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Synopsis :

A new smelting reduction process with coke-packed bed (Kawasaki's STAR process) has been developed to produce ferroalloys or pig iron, by using low grade coke and fine ores. The process is characterized by (1) coke-packed bed shaft furnace, (2) installation of two-stage tuyeres, (3) direct use of fine ore without agglomeration, (4) gravitational powder transportation and injection through the upper tuyer, and (5) fluidized bed pre-reduction furnace for full utilization of a by-product gas. Bench scale tests of smelting reduction, gravitational powder transportation and fluidized bed pre-reduction were carried out independently to confirm the principle and the effectiveness. Campaigns of the pilot plant test for the production of ferrochromium were successfully done in 1986. The scale-

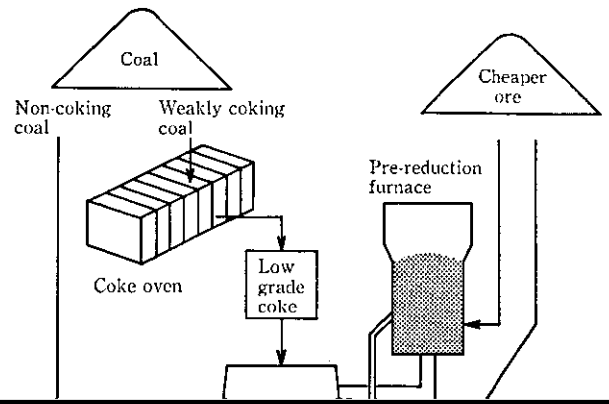
Ferrous Alloy Production by Smelting Reduction
Process with Coke-Packed Bed

要旨

川崎製鉄(株)では低品位コークスと鉛鉱石を直接使用して合金

| | | | | | | | | | | | | | | | | |
|------------------------------------|----|----|----|-----------------------|----|----|----|----|----|----|----|----|----|----|----|----|
| 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 |
| Fluidized bed reduction (iron ore) | | | | | | | | | | | | | | | | |
| Labo. test | | | | Bench scale (0.5 t/d) | | | | | | | | | | | | |
| Fluidized bed reduction (Cr ore) | | | | | | | | | | | | | | | | |
| Labo. test | | | | Bench scale (2 t/d) | | | | | | | | | | | | |
| STAR process (coke) | | | | | | | | | | | | | | | | |
| Bench scale | | | | Pilot (10 t/d) | | | | | | | | | | | | |

YR (coking coal)



(a) Without pre-reduction



融、還元、滴下、泡立ち等の挙動とフラックス組成および量の影響を調べた。溶融還元挙動は温度、フラックス、コークス粒径などで大きく変化することが観察された。コークス粒径やフラックスの条

