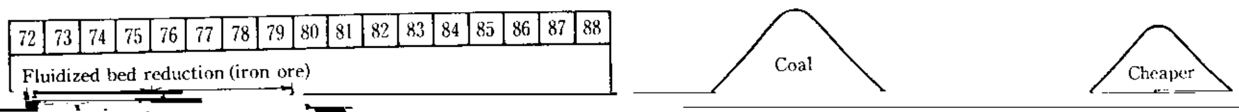
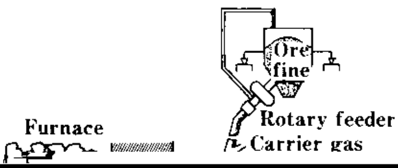
# Ferroalloy Production by Smelting Reduction Process with Coke-Packed Bed*

*Synopsis:*


72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88
Fluidized bed reduction (iron ore)
Coal
Cheaper

[redacted]




tion time.

## 4 Fundamental Studies and Bench Scale Test

[redacted]

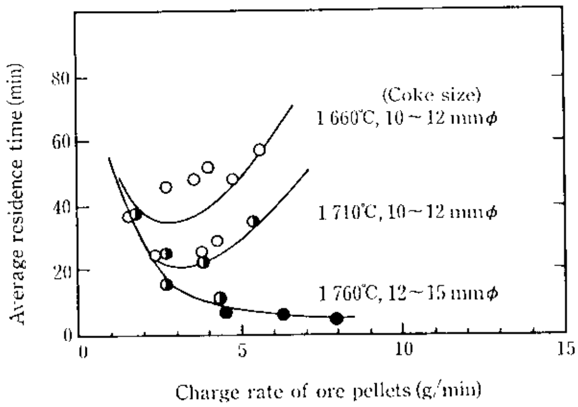



Fig. 5 Effect of the charging rate of ore on the average residence time in the coke-packed bed

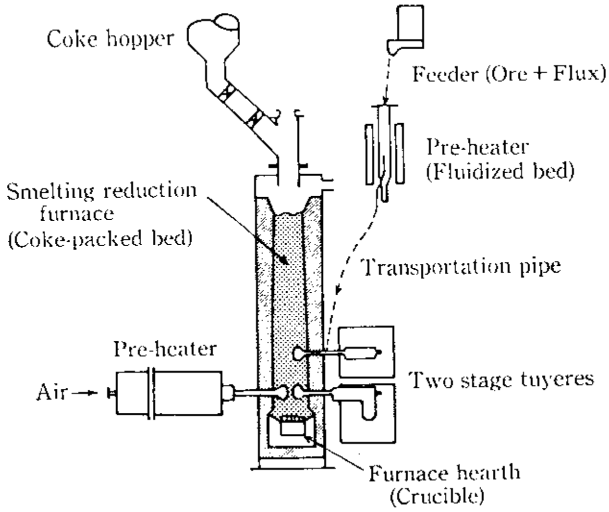
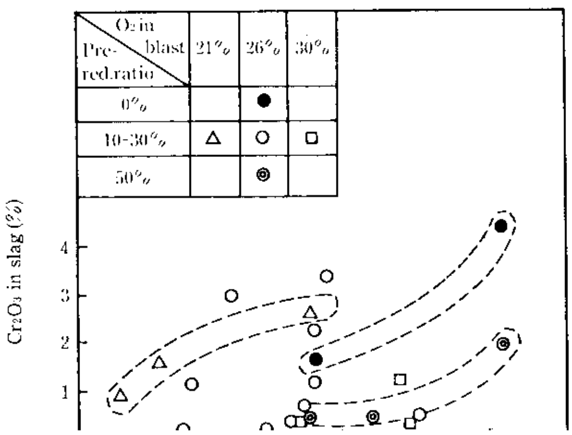



Fig. 6 Schematic diagram of the bench scale smelting reduction furnace

dependent on coke size. When the coke size is larger [redacted]

to be almost the same as with a cold model test. This observation suggested that the coke size should be larger than 14 mm.

**Figure 5** shows the effect of the ore charging rate on the average residence time. Average residence time is a function of ore charging rate, coke size, heat supply, and bed height. Initially, average residence time decreases with increased ore charging, but increases very sharply with further increases in the charging rate because the heat supply becomes inadequate to maintain the endothermic reaction which characterizes smelting reduction. This problem is easily solved with the two-stage tuyeres, as the heat supply to the smelting reduction zone can be controlled by properly distribut- [redacted]



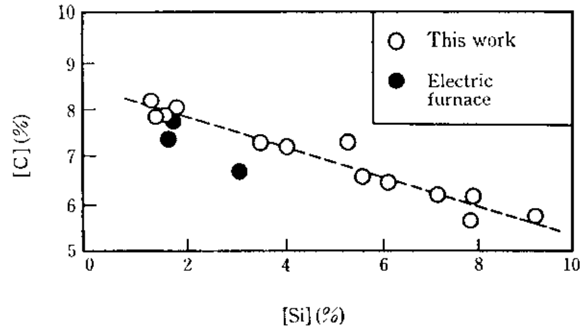



Fig. 9 Relation between C and Si content in metal [illegible]

