

## Viscosity of SiO<sub>2</sub>-CaO-CaF<sub>2</sub> Melts

Osamu Takeda<sup>C,5</sup>, Taku Ohkawara and Yuzuru Sato

*Tohoku University, Department of Metallurgy, Graduate School of Engineering, Sendai, Japan  
takeda@material.tohoku.ac.jp*

The viscosities of SiO<sub>2</sub>-CaO-CaF<sub>2</sub> melts as the basic mixture of mold flux for continuous steel casting were determined by using a rotating crucible viscometer newly developed by the authors. The viscometer was hermetically closed, and the atmosphere around the melts was highly controllable. In the viscosity measurement, an inner cylinder made of graphite was immersed into the melts in a graphite crucible (outer cylinder) under Ar atmosphere at elevated temperatures (1467~1782 K). The torque given to the inner cylinder by rotating the crucible was measured by means of a supersensitive torque sensor (torque range available: 0.001~2 mN×m), and the viscosity was determined. The minimum limit of the viscosity determined was 20 mPa×s. Special attention was given to keep the temperature uniformity inside the furnace of viscometer for precise measurement by placing many tungsten plates as the thermal shield, and excellent temperature uniformity (±0.2 K in a whole crucible) was obtained. The basicity (=  $C_{CaO}/C_{SiO_2}$  in mass) of the melts was 0.79 or 1.25, and the concentrations of CaF<sub>2</sub> were 5, 10, 15, 20, 25 mass%. The results demonstrated that the viscosity of the melts showed a good Arrhenian type linearity in any samples. Significant undercooling (ca. 100 K) was observed in a cooling step of the measurement. This may be due to the excellent temperature uniformity. Liquidus temperature was then determined from the change in viscosity by reheating the sample. The liquidus temperatures were consistent with those from the phase diagram. Furthermore, the loss of fluoride from the melts after the measurement was very small. It suggests almost no change in the melt composition. The viscosity of the melt decreased with increasing the concentration of CaF<sub>2</sub>, but the rate of decrease was smaller than that of literature values.