

INTERIM REPORT

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INTERIM REPORT

NRC Research and Technical
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MONTHLY HIGHLIGHTS
July 1979

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This work was performed under the auspices of the United States Nuclear
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Phenomenological Research

Work continued on evaluating the mechanisms of high cycle fatigue failure in Incoloy 800H for an HTGR helium test environment. At a test temperature of 760°C the fatigue strength depends sensitively on the condition of the surface. Compressive stresses at the surface, induced by surface grinding during fabrication, are beneficial. If, however, they are relaxed through extended exposure at the test temperature, surface softening occurs and the fatigue strength shows a significant decrease. For extended thermal aging times prior to testing, the deleterious effects of the surface softening are overshadowed by bulk strengthening factors and the fatigue strength is restored to its original value.

An evaluation of thermal control specimens in the program to study the effects of simulated I₂, Te₂, and CsI fission products on the structural integrity of HTGR metals shows that the predominant effects on ductility are thermal rather than corrosion effects. Although iodine does show some localized corrosion which could contribute to loss of ductility, no deleterious effects from Te₂ and CsI at the concentration and temperature evaluated (10⁻⁵ atm. at 800°C) could be seen.

Experiments on oxidation of PGX and H451 graphites have been continued in air and in a water vapor/hydrogen/helium mixture in the temperature range of 450 to 600°C and 550 to 750°C, respectively. The activation energy for the reaction of air oxidation has been estimated to be 187 kJ/mol for PGX and 197 kJ/mol for H451. Although water vapor oxidation of these graphites is being studied at temperatures higher than 750°C, the activation energy for PGX in the temperature range described above was calculated to be ca. 189 kJ/mol which is surprisingly similar to that for air oxidation.

As a continuation of work already started in the Helium Impurities Loop (HIL), static experiments have begun which will determine the activities of the various components (C, Cr, Mo, FeO, etc.) of HTGR materials. This will be accomplished by measuring the equilibrium concentrations of CH₄, CO₂, CO, H₂O and O₂ at 730°C, for various initial gas compositions, from which the activities can then be calculated. The Nuclide Corporation mass spectrometer is being utilized to measure the gas composition. The material presently being tested is 304 stainless steel. Future experiments will include Hastelloy X and Incoloy 800.

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