WELD METAL TENSILE STRENGTH DETERMINED BY TESTING FLAT MICRO TENSILE AND ROUND TENSILE SPECIMENS

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1. Introduction

Welded joints are highly inhomogeneous parts of welded structures. Microstructures and mechanical properties in different regions of a joint can vary significantly. For some purposes, i.e. for determining the fracture behaviour, it is very important to know the local values of the yield strength, ultimate tensile strength and other quantities. However, it is rather difficult to determine the tensile properties of heat affected zone, or some specific welds (i.e. laser welds) due to their small dimensions, but it is important for a complete understanding of the joint behaviour. In the absence of the exact properties of HAZ, a flaw assessment procedure using the base metal properties could lead to an unsafe result.

Micro-hardness measured over the joint width can show the differences in strength, but it is not sufficient for determining accurate values of mechanical properties, especially the hardening exponent [1]. Therefore, micro tensile specimens are often used for determining the tensile properties through the zones of the welded joint [2]. In this work, properties of the joints are determined by testing flat micro tensile (MTS) specimens, Fig. 1, and also round tensile (RT) specimens, Fig. 2.

2. Experimental Results and Discussion

Testing is conducted on high-strength low-alloyed (HSLA) steel welded joints. The base metal (BM) is HSLA steel NIOMOL 490; details about the joints fabrication are given in [3]. Overmatched (OM) and undermatched (UM) joints are analysed. Chemical composition of the base metal and both filler materials is also given in [3].

The results (yield strength and ultimate tensile strength) obtained by testing the MTS specimens across OM and UM welded joints are given in Figs. 3 and 4, respectively.
The results obtained for RT and MTS specimens are compared in Fig. 5. For the base metal, rather similar values are obtained, which is in agreement with conclusions from [4], and can be attributed to homogeneous material properties.

However, differences exist between the tensile properties of the weld metals. For OM joint, larger values are obtained by MTS specimens, while the opposite situation is observed in the case of UM joint. This can be attributed to the influence of material heterogeneity, and many zones that are included when cutting the RT specimen from the joint (different fractions of as-welded and reheated microstructures, weld metal zone near the fusion line with significantly different strength, and possibly even a small portion of HAZ). Also, different stress state in the two specimen geometries can also influence the results, which will be discussed elsewhere.

**Fig. 3.** Tensile properties distribution - MTS specimens, OM joint

**Fig. 4.** Tensile properties distribution - MTS specimens, UM joint

**Fig. 5.** Tensile properties - MTS and RT specimens

3. Acknowledgements

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4. References


