EFFECT OF SEVERE HOT DEFORMATION AND DIFFERENT COOLING RATES ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF 0.2 C-0.1 V- 0.02 Nb STEEL

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ABSTRACT

Rebar steels are usually processed from carbon steel. However, carbon limits the deformability and weldability of steel rebars. Microalloying with V and Nb is the optimum solution when high strength in combination with good formability and weldability are essential. Nb replaces V partially for better ductility purposes. Nb plays a bilateral role where, it forms carbonitride which acts as precipitation strengthener. Further active role is played by Nb in grain refinement which would improve appreciably the yield strength and ductility. However, to get full benefit of Nb micro-alloying, the soaking temperature, deformation amount, finish rolling temperature and cooling after rolling should be taken into consideration.

The present article is dealing with 0.2 % C, 0.1% V, and 0.02% Nb steel. Billets with 130×130 mm cross section are austenitised and hold at 1080^{o}C. The billets were hot rolled to 22 mm bar diameter. Hot rolling was finished at 980-1000^{o}C. The final bars were air cooled. On a parallel way, an experimental hot deformation investigation, on the same steel, was carried out at deformation temperature range 1200-850^{o}C with the same amount of deformation (97% reduction in area). However, cooling regimes after deformation were air cooling, water quenching to 850^{o}C followed by air cooling, and water quenching to room temperature. Microstructure investigation was done using both optical and scanning electron microscopes. Further evaluation was done using mechanical testing. The industrial trial has unsatisfied results with a poorer yield strength linked with higher ultimate strength due to islands of abnormal coarse grains of mixed hard phases surrounded by ferrite grains. Bainitic as well as martensitic aggregates are detected in the hard phases islands. Air cooling after pilot hot deformation creates banded ferrite–pearlite microstructure with 9.11μm ferrite grains. However, quick water quenching to 850^{o}C followed by air cooling develops tempered and softened martensite phase. One the other hand, quick water quenching to room temperature develops fine ferrite-martensite texture. Water quenching to 850^{o}C followed by air cooling is the best regime creating accepted mechanical properties.

KEYWORDS: Carbon Steel, Nb Steel, Microstructure Banding, Hot Deformation