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On the Morphology of Steel Solidification Structures formed in the Continuous Casting Mould

Concast AG Dr. M. Wolf

Zürich S. Kohl o

1. Introduction: Fine solidification structures assure best mechanical properties of the product (1). In continuous casting, the strand surface quality depends on the solidification structure formed in the mould; thereby, fine structures are obtainable with a large solidification constant or K-factor (2). However, small K-factors are observed for steels with uneven shell growth ("depressions") such as 0.12 % C-steels (3,4) or austenitic stainless steels (5), thus, also a coarse solidification structure may be expected.

2. Investigation: First, previous investigations (5,6) have been extended to define the alloy effect on macroscopic shell growth and depression formation in the mould more clearly. Second, the microstructure was investigated comparing areas of normal growth with depression areas.

3. Results and Discussions: As shown in Fig. 1, shell growth behaviour fluctuates most widely around 0.12 %C for unalloyed steels, and at Ni'/Cr'≈0.55 for austenitic stainless steels. This is enhanced by high cooling intensity i.e. low mould wall temperature and slow casting speed as well as by unstable casting conditions i.e. mould level variations and non-uniform mould powder behaviour.

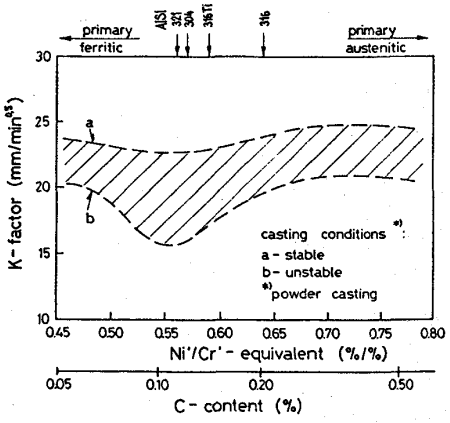

Fig. 1 Alloy effects on K-factor in the mould as function of casting conditions (powder casting)

The investigation of microstructure for a 0.07 % C-steel (Fig. 2) shows distinct dendrite coarsening in the depressed areas. Similar results are also obtained for stainless steel type 304 with Ni'/Cr' of 0.55; in this case, some of the depressed areas show transverse cracks already formed in the mould.

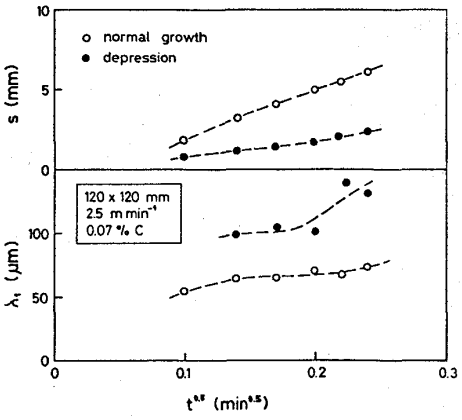

Fig. 2 Shell growth behaviour and primary dendrite arm spacing (open pouring)

4. Conclusion: To obtain even shell growth and fine solidification structure in the mould especially for shrinkage-sensitive steels, stable casting conditions and "soft" mould cooling are required. Besides, the check of microstructure is a useful means to identify the solidification conditions in the continuous casting mould.

5. References:

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