
Abstract

Chemical wear of two carbon-based refractories by SiMn (Silicomanganese) was investigated. Thermodynamic calculations were conducted in FactSage™ 7.2 (FeMn and FactPS database) when temperature was varied at 1550°C, 1600°C and 1650°C for the type K and type SiC refractory. Temperature test work at constant Si mass % were then conducted at static and dynamic conditions. Furthermore, carbon solubility in Mn-Fe-Si-C alloys with Mn:Fe mass ratio of 4.4 at 1550°C, 1600°C and 1650°C was calculated with FactSage 7.2 (FSstel, FeMn and FactPS database). The results from the FactSage calculation and actual test work were in agreement and it was found that the type SiC refractory experienced the most wear. The SEM analyses indicated that SiMn infiltrated both refractories, with the type SiC experiencing infiltration the most due to its porous nature. At 15 mass % Si the alloy was not saturated in SiC resulting in the carbon (type K) refractory experiencing the most wear.

Thermodynamic calculations when Si mass % was varied at 15 mass %, 17 mass % and 18 mass % for the type K and type SiC refractory predicted that the type K refractory would wear out the most. Experimentally it was found that the type K refractory wore out the most and this was due to the solubility of C in the alloy decreasing which allowed more of the type K refractory to dissolve into the alloy. Increasing the Si mass % above 17 resulted in a SiC saturated alloy. The SEM analyses indicated that SiC was precipitated from the alloy and the SiC phases were visible on the type K refractory surface. Infiltration of the alloy into the refractories by capillary action still reached greater depths in the type SiC refractory.

Dynamic motion introduced erosion wear on the refractory surfaces, the impact was insignificant. Main wear mechanism was found to be chemical wear. Finally the type K was found to be the most suited refractory material to use in the hearth area of an industrial furnace as long as the Si mass % in the alloy is maintained below 17 for Mn-Fe-Si-C alloys with Mn:Fe mass ratio of 4.4.

KEYWORDS: carbon solubility, SiC solubility, FactSage™, rotating finger test, ramming paste, refractory test.