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PII: S0264-1275(16)30129-0
DOI: doi: 10.1016/j.matdes.2016.01.129
Reference: JMADE 1330

To appear in:

Received date: 13 September 2015
Revised date: 21 January 2016
Accepted date: 27 January 2016

Please cite this article as: Chenyao Xi, Daqian Sun, Zhaozhi Xuan, Jiegong Wang, Guoshan Song, Microstructures and mechanical properties of flash butt welded high strength steel joints, (2016), doi: 10.1016/j.matdes.2016.01.129

Microstructures and mechanical properties of flash butt welded high strength steel joints

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Abstract

Weld thermal cycles, microstructures and mechanical properties of flash butt welded RS590CL steel joints have been investigated. The results indicated that the weld thermal cycles are characterized by high peak temperatures and rapid heating and cooling rates, and the joints included the weld interface zone (WZ), coarse grain zone (CZ) , fine grain zone (FZ) and partially recrystallized zone (PZ). The WZ and CZ consist mainly of coarsened upper bainite while the FZ has a fine equiaxed grain structure containing ferrite and pearlite with NbC precipitates. The WZ and CZ have higher hardness compared with the FZ, PZ and base metal. The joint strength (584-611MPa) can match the base metal strength (575-595MPa). The impact toughness of weld interface zone in the joints depends on welding parameters. The excessive flash allowance results in reducing the joint toughness. The reasons for the reduced joint toughness are related to the coarsened upper bainite, retained oxides and joining defects in the weld interface zone. The suitable combination of flash allowance (8-9mm), upset allowance (5.5-7.0mm) and upset pressure (123-160MPa) is beneficial for the improvement of joint toughness.

Keywords: High strength steels; Flash butt welding; Microstructures; Mechanical properties