KAWASAKI STEEL TECHNICAL REPORT
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Production of Ultra-Low Carbon Steel by Combined Process of Bottom-Blown Converter and RH Degasser

Norio Sumida, Tetsuya Fujii, Yukio Oguchi , Hitoshi Morishita, Keisuke Yoshimura, Fumio Sudo

Synopsis :
A method for producing ultra-low carbon steel with carbon content 20 ppm or less was investigated, and a highly efficient and yet economic manufacturing process using the combination of bottom-blown converter and RH vacuum degasser was established. First, the decarburizing reaction in the RH vacuum degasser was analyzed using a reaction model, and the relationship between operational conditions and the rate of decarburization was elucidated. On the basis of the analytic results, it was attempted to

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Norio SUMIDA** Tetsuya FUJII** Yukio OGUCHI**
Hitoshi MORISHITA*** Keisuke YOSHIMURA*** Fumio SUDO***

rate in RH was analyzed by using a mathematical model so as to obtain basic data for determining optimum equipment dimensions and operational procedures[1].

A reaction model used for the analysis is shown in **Fig. 1**. In designing the model, the following assumptions were made.

(1) Molten steel is perfectly mixed in both ladle and vacuum vessel.

[redacted]

vacuum vessel only.

(3) The rate of decarburization reaction is proportional to carbon concentration in molten steel and

[redacted]

$$V\frac{dC_L}{dt} = Q'(C_V - C_L) \quad \cdots\cdots (1)$$

$$v\frac{dC_V}{dt} = Q'(C_L - C_V) - ak(C_V - C_e) \cdots (2)$$

Initial conditions are

$$C_L = C_V = C_L^0, \text{ at } t = 0 \quad \cdots\cdots (3)$$

V and v: Volume of molten steel(m³) in ladle

[redacted]

ak: Volumetric coefficient for decarburization reaction (m³/min)

C_L, C_V: Carbon concentration(%) in ladle

[redacted]

That is G is determined by ak alone in case of

3.1 Experiment for Increasing Circulation Rate

3.1.2 Results and discussion

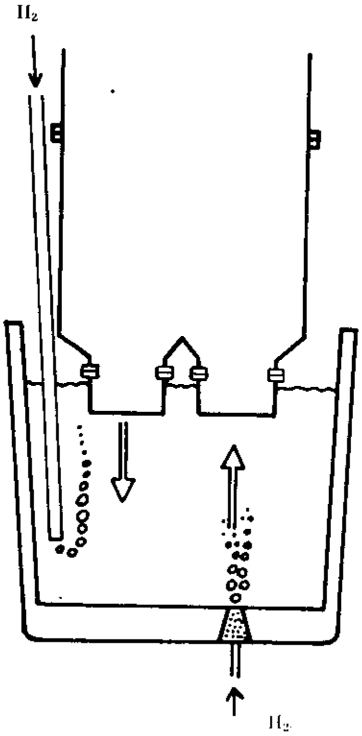
...area, A, of snorkel to the circulation rate, Q (l/min)...

3.2 Experiment for Increasing Decarburization Rate

3.2.1 Snorkel diameter and increase of Ar gas flow rate

hydrogen gas required for improving the decarburization rate was calculated as described below.

Generally, the decarburization reaction proceeds apparently in the form of first order reaction, but in



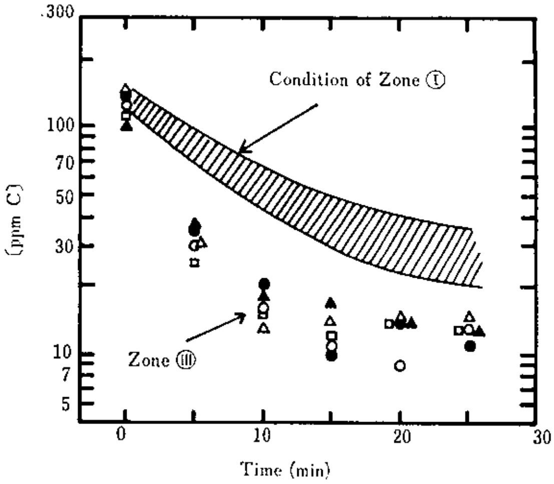


Fig. 9 Decarburization curves for conditions of zone Ⓘ and Ⓘⓘⓘ

3.2.3 Experiment for feeding argon gas into vessel

In parallel with the experiment for hydrogen

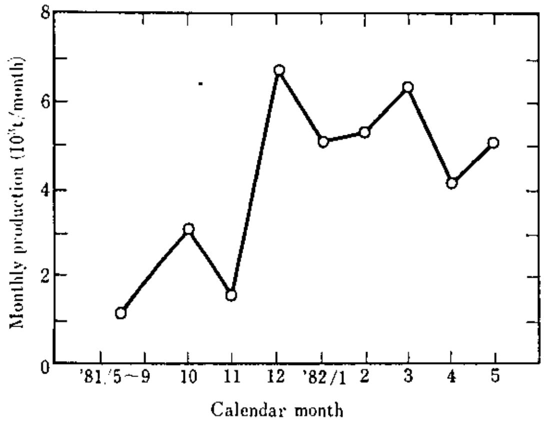


Fig. 10 Monthly production of ultra low ...

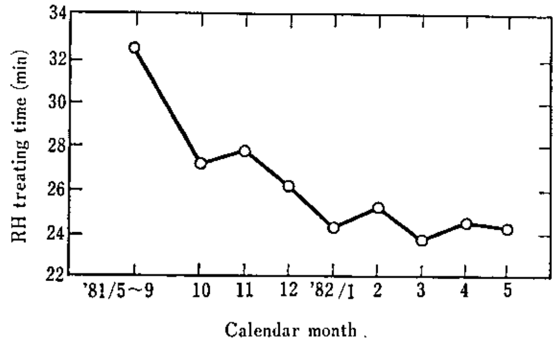
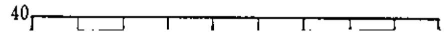


Fig. 11 Monthly change of RH treatment time



5 Mechanical Properties of Ultra-Low Carbon Steel Produced by the New Method

[illegible]

Table 2 An example of chemical composition of ultra-low carbon steels (%)

[illegible]