A STUDY OF THE CORROSION OF THE ZIRCONIUM ALLOYS

P. Barborík, M. Boča
Institute of Inorganic Chemistry SAS, Bratislava, Slovak Republic
uachpeba@sav.sk

INTRODUCTION

Molten salt technology has been used for many decades in industrial process heat transfer, thermal storage, and materials processing applications. The potential utility of molten salts as heat transfer agents was also demonstrated for nuclear reactors, as the liquid fuel in the Aircraft Reactor Experiment (ARE) and the Molten Salt Reactor Experiment (MSRE) programs. The behavior and material compatibility of various molten salts was studied extensively by Oak Ridge National Laboratory (ORNL) from the 1950s through the 1970s in support of the MSRE and the Molten Salt Breeder Reactor programs [1].

Many of the first commercial power reactors used stainless steel to clad the uranium dioxide (UO2) fuel. This changed by the middle 1960’s and zirconium alloys became the main cladding materials for water-cooled reactors. Zirconium alloys were chosen for these primarily because they have a much lower neutron absorption per unit of strength than other commercially available structural materials. Ozhenite Alloys were developed in the USSR for use in pressurized water and steam. The alloys contain tin, iron, nickel and niobium with a total alloy content of 0.5 to 1.5 percent. Their general corrosion and strength properties are similar to the Zircaloys. Zr-1.0wt%Nb: Developed by the USSR for fuel cladding in pressurized water and steam reactors. It is claimed to have excellent postirradiation ductility [2].

OBJECTIVE

The objective of this work is to detect corrosion resistance of Zr-alloys in the eutectic mixture of (LiF-NaF-KF)$_{eut}$ and (LiF-NaF-KF)$_{eut}$-$K_2ZrF_6$ at the temperature of 600 °C and 900 °C. The experiments were carried out during 480 minutes in the resistance furnace (Fig. 1), where the test sample was immersed in the melt.

The tested alloys, Zry-2 and E110 (tab. 1), were chosen for their importance in alloys such as highly corrosion-resistant materials suitable for applications in nuclear energetics.

<table>
<thead>
<tr>
<th></th>
<th>Zr</th>
<th>Fe</th>
<th>Cr</th>
<th>Ni</th>
<th>Sn</th>
<th>Nb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zry-2</td>
<td>98,250</td>
<td>0.135</td>
<td>0.100</td>
<td>0.055</td>
<td>1,450</td>
<td>-</td>
</tr>
<tr>
<td>Zr1Nb</td>
<td>98,910</td>
<td>0.050</td>
<td>0.020</td>
<td>0.020</td>
<td>-</td>
<td>1,000</td>
</tr>
</tbody>
</table>

Tab. 1 Composition of tested alloys in wt%.

CONCLUSION

The work analyzes the surface of materials after corrosion and the composition of cooled melts by X-ray powder diffraction analysis and scanning electron microscope.

ACKNOWLEDGEMENT

This work was supported by the Slovak Research and Development Agency under the contract No. LPP-0344-09.

This contribution is the result of the project implementation: Centre for materials, layers and systems for applications and chemical processes under extreme conditions – Stage II supported by the Research & Development Operational Programme funded by the ERDF.

REFERENCES
