mixing coal and iron ore (pellet feed) and densification

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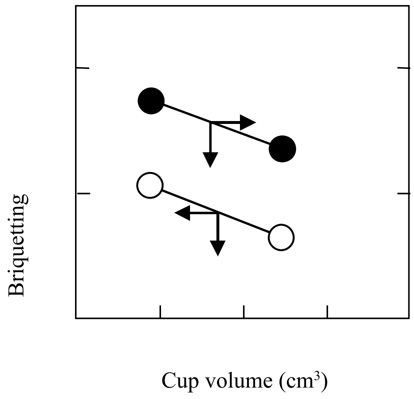

briquette improves as the cup size of the briquetting rolls decreases and the thickness in the depth direction becomes thinner. As a result, briquetting is improved and the apparent density of the briquettes increases. From this result, it was understood that apparent density is one of important factors for increasing the strength of the briquettes.

3.2 Properties of Carbon Iron Composite

3.2.1 External appearance and compression strength

Photo 2 shows photographs of briquettes before and after carbonization, cross-sectional photographs of the same briquettes, and a polarization microscope image of the microstructure of the Carbon Iron Composite. The carbonization yield and reduction rate were 69% and 76%, respectively. No cracking accompanying heat treatment was observed. This is estimated to be because initiation of cracking was suppressed by the use of coal with a low fluidity and coefficient of thermal expansion. As the coke in contact with the iron ore in the Carbon Iron Composite was consumed and reduced, a condition in which the surrounding coke microstructure became porous was observed. However, the compression strength of the Carbon Iron Composite was more than 4 000 N, showing a higher value than that of coke oven coke (**Fig. 4**). Although low fluidity coal was used, it is estimated that the adhesion strength of the coal particles was further strengthened by the synergistic effect of the appearance of thermoplastization and the reduction of the distance between particles by densification.

3.2.2 High temperature reaction properties of carbon iron composite

Photo 3 shows sectional views of Carbon Iron Composite before reaction and after reaction for 1 h in the CO_2 reaction device, together with polarization microscope images of the same briquettes. At a reaction temperature of 1 100°C, the reaction mode is on the boundary between a condition in which the reaction is rate-governing and one in which intragranular diffusion is rate-governing. Therefore, in addition to the porous structure of the coke, it is considered that reactivity at 1 100°C also depends on the reactivity of the coke microstructure. In Carbon Iron Composite, the reaction proceeds from the surface, displaying a typical characteristic of high reactivity coke. Although the reaction rate including the iron fraction was 26.6%, a trial calculation of coke reactivity index (CRI)[3] based on a coke standard gave a result of 53%, which is more than twice as large as that of conventional coke oven coke, while also maintaining a compression strength of more than 2 000 N (**Fig. 5**). Thus, suppression of powdering in the blast furnace can be expected. **Photo 4** shows a photograph of the external appearance of Carbon Iron Composite after heat treatment at 1 700°C, together with a metallographical microscope image. Heat cracking behavior due to thermal expansion of iron was not detected. Cohesion of molten metallic iron with adjoin future study for optimization of the selection of raw materials, blending conditions, briquetting conditions, carbonization process, etc., the authors are confident that this process can make an important contribution to renovation of aging coke ovens and low reduction agent rate operation of blast furnaces.

References

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2) Fujimoto, H.; Itagaki, Sl-6(i)-12h0 Td[F)-13(u)-13(j)-1y(I)-12(t)-12(a)-12(n)-