

Density and Viscosity Measurement of Biodiesel Fuel by Using a Vibrating-Tube Densimeter and a Capillary Viscometer

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Density and viscosity of biodiesel fuel were accurately measured by using a vibrating-tube densimeter and a capillary viscometer. These thermophysical properties of biofuels are necessary not only to domestically and internationally trade, but also to control their qualities as fuels in practical use. A commercially available vibrating-tube densimeter (DMA5000, AntonPaar GmbH) was used for the density measurement. Biofuel samples are generally easy to change their physical and chemical properties in atmosphere due to their high hygroscopicity and oxidizability. To prevent these effects on the density measurement, the densimeter was placed in a glove box whose inner ambience was controlled with low humidity and oxygen concentration. Mechanical constants of the vibrating-tube were calibrated with density standard liquids in a manner traceable to SI units, and thermometers installed in the densimeter were calibrated on the basis of ITS-90. Viscosity effect on the density measurement was taken into account by calibrating with three density standard liquids whose viscosities are different one another. An expanded uncertainty ($k = 2$) of the density measurement is estimated to be 0.06 kg m^{-3} at room temperature. Measurement results for biodiesel reference materials by NIST, SRM2772 and SRM2773, show that the measured densities agreed well with the certified densities of the reference materials within the measurement uncertainties. A glass capillary viscometer, whose apparatus constant was calibrated on the basis of viscosity of water, was used for the viscosity measurement. An expanded uncertainty of the viscosity measurement is estimated to be 0.06 %. A certified reference material (CRM) of biodiesel produced from palm oil is now under development at NMIJ/AIST. Some results for the density and viscosity evaluation of the biodiesel CRM will be presented.