**Politechnika Śląska**

**Wydział Inżynierii Materiałowej**

# ROZPRAWA DOKTORSKA

Effect of the chemical composition and processing parameters on the microstructure and mechanical properties of the bars subjected to innovative XTP process

**mgr inż. Radosław Rozmus**

**PROMOTOR**

**dr hab. inż. Krzysztof Radwański**

**PROMOTOR POMOCNICZY**

**dr inż. Radosław Swadźba**

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**ABSTRACT**

The development of bainitic steels for automotive and railroad applications is associated with improved resistance to low-temperature dynamic loads while maintaining strength. The paper deals with the development of technological parameters of a one-step XTP rolling process, and also discusses the selection of the chemical composition of 7MnB8 steel to reduce the DBTT temperature of the produced bars.

In this paper, a study was conducted that included simulations of the rolling process, and the rolling tests were carried out using the proposed parameter groups. Detailed microstructural studies and an analysis of the effect of parameters on the mechanical properties of 7MnB8 steel showed the obtaining of a gradient structure and fragmentation of the microstructure in the cores of the tested bars and on their surface. A finer structure was found on the surface, compared to the core of the bars and it was shown that lowering the water output during cooling, so that the bar structure on the cross-section is characterized by greater homogeneity. In the structure of 7MnB8 steel with Ti content of 0.088 wt. %, large precipitations of TiN and $Ti_2CS$ were revealed, the presence of which affects the reduction of impact properties. The lowest temperature DBTT = -120 °C was shown for a bar of 7MnB8 steel rolled using the rolling parameters TA = 980 °C, TR = 700 °C and accelerated cooling in 120;0;25 configuration. Based on the results of our own research, a comparative analysis of the microstructure and mechanical properties of steels with different contents of Mn, Mo, Nb, V and Ti subjected to processing was made, with the use of a group of technological parameters for which the lowest DBTT for industrial steel was obtained. It was shown that changing the configuration of alloying additives with a reduction in Ti content leads to elimination of $Ti_2CS$ and coarse TiN particles in the structure. A different bar structure was found to be obtained from steel with increased Mn content up to 2.9 wt. %. In the case of this steel, a UB structure with LB and GB areas was revealed, while, for the steel with Mn content of 1.9 wt. %, mainly GB was observed. The lowest DBTT temperatures of -150 °C and -180 °C were found for S660 and S659 steels, respectively, in which Nb additives were used and Ti content was reduced below 0.03 wt. %.