

## CORROSION OF ALUMINIUM IN IEA-R1 REACTOR STORAGE SECTION

Ramanathan, L.V.; Perrotta, J.A.; Frajndlich, R.

*Centro de Ciência e Tecnologia dos Materiais - IPEN/CNEN-SP*

*Keywords: corrosion; aluminum alloys; fuel elements.*

Introduction Aluminum clad U-Al (U3O8-Al or U3Si2-Al) fuel elements are used in the IEA-R1 research reactor. This reactor has been in operation since 1957 and spent nuclear fuels (SNF) are placed in the spent fuel bay of the pool to cool until a final disposition is made. Original fuel design parameters did not foresee storage of spent fuels for extended periods. Hence, it became necessary to prevent cladding breach due to corrosion. The main activities related to corrosion of Al clad fuels have been: (a) The co-ordinated research project (CRP) of the IAEA and (b) The Latin American Regional Project, sponsored by the IAEA. The Co-ordinated Research Programme (CRP) The International Atomic Energy Agency's (IAEA) concerns about: (a) the state of SNF, (b) insufficient data about the effects of pool parameters on fuel corrosion; and (c) the need to provide overall guidelines, resulted in the initiation of Phase II of a Co-ordinated Research Project (CRP) on "Corrosion of Research Reactor Al-clad Spent Fuel in Water" in 2002, with IPEN as one of the participants. The main activities of this project were related to exposing racks of Al alloy specimens in different spent fuel basins around the world. IAEA coupon racks were suspended in the IEA-R1 reactor pool in 2002, and subsequently withdrawn after one year of exposure to evaluate the extent of corrosion as a function of alloy composition, crevices, bi-metallic effects, coupon orientation and water chemistry. The results of evaluations carried out on these coupons were presented and discussed at a workshop. Coupons of Al alloys of Brazilian origin, used in IPEN made fuel elements were also exposed in the IEA-R1 spent fuel storage section. Coupled coupons were also exposed to simulate crevice and bi-metallic situations that arise within the reactor. During the entire test, the reactor water chemistry was periodically monitored and maintained under specified conditions. After exposure, visual and photographic evaluation of the coupons was carried out. Corrosion pit depths on Al coupons were also measured. Correlation of coupon surface state and basin water parameters lead to many conclusions and the main ones are: (a) pitting was the main form of corrosion; (b) crevice and galvanic effects predominated; (c) reduction in conductivity and chloride ion content were essential to maintain low corrosion rates and (d) dust sediments on Al alloys specimens contributed to pit initiation. Regional Project for Latin America RLA/4/018 Corrosion surveillance is one of the programs within this IAEA sponsored regional project for Latin America. Initiated in June 2001, in this ongoing project the participating countries include Mexico, Peru, Chile, Argentina and Brazil. This project was initiated to serve as a complementary

experimental exercise in the overall assessment in each country of the physical state of irradiated fuel inventories and their storage conditions. In particular, a major objective is to harmonize within the Region, spent fuel wet storage through: (a) water quality standards, monitoring and control, and (b) corrosion monitoring using racks of standard corrosion coupons made from alloys found within the storage basins, especially fuel cladding. IPEN has played a leading role in the area of corrosion surveillance in this project and during the November 2003 characterization workshop held in Santiago, Chile.