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Industrial Member Report Summary – Key Findings for Industry

Underwater Wet Welding - Welding Steel with a Carbon Equivalent up to 0.40 using Rutile and Oxyrutile Electrodes

TWI Core Research Programme

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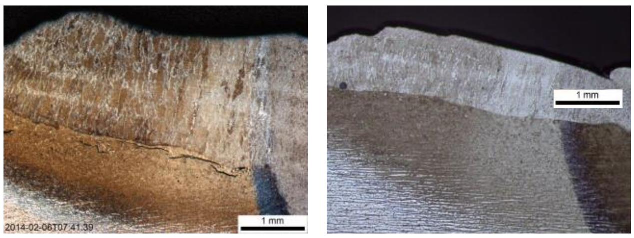
Industrial need

Underwater wet welding (UWW) represents a convenient and cost-effective option for in-situ repairs and modifications to offshore platforms and ship hulls. One of the major challenges when applying this welding process is that the inherently high cooling rates and hydrogen content make underwater wet welds particularly susceptible to fabrication cracking due to hydrogen embrittlement. Therefore, the performance of joints obtained with this technique cannot be compared to their conventional surface welding counterparts. As a consequence, the application of UWW is limited to the installation of temporary attachments and to the repair of secondary structural elements.

The aim of this study was to evaluate the possibility of obtaining underwater wet welds with mechanical properties and soundness comparable to that of welds made 'in air', by applying rutile electrodes in conjunction with a controlled deposition (temper bead) technique or by using recently developed oxyrutile electrodes.

Key findings

- For underwater wet welds made using rutile electrodes and a controlled deposition technique HAZ hardness equal to or below 325HV (AWS D3.6 Class A) could be obtained, although not consistently.
- When hardness values meeting AWS D3.6 Class A were obtained, hydrogen cracking still occurred.
- For underwater wet welds made by buttering with oxyrutile electrodes, HAZ hardness generally meeting the AWS D3.6 requirements for Class B (maximum 375HV) could be obtained.
- Despite the relatively high hardness, the occurrence of HAZ cracking was significantly reduced, compared to welds obtained with rutile electrodes.
- Oxyrutile electrodes are prone to solidification cracking at the weld root and their user friendliness is considered relatively low.



(a) (b)

Weld cap HAZ obtained with:
(a) Rutile electrodes; (b) Oxyrutile electrodes.

How to benefit from this work

- As an Industrial Member of TWI, you have free access to the full report
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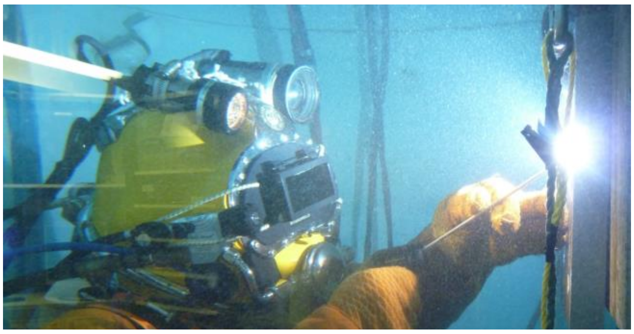

Underwater welding being carried out. Courtesy of Hydroweld UK.