

THE EFFECT OF PRIOR AUSTENITE GRAIN SIZE ON MICROSTRUCTURE AND TENSILE PROPERTIES OF TEMPERED LOW ALLOYED 0.2C STEEL

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The preferred microstructure of recent developed advanced high-strength steels (AHSS) contain significant fraction of lath martensite. The initial austenitic structure has a significant effect on the dispersion of the elements of the quenched and tempered martensite. The mechanical properties of these steels are correlated with the size of the units of formed martensite.

In the present study the low-alloy steel Fe-0.25%C-1.6%Si-1.47%Mn-0.51%Cr-0.27%Mo was investigated. The steel was subjected to homogenization annealing at a temperature of 1150°C. The steel was quenched from 900°C and tempered at 200°C; 280°C; 400°C; 500°C for 1 hour. To decrease the size of prior austenite grains the hot rolling processing at 1000°C, followed by cooling in air was performed. Tensile tests were carried out at room temperature on an Instron 5882 machine.

The deformation of the steel in the austenitic region is an effective way to refine the austenitic structure, which results in a decrease of the size of the elements of the martensitic structure after subsequent quenching. However, for high-strength low-alloy steels, the effect of such treatment on the structure and mechanical properties during subsequent quenching and tempering has not yet been studied.

The investigation of the quenched steel structures in the initial state and after hot rolling operation showed that the average size of the PAGs was 32.7 μm and decreased to 16.6 μm in the pre-rolled steel. The subsequent tempering of quenched steels does not lead to a significant change in the dimensions of the structural elements of lath martensite. The results of tensile tests showed that decrease in the PAG size by ~2 times leads to a significant increase in the yield and tensile strength. The maximum increase in tensile strength of +28% was observed in the quenched steel. The yield strength of the pre-rolled steel after quenching at 900°C and tempering at 200, 280, 400, 500°C was 1360 MPa, 1330 MPa, 1330 MPa, 1250 MPa and 1090 MPa, respectively. With an increase in the tempering temperature, the increase in the tensile strength decreases and after tempering at 500°C it is 70 MPa. The ductility of the steel with a smaller average size of the initial austenitic structure insignificantly decreases, by 1–2% on average. Thus, the use of pre-rolling for high-strength low-alloy steels makes it possible to reduce the size of the PAGs and significantly increase the strength characteristics without a pronounced decrease in ductility.

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