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Thermodynamic Estimation of Ash Melting Behavior and Viscosity for Coal Gasifier

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Abstract

According to the Paris Agreement in 2016, Japan has set a goal of 26% reducing greenhouse gas emissions by 2030 compared with the level in 2013. Integrated gasification combined cycle (IGCC) is showing considerable promise for reducing CO_2 emission as an electric power generation system. It is known that in IGCC slagging gasifiers, the slags (melting ash) should be 'fluid' enough to be tapped. One of the major parameters in the design and operation of the coal gasifier is the knowledge of the melting behaviour of the coal mineral; therefore, estimation of the ash melting temperature and slag viscosity is important to choose coal types.

Thermodynamic estimation of ash melting behaviour was carried out to evaluate 4 different coals and there blended coals using the Factsage software. Factsage is one of the largest fully integrated database computing systems in chemical thermodynamics. Input dataset and selection of thermodynamics database for Factsage modelling was carefully established for estimation of ash melting behaviour. The ratio of slag as a function of temperature was obtained the thermodynamic calculation for various coals. On the other hand, slag viscosity at a temperature was calculated by "modified Urbain model" which was developed by Kondratiev and Jak (2001).

To determine boundary conditions for choosing coals, calculated ash melting temperatures and its viscosity were compared with actual ash melting performance which was obtained by ash fluid experiments. In the ash fluid experiments, variation in the ratio of fluid slag at a temperature ranged from 1100 °C to 1600 °C was measured. The boundary condition for choosing coal was found that the ash melting temperature at the slag ratio of 80% is below 1250 °C, and the slag viscosity is below 30,000 Pa s at the ash melting temperature.