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Development of mineral-filled polymeric membranes obtained by extrusion to implement in separation by MEAUS procedure

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Microporous membranes are commonly used in separation processes such as battery separators and medical applications to control the permeation rate of chemical components. Due to the wide range of chemical structures, optimum physical properties, and low cost of polymers and polymer blends, these materials are known as the best candidates for the fabrication of microporous membranes. The two main techniques to develop polymeric membranes are: solution casting and extrusion followed by stretching. High cost and solvent contamination are the main drawbacks of the solution technique. Techniques to make porous membranes from polymers without using any solvent were developed in the seventies of the last century for some applications, but most of the information on these processes remains proprietary to the companies' and are not available to the scientific community. One of the techniques is MEAUS (melt extrusion annealing uniaxial strain). It is based on the stretching of a polymer film containing a row-nucleated lamellar structure. Then, three consecutive stages are carried out to obtain porous membranes: creating a precursor film having a row-nucleated lamellar structure by mechanisms of shear and elongation-induced crystallization; annealing the precursor film at temperatures near the melting point of the resin to remove imperfections in the crystalline phase and to increase lamellae thickness, and; stretching at low and high temperatures to create and enlarge pores, respectively. In fact, in this process the material variables as well as the applied processing conditions are key parameters that control the structure and the final properties of the fabricated microporous membranes. The material variables include molecular weight, molecular weight distribution and chain structure of the polymer. These factors mainly influence the row-nucleated structure in the precursor films at the first step of the formation of microporous membranes. Among a wide range of resins, polypropylene (PP) is a well-known semi-crystalline polymer and, in comparison with polyethylene, have higher melting point, lower density, higher chemical resistance, and better mechanical properties, which make it useful for many industrial applications.

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