(233) CONTINUOUS CASTING OF CALCIUM TREATED STEEL

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1. Introduction

High grade steels for long products in the automotive industry are generally cast into large bloom sections (1). However, with the continuing requirement to save yield, production costs and energy, strong attempts are made to manufacture such steels by billet casting. This has become feasible by the introduction of Ca treatment enabling to cast Al fine grain steels through small metering nozzles (about 13 to 18 mm ∅) without clogging problems (2). The present investigation describes such technique.

2. Investigation Procedure

On a billet caster equipped for sections 100, 130 and 130 x 250 mm various CaSi addition methods were investigated to achieve reproduceable conditions for casting aluminium containing fine grain steels over 0.020% Al on a reliable basis through metering tundish nozzles. In order to ensure high steel cleanness, full stream protection was applied.

Initial trials were carried out with CaSi injection through a retractable lance. However, with excessive calcium silicide injection quantities the casting success rate was low because of nozzle clogging caused by the formation of solid high CaO containing inclusions. In order to optimise the conditions for the formation of liquid calcium aluminates, Al and Ca additions were calculated and carefully dosed depending on carbon and oxygen content of the steel (3).

After recent installation of a ladle furnace, calcium silicide injection was converted to cored wire feeding which offers several advantages like: simplified operation, less temperature losses, higher calcium recoveries and further improved product quality.

Section: 130 x 130 mm, Nozzle: 15 mm ∅
Analysis: 0,36% C, 0,22% Si, 0,43% Mn, 0,024% Al_{sol}, 0,026% Al_{tol}, 3,8 ppm O in TD

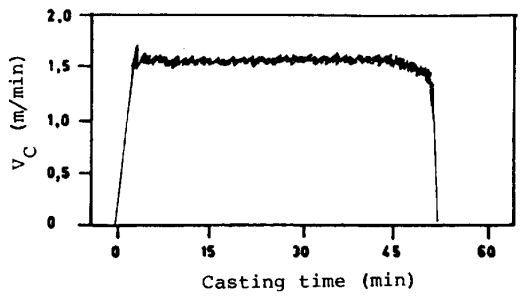

Fig. 1 Casting speed of Ca treated Al fine grain steel through metering nozzle

3. Results

Although the optimised pneumatic calcium silicide powder injection gave good castability (Fig. 1) and final product quality (Fig. 2), further improvement could be achieved by wire feeding in combination with the ladle furnace treatment. Because of the precise control of analysis and deoxidation conditions and due to the better recoveries (2-3 fold compared to pneumatic injection) of the cored wire feeding, the wire quantities could be considerably reduced (0.3-0.8 kg CaSi per ton) depending on the carbon content of the steel. Control of ladle slag, selection of refractories and careful shrouding are of additional importance for the process to assure good castability.

4. Discussion and Conclusions

As has been shown, the billet casting of Al fine grain steels based on Ca treatment can be successfully performed provided that careful control of all parameters pertinent to this somewhat delicate process is established. Also the product properties depend on process control. In future it is expected to replace a substantial portion of bloom production by billet casting of special steels.

REFERENCES

(1) H. Hirata, M. Ozawa, D. Ohtsuga: CONCAST Special Steel Bloom Casting Seminar, Zurich 1982
(2) D. Reiber: CONCAST Special Steel Billet/Bloom Casting Seminar, Zurich 1979
(3) EP-Patent Application 0 083 920

Section: 130 x 130 mm
Analysis: 0,32% C, 0,25% Si, 0,42% Mn, 0,035% Al, 0,03% Ti, 0,0034% B

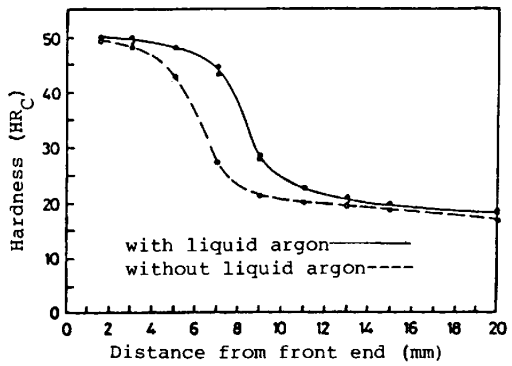

Fig. 2 Hardenability of Ca treated SAE 10B30 with and without stream shielding