STUDY OF THE INFLUENCE OF ADDITIVES ON THE PROCESSES OF COMBUSTION AND LINEAR PYROLYSIS OF POLYAMIDE-6

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A special attention of scientists and experts is drawn to the issue of non-combustion of polymer materials, including polyamides. The impact of additives that educe oxygen under decomposition and the influence of fiber stuffing of various length on thermophysical characteristics of polyamides were studied.

Powder-like additives were pounded and bolted through a bolter of 0.25 mm in diameter. They were thoroughly mixed with granules of polyamide-6 (PA-6) and glass-filled polyamide-6 (GPA-6), and pressed under the temperature of 240-260°C and pressure of 10-15MPa. To conduct tests on linear pyrolysis (LP) in streams of various gases and combustion by moulding under pressure, cylindrical rods of 6 mm in diameter and 50 mm in length were produced in the press form. Kinetic curves of changes in the temperature of the metal substrate with glued polyamide samples of 5 mm in thickness were determined with the help of inculcated chromel-alumel thermocouple with a wire diameter of 200 mkm under the effect of propane-air flame. Combustion of polymer samples was estimated by the method of oxygen index (OI) in accordance with standard GOST 21793-76.

Destruction speed under the linear pyrolysis of polyamide-6 in relation to the temperature of the inert gas was studied. Under 620°C the speed was 1.88 mm/min; under 750°C - 4.33; under 830°C - 5.5 mm/min, therefore with the increase in the temperature the speed of destruction of PA-6 goes up.

It is determined that introduction of natrium silicate glass (NCG), glass fiber (GF) and graphite fiber (GF) provides for the reduction in the temperature of the metal substrate, the growth of the fiber length, as well as the reduction of the warming-up. In the fire testing laboratory (FTL) of the Ministry of Interior Affairs of the Republic of Kazakhstan the coefficients of thermal conductivity (CTC) were determined under 25°C, which are 0.045Wt/mk for PA-6 and 0.0922 Wt/mk for SPA-6. With the introduction of glass fiber, CTC increases 2 times and the depth of warming up in the condensed phase of GPA-6 decreases. Mixtures of pentaerythrite (PER) and terephthalic acid (TPA), as well as PER with pyromellitic acid (PMA) also decrease the warming-up temperature of the substrate due to the forming of carbonized remainder on the surface. A further reduction in the warming-up temperature of the substrate is observed if a mixture of PER, TPA, additives of hypochlorous acidic potassium (HP) and manganese oxide (IV) is introduced.

The largest decrease in the substrate temperature takes place in the presence of HP due to formation of the coke layer on the surface of PA-6, which is a result of oxygen released in the decomposition of HP, hence, oxygen is a carbon-creating agent. It is worth noting that OI of polyamide-6 is equal to 22.0%, additives of natrium nitrate – 21.0%, manganese oxide (IV) – 21.0%. The latter do not affect combustion characteristics of PA-6 since a potion of the released oxygen participates in the combustion reaction.

It is established that the coke layer appears on the surface under combustion of polyamide-6, i.e. air oxygen provides for the carbonized layer.