

Molten Steel Flow Control System in Mold by Electromagnetic Force[†]

1. Introduction

In continuous casting of steel, the following are essential goals:

- (1) Stable high efficiency casting (breakout-less continuous casting)
- (2) Casting of very clean steel with minimal inclusions
- (3) Improved yield by eliminating the need for CC slab conditioning
- (4) Energy saving by direct rolling

Electromagnetic control of the molten steel flow in the continuous casting mold is increasingly used because it provides an extremely effective technology for achieving these aims. The JFE Group possesses advanced technologies in this field, as described in this paper.

2. Outline of JFE Molten Steel Flow Control Technologies

The JFE Group has developed two types of molten steel flow control technology for continuous casting, the flow control mold (FC-Mold) using a static magnetic field and a flow control system (EMLS/EMLA) using a traveling magnetic field, as shown in **Figs. 1** and **2**, respectively. They make it possible to achieve the following:

- (1) Stabilization of operation by controlling the flow rate at the molten steel meniscus (Breakout-less operation)
- (2) Prevention of mold powder entrapment by controlling the flow rate at the molten steel meniscus
- (3) Prevention of inclusion entrapment by controlling the downward flow of molten steel

3. Superiority of JFE Technologies

JFE-type molten steel flow control systems are superior in the following points:

- (1) Optimization of the molten steel flow pattern in the mold is possible.
- (2) Automatic computer control of the applied magnetic flux density is possible.

FC-Mold: Unique automatic control of applied mag-

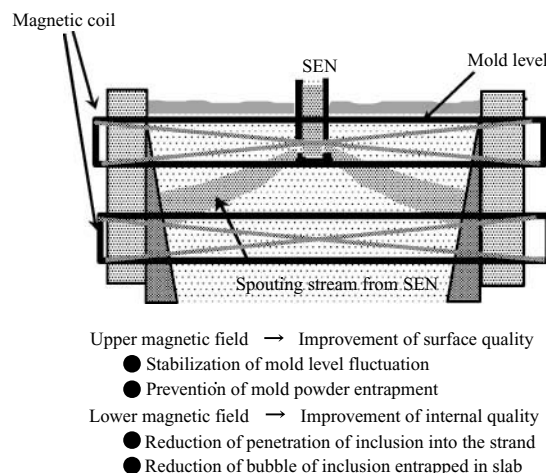
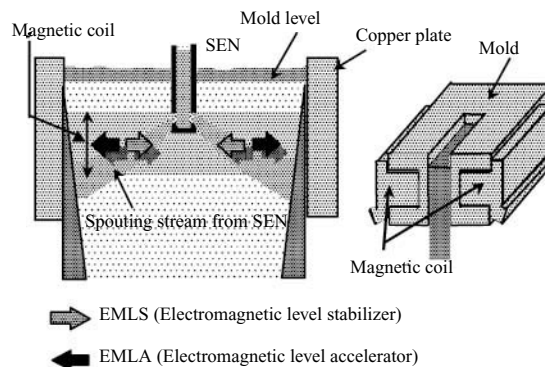


Fig. 1 Molten steel flow control by static magnetic field



Developed flow control technology by traveling magnetic field
 → Realized optimum flow control as cast conditions change

Minimization of non metallic inclusions entrapped in slab by optimum meniscus flow control by EMLS/EMLA with automation.

Fig. 2 Molten steel flow control by traveling magnetic field

netic flux density

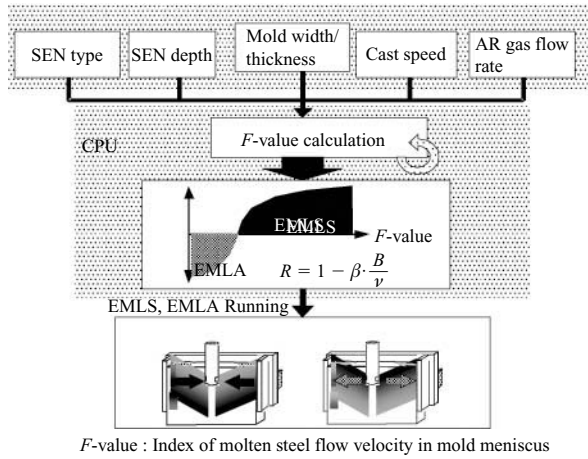
EMLS/EMLA: Automatic control of direction and intensity of traveling magnetic field

As a result, it is possible to realize stable, highly efficient continuous casting operation in the production of high quality, as-cast (conditioning-free) slabs.

4. Example of Application of Computer to Actual Continuous Casting Machine

JFE Group's molten steel flow control system enables automatic computer assisted operation from the start

[†] Originally published in *JFE GIHO* No. 3 (Mar. 2004), p. 68



F -value : Index of molten steel flow velocity in mold meniscus

Fig.3 An example of computer control of molten steel flow control system in caster mold

of casting to the end. An example of application to an actual continuous casting machine is shown in Fig. 3.

5. Summary

The electromagnetic molten steel flow control systems for continuous casting are being used successfully not only at JFE Steel, but also in a large number of continuous casting machines at other steel makers inside and outside of Japan.

References

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- 2) Idogawa, Akira et al. Control of molten steel flow in continuous casting mold by two static magnetic fields covering whole width. Kawasaki Steel Technical Report. no. 35, 1996, p. 74.

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