

Non-Einstein viscosity phenomenon of ABS composites containing lignin-polycaprolactone (LPCL) particulates highly dispersed by high-shear stress

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Lignin powder was modified via ring-opening polymerization (ROP) of caprolactone to form a lignin-polycaprolactone (LPCL) particulate. The LPCL particulates were mixed with an acrylonitrile-butadiene-styrene (ABS) matrix at the extremely high rotational speed of up to 3,000 rpm. Using this high-shear extruding mixer, the LPCL particulate size was controlled in the range of 3.4 μm (conventional twin-screw extrusion) down to 640 nm (high-shear mixer of 3,000 rpm), depending on the applied shear stress. The resulting LPCL/ABS composites clearly showed non-Einstein viscosity phenomena, exhibiting 1,754 Pa·s, which should be compared with 6,189 Pa·s of the neat ABS resin measured at 1 rad/s and 210 °C. The LPCL particulate morphology, damping characteristics, and light transmittance of the developed composites were thoroughly investigated at various levels of applied shear rates and mixing conditions.