Evaluation of a gravimetric calibration facility using a double-wing diverter with four types of working liquids

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A flow calibration facility based on a gravimetric system using a double-wing diverter as a national measurement standard for hydrocarbon flow from 15 m3/h to 0.1 m3/h was constructed at NMIJ. The original working liquids were kerosene and light-oil. The calibration facility was modified to calibrate flowmeters with additional working liquids, those are industrial gasoline and spindle-oil, in order to achieve calibration at wide viscosity range. The kinematic viscosities of industrial gasoline, kerosene, light-oil and spindle-oil are 1.2 mm2/s, 2.1 mm2/s, 6.1 mm2/s and 23 mm2/s, respectively. Since the difference of liquid properties could affect the diverter and the gravimetric system in the calibration facility, uncertainties with the four types of working liquids have been analysed experimentally. The double-wing diverter was adopted to minimize a diverter timing error due to change of the velocity profile in the liquid jet. When the diverter wing cuts the liquid jet, the working liquid adheres on the surface of the wing and droplets on the wings fall down to the weighing tank with duration. The uncertainty due to the droplets from the diverter wings was reduced by a modified diverter operation. The diverter timing errors for all types of working liquids were estimated based on the method described in ISO4185. Working liquid is discharged from the weighing tank after one run of liquid accumulation and the amount of droplets from a discharge pipe with the weighing tank depends on liquid viscosity. The error due to the droplets from the discharge pipe was reduced by a chemical coating, and then the uncertainties at the discharge pipe were evaluated. The expanded uncertainties of the calibration facility have been estimated to be 0.02 % for mass flow and 0.03 % for volumetric flow at all types of liquids.