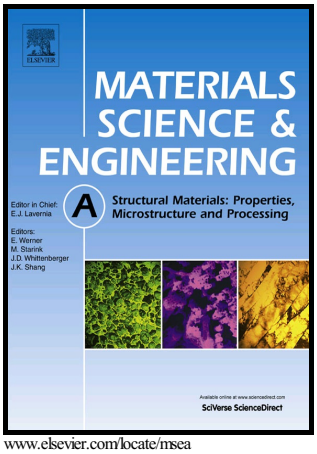

www.elsevier.com/locate/msea

Microstructure-property relationship in a high strength-high toughness combination ultra-heavy gauge offshore plate steel: the significance of multiphase microstructure

X.J. Sun, S.F. Yuan, Z.J. Xie, L.L. Dong, C.J. Shang, R.D.K. Misra

PII: S0921-5093(17)30218-6
DOI: http://dx.doi.org/10.1016/j.msea.2017.02.058
Reference: MSA34734

To appear in: *Materials Science & Engineering A*

Received date: 26 January 2017
Revised date: 15 February 2017
Accepted date: 16 February 2017

Cite this article as: X.J. Sun, S.F. Yuan, Z.J. Xie, L.L. Dong, C.J. Shang and R.D.K. Misra, Microstructure-property relationship in a high strength-high toughness combination ultra-heavy gauge offshore plate steel: the significance of multiphase microstructure, *Materials Science & Engineering A* http://dx.doi.org/10.1016/j.msea.2017.02.058

Microstructure-property relationship in a high strength-high toughness combination ultra-heavy gauge offshore plate steel: the significance of multiphase microstructure

X.J. Sun[1], S.F. Yuan[1], Z.J. Xie[2*], L.L. Dong[1], C.J. Shang[2*], R.D.K. Misra[3*]

[1]School of Materials Science and Engineering, University of Science and Technology Beijing, Beijing 100083 China

[2]Collaborative Innovation Center of Advanced Steel Technology, University of Science and Technology Beijing, Beijing 100083 China

[3]Department of Metallurgical, Materials and Biomedical Engineering, University of Texas at El Paso, El Paso, TX, 79968, USA

zjxie@ustb.edu.cn

cjshang@ustb.edu.cn

dmisra2@utep.edu

[*]Corresponding authors. Tel: +86 010 62332428; fax: +86 10 62332428.

Abstract

We elucidate here the microstructure-property relationship in a high strength and high toughness 60 mm thick ultra-heavy gauge plate steels characterized by ferrite-bainite multi-phase microstructure and compare with the conventional bainitic microstructure. Pilot-scale results indicated that high yield strength of ~486-508 MPa with high ductility of ~10% in uniform elongation, low yield to tensile (Y/T) ratio of ~0.74-0.77, excellent low temperature toughness of ~186-228 J at -60^{o}C and good weldability are obtained in a multi-phase steel through combination of controlled rolling and accelerated cooling. The multi-phase microstructure steel consisted of quasi-polygonal ferrite and lath bainite with the corresponding phase proportion of 3:2 and 2:3 at 1/4 thickness (1/4t) and 1/2 thickness (1/2t) locations, respectively. The positive impact of multi-phase microstructure on ductility, Y/T ratio, toughness and weldability were attributed to the following aspects: (a) results from Crussard-Jaoul (C-J) analysis indicated that the soft ferrite phase in the multi-phase microstructure favorably modifies the work hardening behavior and results in high ductility