Melting Behavior and Element Fluctuation of Coal Ash/Slag Based on In-situ Visual Technique and FactSage Simulation

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Abstract: Our current researches focused on the ash melting behaviors of high-alkali coal, non-high-alkali coal, and fine slag at the sub-particle scale. A high-temperature hot stage microscope (HTTSM), scanning electron microscope (SEM) coupled with energy dispersive spectrometer (EDS), and FactSage modeling were combined to reveal the heterogeneous distribution characteristics of elements for the local melting behavior of ash particles. Results showed that partial melting behavior for all coal ashes was found at the temperature lower than the ash deformation temperature. For high-alkali coals, Na, Si and Mg played the predominate role on causing the local melting behavior. The enrichment of Na and S in the melting zone promoted the formation of low-temperature minerals, while Mg in the un-melting zone was related to the formation of magnesium-containing spinel and olivine. FactSage calculation based on local chemical compositions showed that natural properties of minerals caused on partial melting behavior. In the melting zone, a large amount of liquid phase began to form at about 1100 ℃, which was about 100℃ lower than the un-melted zone. Spinel was the main refractory mineral that inhibited the formation of liquid slag. For non-high-alkali coals, the contents of Na and Si were generally higher in the molten zones, while Mg, Al, Ca, Fe and S were enriched in the unmolten zone. Si displayed the highest fluctuation degree in the melting zone, and Al had the minimum. The results of XRD and FactSage calculation showed that the initial temperature of the formed liquid phase was lower than the deformation temperature of coal ashes, originally related to the Na-rich minerals, such as nepheline and albite. The fluctuation of element content in the local area may cause the low temperature eutectic phenomenon due to the intersecting mineral interaction of multiphase on the phase diagram

Keywords: Coal ash, melting behavior, elemental fluctuation, experiment, FactSage modeling