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The Effect of Steel Composition on Crackformation during  
Solidification in Continuous Casting

Concast AG, Zurich

Dr. M. Wolf

Swiss Institute of Technology, Lausanne Prof. Dr. W. Kurz

1. Introduction: As shown in a recent review (1), probably all internal cracks and also many types of surface cracks can be related to low ductility of steels in the temperature range just below equilibrium solidus. In C-steels, the detrimental effects of P and S are quite clear while the influence of C-content itself is not well understood.

2. Investigation Procedure: It has been attempted to establish the effect of C-content on the microsegregation of tramp elements during the initial stage of strand shell formation in the continuous casting mould (2). This was based on calculations with the extended Scheil-equation as proposed by Brody and Flemings (3) considering the extent of back diffusion during solidification as function of the diffusion coefficient in solid, the local solidification time and the secondary dendrite arm spacing.

3. Results and Discussions: As shown in Fig. 1, the difference between equilibrium and non-equilibrium solidus temperature which can be considered a direct measure for the crack sensitivity of steels has a minimum at 0.10 % C and a maximum at medium C-contents for both cases, the calculated data and the ones determined by thermoanalysis. This behaviour agrees well with actual observations for the effect of C-content on crack formation.

4. Conclusion: From these results it can be concluded that with increasing austenite ratio during solidification, the extent of micro-segregation especially of alloying elements with low distribution coefficient is much enhanced leading to significant decreases in the non-equilibrium solidus which, correspondingly, causes higher crack sensitivity. Based on this approach, also the crack sensitivity of highly alloyed steels can be predicted from the ferrite-austenite ratio during solidification as based on the proper coefficient for Cr- and Ni-equivalents (4).

## 5. References:

- (1) J.K. Brimacombe, K. Sorimachi: Met. Trans., vol. 88 (1977) 489
- (2) M. Wolf: Dr. sc. thesis, ETH Lausanne 1978
- (3) H.D. Brody, M.C. Flemings: Trans. Met. Soc. AIME, vol. 236 (1966) 615
- (4) "A guide to the solidification of steels", Jernkontoret, Stockholm 1977

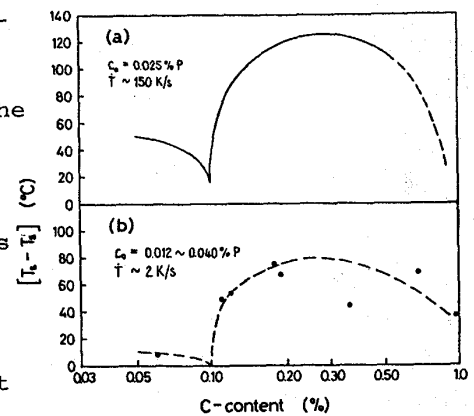


Fig. 1: Difference between equilibrium solidus,  $T$ , and non-equilibrium solidus,  $T'$ , as function of C-content  
a) calculated from P-segregation (2) and b) determined by thermoanalysis (4)