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Industrial Member Report Summary – Key Findings for Industry

Linear Friction Welding of Nickel Superalloys for the Oil and Gas Industry

TWI Core Research Programme

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Industrial need

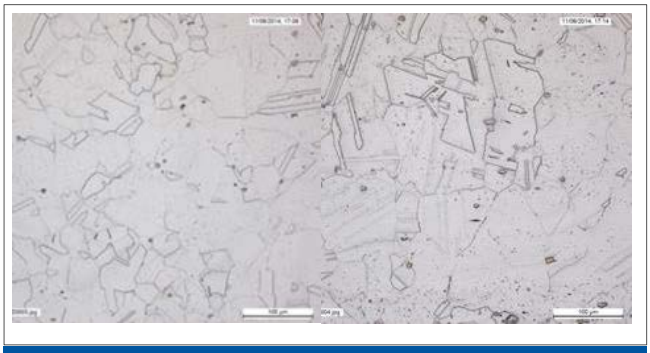
Nickel Superalloy 718 (Ni718) is used in numerous subsea assemblies. Friction welding techniques offer the potential for solid-phase additive manufacture to build up semi-finished, close to net shape products by the successive welding of relatively simple shapes. This approach can dramatically reduce the volume of raw material used and the extent of machining required in part production, which can result in significant cost savings, time savings and associated environmental benefits.

Ni718 bolts have previously been selected as suitable demonstrators to show the potential of this approach as they are currently machined from billets, or hot press forged, and these are relatively expensive, and time consuming methods

Key Findings

Demonstrator parts matching API 6A718 specification:

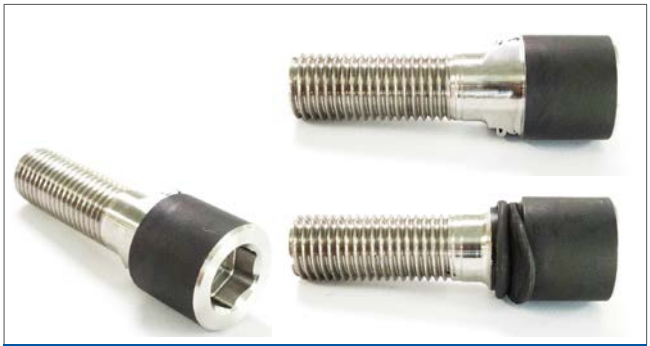
- Pre-welding heat treatment of Ni718 does not offer any benefit in terms of weld quality.
- LFW of as received Ni718 shows a narrow process window. Nominal parametric conditions were defined.
- Annealing treatment matching API6A718 was found.
- Age hardening treatments were trialled with grain size, δ phase and tensile properties consistent with API Standard 6A718 (2009).



Annealed weld centreline and parent material

Economic assessment for the manufacture of Ni718 LFW bolts:

- Compared with an aggressive CNC production strategy, the LFW production route can offer significant cost savings due to increased speed of manufacture, and savings in input material.
- For the three bolt sizes studied, the LFW route was found to offer global savings of up to 60% compared to the CNC route.



M16 bolt demonstrator

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