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Separation of Nuggets by Self–Reduction and Holding Treatment of Coal Composite Iron Ore Briquette

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All over the world most of industrialized non–coking ironmaking methods use the preprocessed product of coal such as coal gas and chestnut coal. What draws the attention in processes using coal gas is the production of iron nugget in rotatory hearth furnace. This process doesn't need high quality of fuel gas is not high and it has no problem in re–oxidation of product. In some references CCB was made from metallurgical waste arising in stainless steelmaking, and one process was proposed, which separated the alloy nugget contained valuable metals proceeding self–reduction and holding treatment and the basic studies had been made.

In this work the fundamental study has been carried out to separate nugget from coal composite iron ore briquette (CCB), which was made from our local magnetite and brown coal adapting self–reduction and self–differentiation separation method. Thermodynamic analysis was made on slag in CCB. Coal composite iron ore briquette (CCB) was manufactured through hot briquetting, the effects were investigated on its self–reduction and holding treatment parameters in separation of nugget. Iron oxide only exists in CCB. Thus high reduction temperature isn't needed and at comparatively low temperature, 1 350~1 400°C, CCB could be quickly reduced and form iron nugget. Carbon to oxygen, C/O 1.1 is favorable for formation of metal nugget. Thus the experiments were conducted by C/O 1.1. The fluctuation extents of Al_2O_3 and MgO content were very low with basicity and the average contents of Al_2O_3, MgO were 4.8%, 3.0% respectively. According to equilibrium calculation results by Factasge the liquid formation temperature of slag with increasing basicity in $CaO–SiO_2–Al_2O_3–MgO$ system was the minimum between 2.0~2.1 of basicity. Also C_2S in slag must be formed extremely to separate the metal nugget from reduced product of briquette. Hence analyzed the slag composition manufactured from different conditions and researched the liquid formation temperature, the changes of liquid phase to solid phase ratio with different temperature and C_2S content formed in slag.

C_2S content in slag increased and then decreased with the increasing basicity and it was the greatest to the maximum of 86% at basicity 2.0. Macroscopic iron nugget wasn't formed when reduction temperature was 1 350°C. At 1 400°C big iron nugget was formed and self–differentiation of reduced product happened, but its effect wasn't good and lumps still existed in slag. Thus the separation effect should be improved through holding treatment. So holding treatment of reduced product was proceeded for 5min. Fig.3 shows the pattern of reduced product after holding treatment at 1 100°C. Slag in reduced product was differentiated almost completely.

Sensible processing parameters of self–reduction and holding treatment were C/O 1.1, basicity 2.0, reduction temperature 1 400°C, reduction time 20min, respectively and after screening using 106μm griddle, the recovery ratio of Fe was 97.5%, the composition of iron nugget was Fe 94.12%, C 3.85%, P 0.04%, S 0.0093%, and Si wasn't detected.