EFFECT OF CARBON CONTENT ON THE STRENGTH OF HSLA STEELS AFTER TEMPFORMING

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Currently, special attention is paid to the development of structural steels and alloys adapted to the climatic conditions of the Far North, as well as for various constructions exploited at low temperatures. The first generation of HSLA steels showed a yield strength above 350 MPa [1]. The yield strength of modern HSLA steels has increased to 700 MPa as a results of dispersion strengthening provided by microalloying and grain refinement owing to thermomechanical treatment [2]. The strengthening by grain size also plays an important role in the strength of high-strength steels with ultrafine-grained ferrite.

The objects of the study were three steels of the following chemical compositions: 1) Fe-0.15C-1.32Mn-1.42Cr-0.45Mo-0.42Cu-0.17Ti; 2) Fe-0.26C-0.23Si-0.54Mn-0.42Cr-0.44Mo-0.06Ti; 3) Fe–0.36C–0.4Si–0.56Cr–0.57Mn–0.54Mo (all in wt %). Tempforming was chosen as a promising treatment of HSLA steels. The samples were tempered at temperatures of 550, 600, or 650°C for 1 h followed by multiple rolling at a tempering temperature to a total strain of 1.5.

Tempforming is an effective method to increase the strength without remarkable degradation of plasticity. The yield strength of steel with 0.15%C increases from 810 MPa to 1140 MPa, while total elongation decreases from 18.3 to 10.5% with a decrease in tempforming temperature from 650 to 550°C. The yield strength of steel with 0.26%C increases from 985 MPa to 1160 MPa with a decrease in tempforming temperature from 650 to 600°C, elongation decreases from 11.3 to 9.2%. The yield strength of steel with 0.36%C increases from 1180 MPa to 1510 MPa with a decrease in tempforming temperature from 650 to 550°C, elongation decreases from 13.3 to 7.2%.

Therefore, with an increase in the carbon content from 0.15 to 0.36%, the yield strength increases by about 25% along with corresponding decrease in plasticity.

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