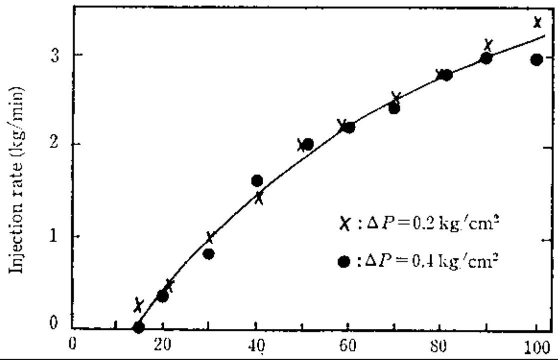



Fig. 10 Influence of the fluidizing gas amount on the ore injection rate

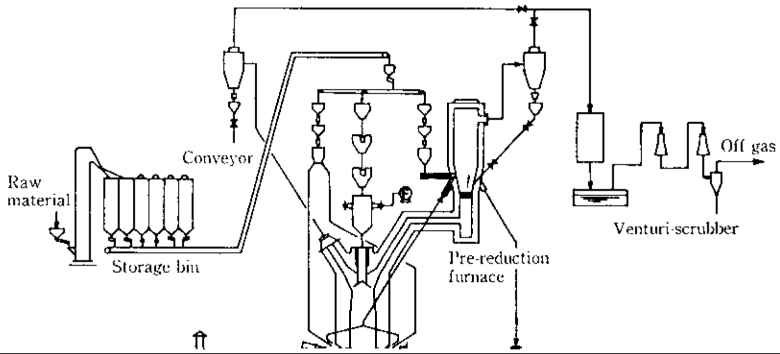
### 4.3 Gravitational Ore Transportation System

One of the fundamental features of the STAR process is the direct injection of fine ore into the smelting reduction furnace through the upper tuyeres. The abra- [illegible]

[illegible] container were regarded as a pre-reduction furnace and [illegible]

sion of the transportation tubes and injection tubes is a serious problem with the conventional pneumatic powder transportation system, and may become even more serious when hot pre-reduced ore is used. Thus, the realization of a practical STAR process required develop- [illegible]

smelting reduction furnace respectively. As the ore flow rate control device, a small fluidized bed was used, in which the flow rate of the ore was controlled by the amount of fluidizing gas. The effects of fluidizing gas volume, transport pipe angles [illegible] the required pow- [illegible]



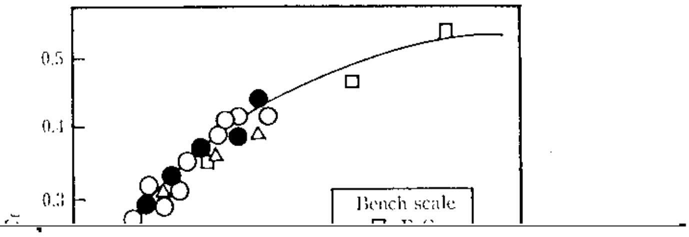
Raw material
Conveyor
Storage bin
Off gas
Venturi-scrubber
Pre-reduction furnace

Table 1 Operation tests of pilot plant

Top gas temperature varied in the range from 700°C to 1000°C, and was mainly dependent on the coke ratio

Table 2 An example of heat balance and parameter $E_f$ of the pilot plant test

| | Zone I | Zone II | Zone III |
|---|---|---|---|
| Input | 4 890 kcal/h | [A] 8 930 kcal/h | 980 kcal/h |



[redacted]

fluidity and melting point of slag by the adjustment of slag composition.

(2) A gravitational powder transportation system was developed to feed fine ore to the smelting reduction furnace.

(3) Operating and equipment conditions for upscaling the process can be estimated from the heat utilization parameter.

(4) The production cost of ferrochromium on a com-


64

11) H. Katayama, T. Koitabashi, and T. Hamada: *Tetsu-to-Hagané,* 73(1987), 15, 2130

12) T. Hamada, Y. Takada, H. Katayama, S. Takeuchi, and T. Fukutake: 5th IISC, Washington D. C. (U.S.A.), April (1986), 19

13) M. Sumito, T. Inatani, Y. Takada, H. Katayama, T. Hamada, and N. Tsuchiya: *Tetsu-to-Hagané,* 69(1983)4, S12

14) Y. Takada, H. Katayama, M. Sumito, T. Inatani, T. Hamada and N. Tsuchiya: *Tetsu-to-Hagané,* 70(1984)2, A25

15) H. Katayama, Y. Takada, M. Sumito, T. Inatani, T.


[redacted]