

Reduction Behavior of Medium Grade Manganese Ore from Karangnunggal during a Sintering Process in Methane Gas

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Abstract : In this investigation, manganese has been produced from medium grade manganese ore from Karangnunggal mine (West Java, Indonesia). The ores were grinded using a jar mill to pass through a 150 mesh sieve. The effects of keeping it at a temperature of 1200 °C in methane gas on the structural properties have been studied. The material's properties have been characterized on the basis of the experimental data obtained using X-ray fluorescence (XRF), X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), and Fourier transform infrared (FTIR) spectroscopy. It has been found that the ore contains MnO₂ as the main constituents at about 46.80 wt.%. It can be also observed that the ore particles are agglomerated forming dense grains with different texture and morphology. The irregular-shaped grains with dark contrast, the large brighter grains, and smaller grains with bright texture and smooth surfaces are associated with the presence of manganese, calcium, and quartz, respectively. From XRD patterns, MnO₂ is reduced to hausmannite (Mn₃O₄), manganosite (MnO) and manganese carbide (Mn₇C₃). At a temperature of 1200°C the keeping time does not have any effect on the formation of crystals and the crystalline phases remain almost unchanged in the time range from 15 to 90 minutes. An increase of the keeping time up to 45 minutes during the sintering process leads to an increase of the MnO concentration, while at 90 minutes, the concentration decreases. At longer keeping times the excess reaction of the methane gas and manganese oxide in the ore causes an increase of carbon deposition. As a result, it blocks the particle surface and then hinders the reduction process of manganese oxide. From FTIR spectrum allows one to explain that the appearance of C=O stretching mode arises from absorption of atmospheric methane and manganese oxide of the ore. The intensity of this band increases with increasing the keeping time, indicating an increase of carbon deposition on the surface of manganese oxide.

Keywords : manganese, medium grade manganese ore, structural properties, keeping the temperature, carbon deposition

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