

THE INFLUENCE OF THE RATIO OF MAIN COMPONENTS IN INTUMESCENT FIRE-RETARDANT COATING

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One of the common ways to optimize fire-retardant intumescent compositions (IC) consisting of ammonium polyphosphate (APP)/melamine (MA)/pentaerythritol (PE)/TiO₂/binder is by experimentally selecting the best ratio of main ingredients (APP, MA and PE) in the system, which does prove to be a good strategy for managing fire-retardant properties as well as operational parameters and cost of IC.

For 52 coating with different ratios of components a step-by-step measuring of intumescence factor in the temperature range of 200–800 °C was carried out. The results of experimental study of the intumescent char characteristics for ICs with varying content of main ingredients are summarized in Table.

Table. Intumescence factor K (cm³/g) for ICs measured in temperature range 200–800 °C

Component	Content, %	$K_{\max}^{1)}$, cm ³ /g	$T_{\max}^{2)}$, °C
APP	12	26	450
	42–49	32–46	420
	19–33	67–108	500
PE	6	60	400
	21–25	39–44	400
	12–17	48–52	450
MA	6	112	420
	10–12	78–88	500
	21–25	35–48	450

¹⁾ Maximum registered intumescence factor. ²⁾ Temperature at which maximum value of K was registered.

By analyzing the compositions of these ICs and conducted fire tests, it is possible to predict that intumescent coatings containing 30–32 % of APP, 8–10 % of MA and 12–14 % of PE are optimized to provide higher fire resistance rate (>60 min) for structural steel. In turn, when it comes to lower fire resistance, up to 30 min, it is advisable to use APP:MA:PE in ratios close to 2:1:1.

The influence of Vinnapas EZ 3010 polymer binder content also studied on the intumescent char formation in APP/MA/PE/TiO₂ system (the weight ratio of listed components is 3:1:1:0.8). These results indicate that an excessive amount of binder in the system can significantly reduce its fire-retardant effectiveness due to the adverse effect on intumescence factor. Based on authors observations, the optimal content of binder in IC for ethylene-vinyl acetate type polymers is approximately 9–11 % (18–22 % for most commercially available aqueous dispersions of said polymers). If the polymer content is under 9 %, intumescent char formed by such coating would have a loose irregular structure, while for systems with over 11 % of polymer binder intumescence factor would decrease with the increase of polymer content, up until the expansion would cease.