Viscosity of soda-lime silicate glass raw materials during batch-to-melt conversion

Yoji Doi*†[1,2], Benjamin Mccarthy[3], Michael Schweiger[3], Pavel Hrma[3], and Tetsuji Yano[2]

[1]Production Technology Division, Asahi Glass Co., Ltd. (AGC) – Japan
[2]Department of Material Science and Engineering, Tokyo Institute of Technology (TIT) – Japan
[3]Pacific Northwest National Laboratory (PNNL) – United States

Abstract

The viscosity of an industrial glass batch during conversion to molten glass within the temperature from 1050∘C to 1300∘C was measured at the shear rate of 0.02 s–1 to access the effects of grain size and briquetting on glass batch melting. Based on the mass fraction of undissolved sand (xs), determined using x-ray diffraction analysis of quenched batches samples, and the gas phase fraction (p), obtained from the volumetric measurements, we established the relationship $\ln(\eta b/\eta m) = a0 + bsxs + app$, where ηm the transition melt viscosity, a0 is the melt homogeneity coefficient, bs is the coefficient for undissolved sand, and ap is the coefficient for bubbles. The resulting coefficients of bs and ap were 8.756 and 0.658, respectively. The results indicated that undissolved silica sand strongly influenced on the viscosity. Due to the effect, finer raw materials and briquetting resulted in a lower viscosity during conversion. The result suggested that finer raw materials and briquettes are expected to enhance the melting rate of the batch blanket in an industrial melting furnace due to decrease of viscosity during conversion.

Keywords: Glass raw materials, viscosity, briquettes, particle size, melting kinetics

*Speaker
†Corresponding author: yoji-doi@agc.com