'81－S 156

621.746.047: 536.421: 620.191.3

(142) ELEMENTS OF SURFACE MARK FORMATION IN CONTINUOUS CASTING OF STEEL

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I. Introduction

The very first seconds of solidification are of utmost importance in determining the surface quality of a casting. This is particularly true if casting is done in a mold giving a high cooling rate, e.g. as in continuous or ingot casting of steel. Transparant organic substances and steel were used to simulate the first stage of solidification in the continuous casting mold. Direct observation of solid shell formation at the very beginning of solidification indicated the importance of liquid meniscus shape and stability, especially just before close contact with the mold wall.

II. Experiments

As the first step, surface mark formation on chilling mold wall was simulated by organic substances. For direct observation of meniscus, a refractory mold was prepared with water-cooled metal on one face and a transparant quartz window perpendicular to this face. Liquid steel was bottom poured under gas atmosphere such as air, H_2 or Ar or under molten slag. Form and movement of the meniscus were photographed through the window (Fig. 1) and compared with theoretically determined shape. Steel casting simulation was carried out using Laboratory Continuous Caster.

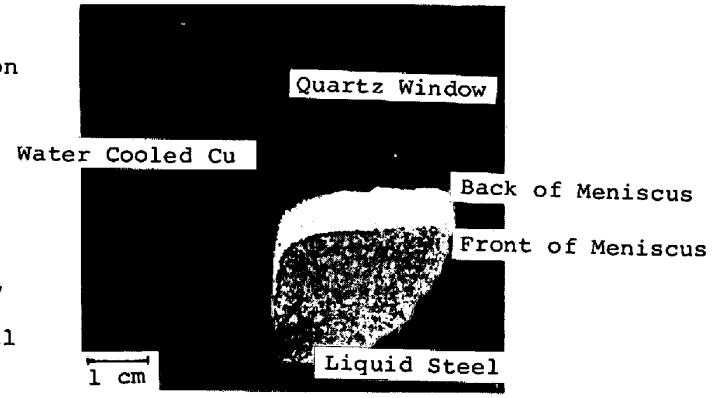

Fig. 1 Shape of ascending steel meniscus (Conditions; air atmosphere, static water-cooled Cu mold)

III. Results

By organic simulation two types of marks were observed to form; oscillation mark and folding marks; depending upon relative movement between shell and mold wall. The profile of solidified layer suggested a partial solidification of the meniscus. Discrepancies were found between the calculated and the observed shape of the meniscus, particularly in the vicinity of the mold wall, this being interpreted as the effect of partial solidification in the meniscus. A direct relationship was found between the discrepancy and depth and the discrepancy and pitch of the marks observed on steel casting. By steel casting simulation using Laboratory Continuous Caster, it became clear that the strength of the partially solidified meniscus and compressive forces acting on the meniscus induced by mold movement play important roles in determining cast surface morphology. Based on these findings elements of surface mark formation in continuous casting of steel were cleared.