

Valorization of Plastic and Cork Wastes in Design of Composite Materials

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Abstract : Plastic is a revolutionary material. However, the pollution caused by plastics damages the environment, human health and the economy of different countries. It is important to find new ways to recycle and reuse plastic material. The use of waste materials as filler and as a matrix for composite materials is receiving increasing attention as an approach to increasing the economic value of streams. In this study, a new composite material based on high-density polyethylene (HDPE) and polypropylene (PP) wastes from bottle caps and cork powder from unused cork (virgin cork), which has a high capacity for thermal insulation, was developed. The composites were prepared with virgin and modified cork. The composite materials were obtained through twin-screw extrusion and injection molding. The composites were produced with proportions of 0 %, 5 %, 10 %, 15 %, and 20 % of cork powder in a polymer matrix with and without coupling agent and flame retardant. These composites were investigated in terms of mechanical, structural and thermal properties. The effect of cork fraction, particle size and the use of flame retardant on the properties of composites were investigated. The properties of samples elaborated with the polymer and the cork were compared to them with the coupling agent and commercial flame retardant. It was observed that the morphology of HDPE/cork and PP/cork composites revealed good distribution and dispersion of cork particles without agglomeration. The results showed that the addition of cork powder in the polymer matrix reduced the density of the composites. However, the incorporation of natural additives doesn't have a significant effect on water adsorption. Regarding the mechanical properties, the value of tensile strength decreases with the addition of cork powder, ranging from 30 MPa to 19 MPa for PP composites and from 19 MPa to 17 MPa for HDPE composites. The value of thermal conductivity of composites HDPE/cork and PP/ cork is about 0.230 W/mK and 0.170 W/mK, respectively. Evaluation of the flammability of the composites was performed using a cone calorimeter. The results of thermal analysis and fire tests show that it is important to add flame retardants to improve fire resistance. The samples elaborated with the coupling agent and flame retardant have better mechanical properties and fire resistance. The feasibility of the composites based on cork and PP and HDPE wastes opens new ways of valorizing plastic waste and virgin cork. The formulation of composite materials must be optimized.

Keywords : composite materials, cork and polymer wastes, flammability, modified cork

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