrasion resistance. Although there are blowing agents on the market to improve the lightweight, when these are incorporated into molten polymers during the extrusion or injection molding, it is necessary to have some specific processing conditions (e.g. effect of temperature and hydrodynamic stresses) to obtain good properties and acceptable surface appearance on the final products. Therefore, it is a great advantage for the compounder industry to acquire compounds that already include the blowing agents. In this way, they can be handled and processed under the same conditions as a conventional raw material. In this work, the expandable TPEs compounds, namely a TPU and a SEBS, with the incorporation of blowing agents, have been developed through a co-rotating modular twin-screw parallel extruder. Different blowing agents such as thermo-expandable microspheres and an azodicarbonamide were selected and different screw configurations and temperature profiles were evaluated since these parameters have a particular influence on the expansion inhibition of the blowing agents. Furthermore, percentages of incorporation were varied in order to investigate their influence on the final product properties. After the extrusion of these compounds, expansion was tested by the injection process. The mechanical and physical properties were characterized by different analytical methods like tensile, flexural and abrasive tests, determination of hardness and density measurement. Also, scanning electron microscopy (SEM) was performed. It was observed that it is possible to incorporate the blowing agents on the TPEs without their expansion on the extrusion process. Only with reprocessing (injection molding) did the expansion of the agents occur. These results are corroborated by SEM micrographs, which show a good distribution of blowing agents in the polymeric matrices. The other experimental results showed a good mechanical performance and its density decrease (30% for SEBS and 35% for TPU). This study suggested that it is possible to develop optimized compounds for footwear applications (e.g., sole shoes), which only will be able to expand during the injection process.

Keywords : blowing agents, expandable thermoplastic elastomeric compounds, low density, footwear applications
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