Abstract

During the production of steel slabs, blooms and billets formation of surface cracks can be often observed. The formation of the cracks occurs usually during straightening of cast slab, bloom or billet in the temperature range 600°C – 1000°C and is correlated very well with the II ductility trough of steels.

The main goal of the experimental part of this project was to investigate the influence of microstructure (mainly microsegregation) and the deformation on the formation of the II ductility trough. Therefore, high temperature tensile tests were performed on the “in-situ” solidified and solution treated samples of two microalloyed steels.

The second experimental topic investigated in this research project was the analysis of the crack formation on the surface of blooms, which are hot charged in the furnace after continuous casting. The high temperature tensile tests were performed on the “in-situ” solidified samples of two microalloyed steel grades. The proposition for the improvement of the time – temperature history of cast bloom during hot charging has been suggested and evaluated with experiments and simulation.

The precipitation kinetics of the Nb(C,N) in austenite for the microalloyed steels has been numerically analyzed in this work. The experimental results on the Nb(C,N) precipitation kinetics in deformed and undeformed austenite from the literature have been reviewed. Based on this data and with the precipitation kinetics module of software package MatCalc, computer simulations were performed. An improvement in the numerical prediction of the precipitation state of Nb(C,N) has been achieved with critical analysis of the elements of the classical nucleation theory.

Additionally, a new approach for the numerical analysis of the precipitation kinetics in the cast microalloyed steels has been developed. The predicted precipitate fraction, mean radius and precipitate density as well as the precipitate composition after continuous casting of two microalloyed steels were simulated with the software package MatCalc and compared with experimental results obtained from transmissions electron microscopy.