

Technical Meeting on Advanced Technology Fuels: Progress on their Design, Manufacturing, Experimentation, Irradiation, and Case Studies for their Industrialization, Safety Evaluation, and Future Prospects

Contribution ID: 28

Type: **not specified**

CORROSION KINETICS OF AUSTENITIC STAINLESS STEEL UNDER WATER NORMAL OPERATION PWR CONDITION

Wednesday 29 October 2025 11:00 (25 minutes)

In the context of accident tolerant fuel (ATF) development, long-term corrosion tests were conducted on a niobium-stabilized austenitic stainless steel (Nb-ASS) to assess its oxidation resistance under normal water operation conditions in a pressurized water reactor (PWR) environment. Due to the limited availability of corrosion data for this alloy in such conditions, two independent experimental campaigns were carried out. The specimens were exposed to ultrapure, deoxygenated water at 360°C and 20 MPa for approximately 84 days, with sampling intervals of 21 days, enabling the modeling of weight gain kinetics.

Under these conditions, the oxidation behavior of stainless steels is typically characterized by the formation of a dual-layer oxide scale, composed of an outer magnetite layer and an inner chromium-rich spinel (chromite) layer. After X-ray diffraction (XRD) analysis confirmed the presence of both phases on the tested samples, a bilayer model consisting of equal proportions of magnetite and chromite was adopted to estimate the oxide thickness.

This study presents a methodology for determining oxide layer thickness from mass gain data and compares the results with published values for Zr-, Fe-, and Ni-base alloys. Additionally, oxidation kinetics were analyzed assuming a solid-state diffusion mechanism governed by a parabolic rate law. The calculated kinetic parameters further support the high oxidation resistance of the Nb-ASS alloy compared to conventional Zr-base alloys. Its behavior also closely resembles that of widely used austenitic stainless steels, such as AISI 304, reinforcing its potential as a promising ATF cladding candidat.

Author: SANCHES PEREIRA DA SILVA, Vanessa (AMAZUL)

Co-author: DE CAMARGO, Fabio (AMAZUL)

Presenter: SANCHES PEREIRA DA SILVA, Vanessa (AMAZUL)

Session Classification: 2

Track Classification: Experimental Testing of ATF Materials and Validation Database