PROCESS EQUIPMENT CORROSION PROBLEMS

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At Los Alamos National Laboratory, a process is run that converts impure plutonium dioxide into impure plutonium metal. This process reduces the plutonium dioxide to metal in a molten calcium chloride salt system using calcium metal as a reducing reagent. As a result of this reaction, the calcium metal is converted to calcium oxide. The reaction is limited by the solubility of the calcium oxide byproduct, which builds up in the calcium chloride matrix. The conversion process has been advanced by sparging the molten calcium oxide / calcium chloride mixture with chlorine gas to convert the calcium oxide byproduct to calcium chloride. The ability to do this has allowed the performance of multiple runs in one heating and cooling furnace cycle rather than being restricted to one single run.

However, the fact that chlorine gas is being pumped into stainless steel, tantalum and inconel equipment at a high temperature, created a new problem. The excess chlorine gas severely corroded metal components with which it had contact. The metal degradation was so severe that the process could not be operated without some modification to the system. A separate argon gas line was routed to the bottom of the furnace tube to force the excess chlorine gas into the off-gas system. The furnace is attached to a chlorine gas solids separation apparatus, as well as a spectrophotometer to detect chlorine gas in the off-gas stream, followed by primary and secondary sodium hydroxide scrubbers. It will be shown that the design modifications to the furnace allow this process using chlorine gas to operate with little corrosion to equipment. These modifications will be described and discussed.