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Analysis of optimal process conditions and mechanical properties on nanocomposites according to structural changes of halloysite nanotubes

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ABSTRACT

Halloysite is a naturally occurring aluminosilicate in the shape of nanotubes, also known as halloysite nanotubes (HNTs). These HNTs have been considered as a functionally effective material capable of mechanically strengthening resins by restrictive matrix dislocation movement. Especially, there are studies showing that adding HNTs to plastics improves tensile strength, impact resistance, and fire retardancy. This study consisted the heat treatment of HNTs and optimization of their dispersion in unsaturated polyester resin as an attempt to enhance the impact and tensile properties of resulting nanocomposites. Herein, the contents of HNTs were 0.5, 1, and 3 wt.%. Limiting the content of HNT, it will be possible to observe the aggregation phenomenon according to the content of HNT. Dispersion was carried out by ultrasonication and evaluated by TEM observations. Structural changes of heat-treated HNTs were analyzed by X-ray diffraction. It was concluded that the structural changes of HNTs were caused by chemical change due to heat treatment temperature. The mechanical properties were assessed by impact and tensile tests. Results of the tests showed that impact reinforcing effect was higher than the tensile reinforcement effect under the same conditions. In terms of impact reinforcing effects, the 700°C heat-treated HNT nanocomposite was superior with high impact strength. Therefore, the rheological property of matrix resin was affected by HNT. However, the nanocomposites reinforced HNT were also limited according to the types of untreated or heat-treated HNT, the dispersion method, manufacturing process conditions, and performance evaluation method of samples.

KEYWORDS: halloysite nanotube (HNT), nanocomposite, ultrasonic homogenization, unsaturated polyester resin (UP), heat treatment, mechanical property