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Producing and Mechanical Testing of Urea-Formaldehyde Resin Foams Reinforced by Waste Phosphogypsum

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Abstract : Many of thermosetting resins have application only in filled state, reinforced with different mineral fillers. The co-filling of polymers with mineral filler and gases creates a possibility for production of polymer composites materials with low density. This processing leads to forming of new materials – gas-filled plastics (polymer foams). The properties of these materials are determined mainly by the shape and size of internal structural elements (pores). The interactions on the phase boundaries have influence on the materials properties too. In the present work, the gas-filled urea-formaldehyde resins were reinforced by waste phosphogypsum. The waste phosphogypsum (CaSO₄.2H₂O) is a solid by-product in wet phosphoric acid production processes. The values of the interactions polymer-filler were increased by using two modifying agents: polyvinyl acetate for polymer matrix and sodium metasilicate for filler. Technological methods for gas-filling and recipes of urea-formaldehyde based materials with apparent density 20-120 kg/m³ were developed. The heat conductivity of the samples is between 0.024 and 0.029 W/m^oK. Tensile analyses were carried out at 10 and 50% deformation and show values 0.01-0.14 MPa and 0.01-0.09 MPa, respectively. The apparent density of obtained materials is between 20 and 92 kg/m³. The changes in the tensile properties and density of these materials according to sodium metasilicate content were studied too. The mechanism of phosphogypsum adsorption modification was studied using methods of FT-IR spectroscopy. The structure of the gas-filled urea-formaldehyde resins was described by results of electron scanning microscopy at three different magnification ratios – x50, x150 and x 500. The aim of present work is to study the possibility of the usage of phosphogypsum as mineral filler for urea-formaldehyde resins and development of a technology for the production of gas-filled reinforced polymer composite materials. The structure and the properties of obtained composite materials are suitable for thermal and sound insulation applications.

Keywords : urea formaldehyde resins, gas-filled thermostes, phosphogypsum, mechanical properties
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