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STRESS CORROSION CRACKING OF TYPE 422 STAINLESS STEEL

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Transmutation refers to the transformation of spent nuclear fuels that occurs when the nucleus of an atom changes because of natural radioactive decay, nuclear fission, nuclear fusion, neutron capture or other related processes. An important component of a transmutation facility is a target system that produces and utilizes an intense source-driven neutron flux for fission of transuranix and transmutation of fission products. These neutrons are generated by direct impingement of accelerated proton beam on to a target material such as martensitic Type 422 Stainless Steel (SS), by a process known as Spallation. It is known that this target material may become susceptible to stress corrosion cracking (SCC), hydrogen embrittlement (HE) and localized (pitting and crevice) corrosion during Spallation process.

This paper presents the results of SCC tests of quenched and tempered martensitic Type 422 SS in neutral and acidic aqueous environments at ambient temperature and 90°C.The susceptibility of smooth and notched tensile specimens to SCC was evaluated by using constant load (CL) and slow strain rate (SSR) test methods. During CL testing, a calibrated proof ring was used to apply a constant load to the test specimen. The magnitude of the applied stress was based on ambient temperature yield strength of the material. On the contrary, the test specimen during SSR testing was continuously strained in tension until fracture at a strain rate of $3.3*10^{-6}sec^{-1}$.The fractographic evaluations of all broken specimens were performed by using scanning electron microscopy (SEM).

The results of SSR testing using smooth specimen indicated that the magnitude of failure stress (σ_f), time to failure (TTF), %elongation (% El) and %reduction in area (%RA) were significantly reduced in the 90°C acidic environment showing a synergistic effect of pH and higher temperature. Other investigators have reported a similar behavior. The presence of a notch further reduced the values of %RA, %El and TTF for Type 422 SS, as expected. However, the magnitude of σ_f was increased to some extent in the presence of a notch primarily due to a smaller area at the root of the notch. SEM micrographs of the primary fracture faces showed ductile failures (dimples) at ambient temperature, but intergranular brittle failures were observed at 90°C in both environments. The CL tests are currently in progress.

Tests are in progress to evaluate the susceptibility of Type 422 SS to HE by applying controlled electrochemical potential (E_{cont}) while specimen is stressed under CL or SSR conditions. Simultaneously polarization studies are being performed to evaluate the localized corrosion behaviour of this alloy in similar environments. The comprehensive test results will be presented in this conference.