示唆する。すなわち、この問題は上下段の羽口に分配する酸素富化量あるいは熱風量を適切に調整して熔融還元帯への熱供給を制御すれば容易に解決することができる。





Table 1 Operation tests of pilot plant

| Run No. | Start Time | End Time | Temperature (°C) | Reduction (%) | Alloying Element (%) |
|---------|------------|----------|------------------|---------------|----------------------|
| 1 | 08:00 | 10:00 | 1200 | 85 | 0.5 |
| 2 | 10:30 | 12:30 | 1200 | 85 | 0.5 |
| 3 | 13:00 | 15:00 | 1200 | 85 | 0.5 |
| 4 | 15:30 | 17:30 | 1200 | 85 | 0.5 |
| 5 | 18:00 | 20:00 | 1200 | 85 | 0.5 |
| 6 | 20:30 | 22:30 | 1200 | 85 | 0.5 |
| 7 | 23:00 | 01:00 | 1200 | 85 | 0.5 |
| 8 | 01:30 | 03:30 | 1200 | 85 | 0.5 |
| 9 | 04:00 | 06:00 | 1200 | 85 | 0.5 |
| 10 | 06:30 | 08:30 | 1200 | 85 | 0.5 |
| 11 | 09:00 | 11:00 | 1200 | 85 | 0.5 |
| 12 | 11:30 | 13:30 | 1200 | 85 | 0.5 |
| 13 | 14:00 | 16:00 | 1200 | 85 | 0.5 |
| 14 | 16:30 | 18:30 | 1200 | 85 | 0.5 |
| 15 | 19:00 | 21:00 | 1200 | 85 | 0.5 |
| 16 | 21:30 | 23:30 | 1200 | 85 | 0.5 |
| 17 | 00:00 | 02:00 | 1200 | 85 | 0.5 |
| 18 | 02:30 | 04:30 | 1200 | 85 | 0.5 |
| 19 | 05:00 | 07:00 | 1200 | 85 | 0.5 |
| 20 | 07:30 | 09:30 | 1200 | 85 | 0.5 |
| 21 | 10:00 | 12:00 | 1200 | 85 | 0.5 |
| 22 | 12:30 | 14:30 | 1200 | 85 | 0.5 |
| 23 | 15:00 | 17:00 | 1200 | 85 | 0.5 |
| 24 | 17:30 | 19:30 | 1200 | 85 | 0.5 |
| 25 | 20:00 | 22:00 | 1200 | 85 | 0.5 |
| 26 | 22:30 | 00:30 | 1200 | 85 | 0.5 |
| 27 | 01:00 | 03:00 | 1200 | 85 | 0.5 |
| 28 | 03:30 | 05:30 | 1200 | 85 | 0.5 |
| 29 | 06:00 | 08:00 | 1200 | 85 | 0.5 |
| 30 | 08:30 | 10:30 | 1200 | 85 | 0.5 |
| 31 | 11:00 | 13:00 | 1200 | 85 | 0.5 |
| 32 | 13:30 | 15:30 | 1200 | 85 | 0.5 |
| 33 | 16:00 | 18:00 | 1200 | 85 | 0.5 |
| 34 | 18:30 | 20:30 | 1200 | 85 | 0.5 |
| 35 | 21:00 | 23:00 | 1200 | 85 | 0.5 |
| 36 | 23:30 | 01:30 | 1200 | 85 | 0.5 |
| 37 | 02:00 | 04:00 | 1200 | 85 | 0.5 |
| 38 | 04:30 | 06:30 | 1200 | 85 | 0.5 |
| 39 | 07:00 | 09:00 | 1200 | 85 | 0.5 |
| 40 | 09:30 | 11:30 | 1200 | 85 | 0.5 |
| 41 | 12:00 | 14:00 | 1200 | 85 | 0.5 |
| 42 | 14:30 | 16:30 | 1200 | 85 | 0.5 |
| 43 | 17:00 | 19:00 | 1200 | 85 | 0.5 |
| 44 | 19:30 | 21:30 | 1200 | 85 | 0.5 |
| 45 | 22:00 | 24:00 | 1200 | 85 | 0.5 |

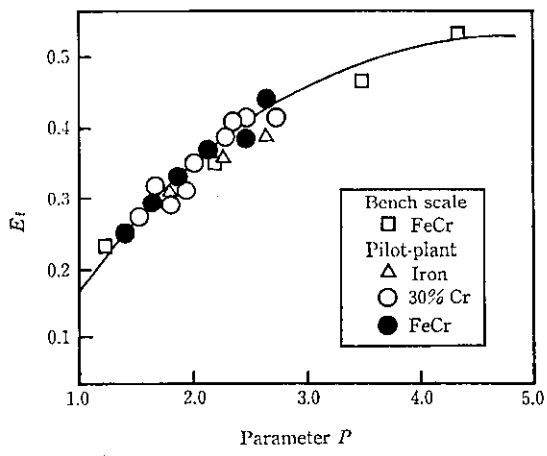


Fig. 14. Relationship between E_t and parameter P .

