OPTIMIZATION OF FIRE-RESISTANT AND FIRE-THERMAL PROTECTIVE PROPERTIES OF INTUMESCENT COMPOSITES USING MATHEMATICAL EXPERIMENTAL PLANNING

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Abstract: Using the method of mathematical planning of the experiment, the formulation of a foaming polymer composite material based on an ethylene-vinyl acetate thermoplastic binder was optimized. To determine the dependence of the combustibility characteristics (maximum temperature increment and weight loss) of the composite on the content of components in its gas-coke-forming system, a regression model of a full factorial experiment was used using the completed matrix of the orthogonal central-composition plan (OCCP) of the two-factor model of the 2nd order experiment. By adjusting the composition of the gas-coke-forming system, consisting of ammonium phosphate, amine, and carbonate mineral, a slow-burning material with improved thermal insulation ability was obtained. For the studied composition, it was found that the one of the factors causing a decrease in combustibility and an increase in the fire resistance limit (up to 104 min) is the formation of a foamed mechanically strong coke-like structure, stable in a wide temperature range (300–800 °C).

Keywords: mathematical planning of the experiment; heat-expandable composition; gas-coke-forming system; foaming ability; flammability; fire resistance limit

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Figure Captions

Figure 1 The surface of the regression equation in natural variables for the mass loss of samples (according to Table 2, calculated in Excel)

Figure 2 The results of testing the foaming capacity (*a*) and the relative compressive strain (*b*) of the samples during heating in the temperature range of 250–800 °C: *1* — TPCM 1.9; and *2* — TPCM 4.6

Table Captions

Table 1 Orthogonal central-compositional plan matrix of a two-factor experiment [19]

Table 2 Experimental values of the system responses with varying values of the OCCP factors

Table 3 The results of assessing the significance of the regression coefficients

Table 4 Characteristics of fire-fighting couplings with inserts made of thermofoamable polymer composite materials according to the results of thermal insulating ability tests [18]

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