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Influence of Aluminium on Grain Refinement in As-Rolled Vanadium-Microalloyed Steels

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Abstract : The influence of aluminium content, reheating temperature, and sizing (final) strain on the as-rolled microstructure was systematically investigated in vanadium-microalloyed and C-Mn plate steels. Reheating, followed by hot rolling and air cooling simulations were performed on steels containing a range of aluminium and nitrogen contents. Natural air cooling profiles, corresponding to 6 and 20mm thick plates, were applied. The austenite and ferrite/pearlite microstructures were examined using light optical microscopy. Precipitate species and volume fraction were determined on selected specimens. No influence of aluminium content was found below 0.08% on the as-rolled grain size in all steels studied. A low Al-V-steel produced the coarsest initial austenite grain size due to AlN dissolution at low temperatures leading to abnormal grain growth. An Al-free V-N steel had the finest initial microstructure. Although the as-rolled grain size for 20mm plate was similar in all steels tested, the grain distribution was relatively mixed. The final grain size in 6mm plate was similar for most compositions; the exception was an as-cast V low N steel, where the size of the second phase was inversely proportional to the sizing strain. This was attributed to both segregation and a low VN volume fraction available for effective pinning of austenite grain boundaries during cooling. Increasing the sizing strain refined the microstructure significantly in all steels.

Keywords : aluminium, grain size, nitrogen, reheating, sizing strain, steel, vanadium
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