(128) Review of Mould Friction Measurements

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1. Introduction: Modern continuous casting technology based on hot charging or direct rolling requires close control of strand surface quality. A major factor of influence is the lubrication effect of mould powder. Hence, the measurement of mold friction appears to be an essential tool for process optimization. For effective measurement, the friction sensor should be as close to the mold as possible in order to avoid the disturbance by other factors.

2. Investigation Procedure and Results: In an early attempt, a freely suspended mold was used and the net friction force measured by piezo-quartz transducers mounted in the mold support (1). As shown by the example in Fig. 1 for 40 kg/mm^2-plate grade steel, there is quite a strong dependence of longitudinal face cracks on the friction force.

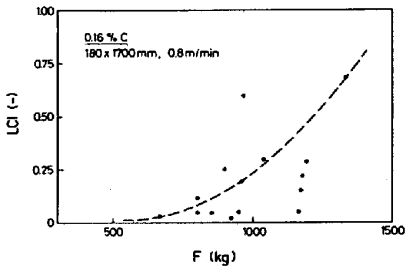

Fig. 1 Long. crack index, LCI versus friction force, F

The extent of friction forces very much depends on the stability of casting conditions - beside the optimum choice of mold powder. This has been clearly shown on subsequent trials with a relative friction indicator based on the accelerometer principle, the M.L. Tektor (2). For instance Fig. 2 gives for a 3 % Si-steel high friction at start of cast but a low friction level as soon as a stable level of casting speed is reached. Of course, the optimum speed level depends on the powder type: the case of an austenitic stainless steel of type SUS 304 in Fig. 3 cast with a low viscosity powder ($\eta \sim 1{,}5$ poise at 1300°C) indicates lowest friction levels at 1,2 m/min and higher. Hence, such conditions will also lead to best surface quality, and a relative viscosity $\eta \cdot V^2$ of about 5 poise · m^2/min^2 found for most stable slag film conditions (3).

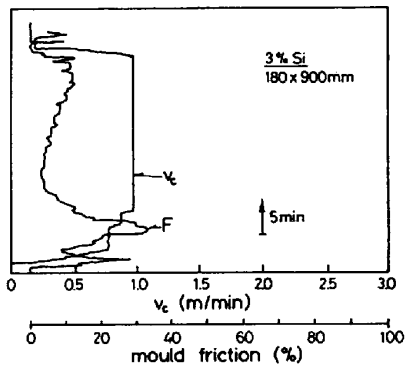

Fig. 2 Curves for casting speed, V_C, and relative friction, F

3. Discussion and Conclusion: Extensive trials with mold friction measurement for many different steel types have confirmed its importance for the evaluation of mold powder performance as well as strand surface quality. Thereby, the M.L. Tektor was found to be a very simple and efficient device of high reproducibility - provided a stable mold oscillation system without mechanical disturbances (short lever-type). This contributes an important element to the direct processing of as-cast products without any visual surface inspection.

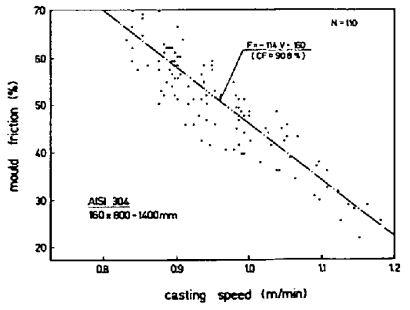

Fig. 3 Relative friction, F, versus casting speed, V_C

References: (1) M. Schmid: CONCAST News 12, 1/1973, 6-8,
(2) B. Mairy, D. Ramelot: Rev. Mét.-CIT, May1980,403-408,
(3) M. Wolf: Trans. ISIJ 20 (1980), 710-724