

Accepted Manuscript

Numerical modeling of oxygen mass transfer in a wire wrapped fuel assembly under flowing lead bismuth eutectic

A. Marino, J. Lim, S. Keijers, J. Deconinck, A. Aerts



PII: S0022-3115(17)30145-9

DOI: [10.1016/j.jnucmat.2017.12.017](https://doi.org/10.1016/j.jnucmat.2017.12.017)

Reference: NUMA 50682

To appear in: *Journal of Nuclear Materials*

Received Date: 25 January 2017

Revised Date: 30 August 2017

Accepted Date: 11 December 2017

Please cite this article as: A. Marino, J. Lim, S. Keijers, J. Deconinck, A. Aerts, Numerical modeling of oxygen mass transfer in a wire wrapped fuel assembly under flowing lead bismuth eutectic, *Journal of Nuclear Materials* (2018), doi: 10.1016/j.jnucmat.2017.12.017.

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Numerical modeling of oxygen mass transfer in a wire wrapped fuel assembly under flowing lead bismuth eutectic

A. Marino*¹, J. Lim¹, S. Keijers¹, J. Deconinck² and A. Aerts¹

¹SCK•CEN (Belgian Nuclear Research Centre), Boeretang 200, 2400 Mol, Belgium

²Vrije Universiteit Brussel, Pleinlaan 2, 1050 Elsene, Belgium

Abstract

Corrosion of steels in lead bismuth eutectic (LBE) cooled reactors can be mitigated by forming a protective oxide layer on the steel surfaces. The amount of oxygen necessary to ensure continuous oxide layer formation on fuel cladding depends on the characteristics of the steel and on the local temperature, local oxygen concentration and velocity of the LBE in contact with the steel. The most critical areas from a corrosion point of view are high temperature and low oxygen concentration regions. Wire-wrapped fuel assemblies (FAs) which are foreseen to be used in LBE cooled reactors, are characterized by hot spots and quasi-stagnant areas where oxygen could be depleted. Experimental measurements to verify whether the oxygen concentration in those critical areas is sufficiently elevated for oxide layer formation, are practically impossible. This information can be however obtained by numerical modeling. This paper focuses on the development of a numerical model of oxygen mass transfer in a 19-pin scaled fuel assembly (FA) representative of the MYRRHA reactor core. Oxidation of steels and oxygen transport from the bulk of the LBE to the surface of steels were simulated simultaneously. The simulations provide a local oxygen concentration mapping at steel/LBE interface enabling to identify the regions of the core which could be prone to corrosion due to oxygen depleted LBE. Operation recommendations for the MYRRHA reactor were given based on the simulation results.

Keywords

Lead bismuth eutectic (LBE), oxygen mass transfer, oxidation, wire wrapped fuel assembly.

*Corresponding author. Tel.: +32 14 338011, E-mail address: amarino@sckcen.be

Download English Version:

<https://daneshyari.com/en/article/7963120>

Download Persian Version:

<https://daneshyari.com/article/7963120>

[Daneshyari.com](https://daneshyari.com)