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Antimicrobial Properties of SEBS Compounds with Zinc Oxide and Zinc Ions

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Abstract : The increasing demand of thermoplastic elastomers is related to the wide range of applications, such as automotive, footwear, wire and cable industries, adhesives and medical devices, cell phones, sporting goods, toys and others. These materials are susceptible to microbial attack. Moisture and organic matter present in some areas (such as shower area and sink), provide favorable conditions for microbial proliferation, which contributes to the spread of diseases and reduces the product life cycle. Compounds based on SEBS copolymers, poly(styrene-b-(ethylene-co-butylene)-b-styrene, are a class of thermoplastic elastomers (TPE), fully recyclable and largely used in domestic appliances like bath mats and tooth brushes (soft touch). Zinc oxide and zinc ions loaded in personal and home care products have become common in the last years due to its biocidal effect. In that sense, the aim of this study was to evaluate the effect of zinc as antimicrobial agent in compounds based on SEBS/polypropylene/oil/ calcite for use as refrigerator seals (gaskets), bath mats and sink squeegee. Two zinc oxides from different suppliers (ZnO-Pe and ZnO-WR) and one masterbatch of zinc ions (M-Zn-ion) were used in proportions of 0%, 1%, 3% and 5%. The compounds were prepared using a co-rotating double screw extruder (L/D ratio of 40/1 and 16 mm screw diameter). The extrusion parameters were kept constant for all materials. Tests specimens were prepared using the injection molding machine. A compound with no antimicrobial additive (standard) was also tested. Compounds were characterized by physical (density), mechanical (hardness and tensile properties) and rheological properties (melt flow rate - MFR). The Japan Industrial Standard (JIS) Z 2801:2010 was applied to evaluate antibacterial properties against Staphylococcus aureus (S. aureus) and Escherichia coli (E. coli). The Brazilian Association of Technical Standards (ABNT) NBR 15275:2014 were used to evaluate antifungal properties against Aspergillus niger (A. niger), Aureobasidium pullulans (A. pullulans), Candida albicans (C. albicans), and Penicillium chrysogenum (P. chrysogenum). The microbiological assay showed a reduction over 42% in E. coli and over 49% in S. aureus population. The tests with fungi showed inconclusive results because the sample without zinc also demonstrated an inhibition of fungal development when tested against A. pullulans, C. albicans and P. chrysogenum. In addition, the zinc loaded samples showed worse results than the standard sample when tested against A. niger. The zinc addition did not show significant variation in mechanical properties. However, the density values increased with the rise in ZnO additives concentration, and had a little decrease in M-Zn-ion samples. Also, there were differences in the MFR results in all compounds compared to the standard.

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