MT-CWR-85-033

PROGRESS STATEMENT

Use of Radioactive Tracers to Detect Stress Corrosion Cracking in Offshore Structural Welds

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July, 1985

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Summary

Since the last progress report, stress-corrosion cracking tests have been performed on specimens welded with Multimet 155 superalloy welding consumables, fabrication of specimens containing other concentrations of tracer elements has progressed, and results of irradiation studies have been received from Los Alamos National Laboratories. In addition, the preliminary results of this project have been presented at the AWS National Convention in Las Vegas, Nevada, and a paper has been prepared and accepted for poster presentation at the Eleventh World Conference on NDT sponsored by ASNT is Las Vegas, Nevada, next November.

Stress Corrosion Cracking Tests

Preliminary results of stress-corrosion cracking tests done on welds of Multimet 155, a superalloy containing high levels of cobalt and nickel, indicate that both nickel and cobalt are released as soluble corrosion products by stress corrosion cracking of this ferrous alloy in an artificial seawater environment (see Table I). Specimens have also been fabricated and will soon be tested to determine if the same results will be applicable to corrosion fatigue of this alloy in the same corrosion medium (artificial seawater).

Additional Specimens

In order to better extrapolate to the very low levels of tracers expected for the final application of the results of this project, welds are being

fabricated from alloys containing lower levels of tracers. A weld has been made with a 308L stainless steel electrode and WOL-CT specimens are currently being machined. Approximately 150 ft (27.7 m) of 3/32 in (2.4 mm) diameter wire has been made from 0.5 in (12.7 mm) diameter rounds of 18Ni (250) maraging steel. Additional wire is currently being drawn and welding will commence as soon as sufficient wire to complete a weld is produced.

Table I. Corrosion Product Resleased by Stress-Corrosion Cracking of a Superalloy in Artificial Seawater

Element	Percentage of of Alloy	Tracer Released mg/cm_2	Normalized Tracer Release Release (mg/cm_2-%)
Ni	20.1	3.0	0.15
Co	19.8	0.4	0.02

Irradiation Studies

Results of irradiation studies done at Los Alamos National Laboratories (LANL) indicated that the potential for in-situ irradiation of these welds is good if Co-60 is used as the tracer element and problems with formation of Fe-59, a beta-emitting radioactive isotope of iron are overcome. The noise from this isotope of iron can probably be eliminated either with an energy-specific radiation detector or a time delay before first inspection. It should be noted that this particular isotope of iron was considered as a tracer element, but quickly eliminated from the potential tracer list due to its' relatively short half-life of 45 days.

Future Efforts

Work in the next quarter will consist of producing and machining the welds made from the 18Ni (50) wire and initiating corrosion fatigue studies of these welds using WOL-CT specimens. The literature has shown that corrosion fatigue is a serious concern with offshore structures and pipelines, but that stress-corrosion cracking is much less likely to occur. Given the time constraints regarding this project, we have decided to do corrosion fatigue studies first, then follow-up with stress-corrosion cracking if needed. Evaluation of the irradiation studies conducted at LANL will be used to determine the background radiation which occurs when welds are subjected to a neutron source. Use of such a source could potentially eliminate the environmental problems associated with the use of welding consumables containing activated radioactive tracers.