Diffusive-chemical modification of polymer composite materials in supercritical carbon dioxide

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Supercritical carbon dioxide application to polymer composites and layered compounds modification is very perspective in connection with elaboration of new approaches in modification technology. In this work we present results on fireproof activity examination of polymeric materials impregnated with phosphorus compounds such as triphenylphosphine (TPP), ammonium polyphosphate (APP) and thermally-induced expanded compounds - oxidized carbon (OC), oxidized polysaccharides (OPS). Organic compounds activity is related to heat absorption caused flame retardants release to combustion front gas phase. Efficiency of fireproof activity of oxidized graphite and polysaccharides is determined by their ability to swell polymeric material via gas boiling during heating and to form heat-insulating layer interfering combustion front propagation.

Measuring of the heat absorption processes in oxidized graphite, oxidized polysaccharides and composite polymeric materials impregnated with flame retardant additives from supercritical carbon dioxide medium were carried out by differential thermal analysis. Heat absorption process was registered by thermoelectric couple connected to sample crucible. All the processes were controlled by “Thermo” computer package.

Plasticized composites were prepared from low molecular weight organosilicon rubber with molecular weight $2\text{-}10*10^4$ and having link structure HO-[-Si $(CH_3)_2$ O-]$_n$-H. Graphite particles were modified with sulfuric and nitric acid mixture with subsequent sulfur atoms intercalation into graphite interplanar space. It was shown that given procedure leads to graphite bisulphate formation - C_{24}^{+} (HSO_4^-) 2 H_2SO_4 (low oxidized graphite). Synthesis of highly oxidized graphite $[C_4O\ (OH)]_n$ was carried out by potassium permanganate in sulfuric acid with sodium nitrate intermixture.

Application of low and highly oxidized graphites for diffusive-chemical modification is related to establishment of stepwise behavior of thermally-induced oxidized graphite expansion. Therefore oxidized graphite particles were preliminary dilated in order to expand the interplanar space, and then modified by pore formation agent. It was shown that unlike low oxidized graphites possessing endothermic effect at expansion the sharp exothermic peak in range of 190-210^{o}C was observed for highly oxidized graphites.

Oxidized graphites and composite polymeric materials modification conditions in the supercritical carbon dioxide were determined in order to specifically form a cellular structure that promotes diffusive-chemical processes carrying out.

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