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Ferrite grain size control via two-stage cooling for structural steel tubes

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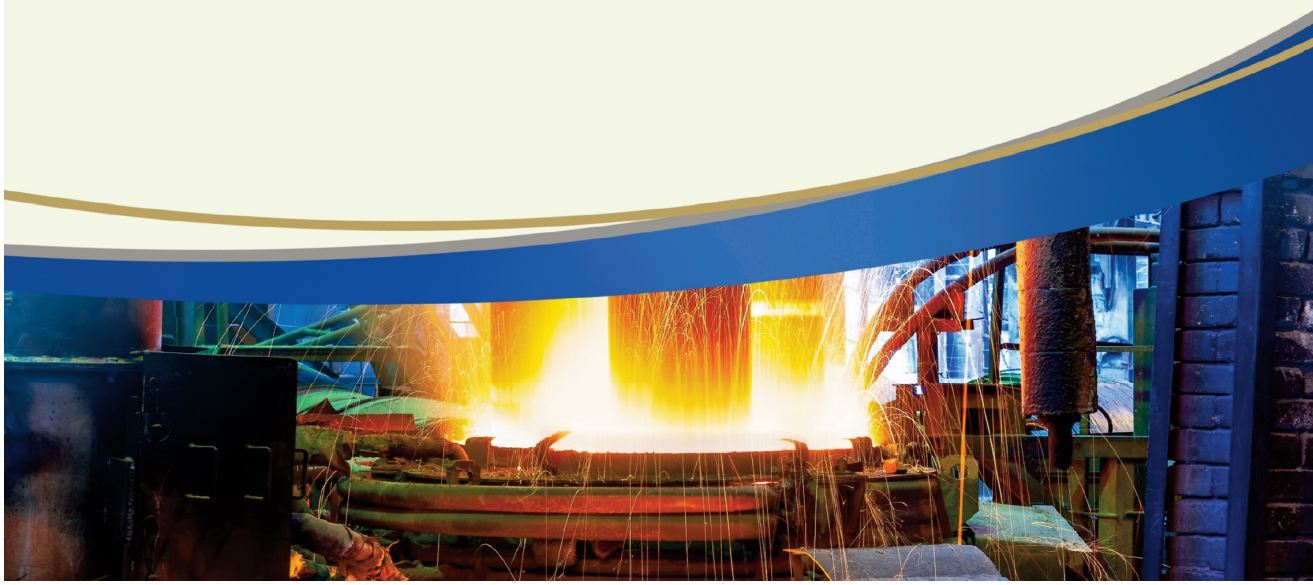
ABSTRACT:
In this work, ferrite grain size control during the manufacture of S355 steel tubes is investigated. Recent changes to standards, allow for accelerated cooling, replacing natural cooling. Annealed tubes are cooled with a two-stage process: rapid water cooling followed by slower natural cooling. Various amounts of ferrite are formed during each cooling stage. The aim of this work is to identify the levels of grain size refinement capable using two-stage cooling.

Dilatometry tests have been completed to simulate transformation and microstructure changes with varying industrial and hypothetical cooling regimes. Results show that by increasing the cooling rate from 1°C/s to 50°C/s reduces the ferrite grain size from 5.72µm to 2.60µm, with the grain size being "locked in" within the first 35% of ferrite formation. Fast cooling during the first 35% of ferrite formation maximizes grain refinement by forming stable ferrite nuclei at high undercoolings that are retained in final microstructure.



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