THE ANALYSIS OF INCONEL 690 OXIDATION PRODUCTS AND MEASURMENT OF THEIR GROWTH RATES AS A FUNCTION OF TEMPERATURE USING X-RAY DIFFRACTION

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The processing of nuclear materials at the Savannah River Site has generated approximately 34 million gallons of high level radioactive waste. The Defense Waste Processing Facility (DWPF) converts this liquid waste into glass, which is suitable for long term storage in a geologic repository.

One of the major limitations to long service life of components in the DWPF melter is the highly corrosive environment encountered in elevated temperature regions, particularly in the vapor space above the molten glass pool. Severe degradation and failure of critical components, made of Inconel 690, have resulted in lost production time and increased costs due to component repair or replacement. Furthermore, disposal costs of contaminated parts are high.

The objective of this research was to develop a basic understanding of the surface reactions that take place on Inconel 690 nickel-based alloy in an oxidizing environment, typical of what is found in the vapor space. The presence of protective oxide scales containing chromium, aluminum, or silica on nickel based alloys have been shown to provide corrosion resistance in some high temperature oxidizing environments. Understanding the mechanisms by which the protective scales form and spall is critical. This research focused on using x-ray diffraction (XRD) to observe the surface reactions on this alloy at temperatures near its service limit, from 900 to 1200 °C. Data gathered allowed for the determination of fundamental kinetic and semi-quantitative data on the intermediate high temperature phases as well as final phases formed on the surface of the alloy. This is a significant advantage over the traditional gravimetric methods, which only measure mass loss as a function of time. Understanding how these reactions occur on the surface of the alloy, especially the formation of the intermediate phases, provides critical information for predicting component longevity as a function of temperature.