Progress in Using Chromite Fines

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Abstract: Microwave heating method was used to reduce coal-containing chromite fines, scarce chromite resources can be fully used, technical process of ferrochrome smelting is simplified. Microscopic structure is analyzed on coal-containing chromite fines being volume reduced by microwave, whose significance lies in manifesting the characteristic of microwave heating in coal-containing chromite fines reduction.

Key words: coal-containing chromite fines; microwave heating; volume reduction; research progress
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1 Introduction

Microwave is a kind of new calefaction energy whose remarkable advantage is fast selective voluminal heating. Phenomenon is avoided that transfer of heat mass are non-uniform when fine ore is heated by conventional way. Owing to characteristics of volume heating of microwave[1] and self-reduction of carbon-containing chromite fines[2-3], carbon-containing chromite fines can be reduced quickly in closed system, obtaining high metallized sponge ferrochrome. A large quantities of fines can be used in this way.

2 Microscopic structure of coal-containing chromite fines reduced by microwave

Cataclasm degree of microscopic structure in chrome grains turned worse until disintegration when composition of coal and alkalinity ($C:O=0.842$, $CaO:SiO_2=0.3939$) were the same. Both the degree of reduction and metallization rised with the reduction proceeding. The elevation of the temperature caused the degree of metallization to descend in condition of lower coal content.

At 1000 ℃, irregular microscopic cracks firstly appeared thin and long with different densities from exterior to inner part of the chromite grains, which contained metal phase (Fe-Cr alloy), but in general, chromite grains were still integrity. The phenomenon of cataclasm during microwave heating reduction only occured on the edge of chromite grains. The structure of remnant carbon with metal Fe annulus around formed because of some iron oxide in coal. Calcic lime reacted with SiO_2, Al_2O_3 and MgO in the anthracite and chromite fines, then resultant slag filled in holes around chromite grains.

At 1100 ℃, the cracks inside chromite ore grains get wider and denser. The phenomenon of cataclasm to collapse by heating happened in local part of the mineral grains. The metal Fe-Cr reduced distributed as dots or worms in the chromite fine grains, and the structure of discontinuous metal hoop formed because of aggregation of Fe-Cr in some areas. It was asymmetric in distribution of the chrome and irons in chromium iron alloy reduced. Chromium was in gray phase, while white phase was mainly composed of Fe.

The composition of slag was composed of $CaO\cdot SiO_2$ (outside the chromite grains) and spinel ($[Fe,Mg]O\cdot[Cr,Al,Fe]_2O_3$) (inside the chrome grains) basically. The iron content in phase of metal increases compared with the content at 1000 ℃.

When temperature reached 1200 ℃, degree of cataclasm in chromite ore grains aggravates because the temperature was a little lower than the reaction temperature of magnesium chromium pinel ($[Fe,Mg]O\cdot[Cr,Al,Fe]_2O_3$) and higher than that of iron chromium spinel ($[Fe,Mg]O\cdot[Cr,Al,Fe]_2O_3$). The Cr-Fe alloy reduced gathered obvipusly. Meanwhile, chromite grains inside had broken up to numerous smaller ones and the phase of metal had begun to separate with

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that of slag. The boundary of the chromite fine grains became unclear and merged with the slag around. The characteristic of slag was that the content of Al_2O_3 and MgO increased and melilite formed in slag.

At 1300 ℃, the chromite grains inside already completely cataclasm because the temperature was higher than that of coal-containing chromite reduction. Small metal phase as Cr-Fe alloy and slag composed of magnalium and chrome formed[4]. The content of Cr_2O_3 in SiCa slag around the chromite grain became lower. There are dense structure of Fe-Cr reduced in shape of tiny spots everywhere in the chromite grains.

3　Conclusion

(1) The major structure of coal-containing chromite fines volumnally reduced by microwave is microscopic cataclasm by heating, microscopic cataclasm inside chromite grains turns aggravated to collapse with the temperature rising. Meanwhile the degree of reduction and the velocity ofmetallization of the material also rise accordingly, but in condtion of lower coal composition, the velpcity of metallization descends when temperature rising.

(2) The microwave heating can accelerate temperature rising of coal-containing chromite fines, and chromite grains generate a lot of cataclasm texture, which helps to the internal diffusion of CO generated in gasification of carbon, reduction reaction on interface and accelerate the reduction of solid-solid phase.

(3) The lime powder can speed up the reduction of chrome ore containing more silicon and aluminium. It can accelerate the formation of slag of calcium silicon around chromite grains and slag of magnalium inside chromite grains.

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铬铁矿粉利用研究进展

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摘　要：利用微波加热的方法来还原含煤铬铁矿粉，稀缺的铬铁矿资源可以得到充分利用。微波体加热还原含煤铬铁矿过程中微波结构也进行了分析，在微观层面上证明了微波加热的物性、优点。

关键词：含煤铬铁矿粉；微波加热；体还原；研究进展

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