THE RESULTS OF EXPERIMENTAL MODELING OF THE PROCESSES OF INTERACTION OF THE CORIUM PROTOTYPE WITH ALUMINUM OXIDE CERAMICS AND A LEAD LAYER

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The main element of the core catcher of a light-water reactor is sacrificial materials, which are used to change the physical and chemical properties of the melt basin [1-2]. Their role is very important, therefore, the search for new materials to be used in the core catcher as sacrificial materials is an urgent task.

This paper presents the results of the experiments carried out with a ceramic material made of aluminum oxide (Al_2O_3) with a lead layer (fluidized bed) as a sacrificial material. Computer simulation in the Ansys program showed that, due to the heat transfer from the corium to lead phase transitions, the growth rate of the average temperature of the corium decreases due to decay heat [3]. At the same time, the interaction between lead and the sacrificial material leads to an increase in the intensity of heat exchange processes compared to the interaction between corium and the sacrificial material. This fact can lead to accelerated destruction of the sacrificial material and its further dissolution in the corium for the successful completion of gravitational inversion.

Experiments on the interaction of corium with candidate sacrificial material were carried out at the «Lava-B» facility [4]. The experimental facility includes two main functional blocks: an electric melting furnace (EMF) for preparing the corium and a melt receiver (MR), which houses an experimental section for modeling the studied processes.

The experiment showed that during the interaction between corium with sacrificial material, melting and subsequent boiling of the lead component took place. These processes are confirmed by thermocouple readings and the presence of lead in the melt receiver chamber and on the surface of the trap. In this case, when the boiling point of lead is reached, the rate of increase in the temperature of the ceramic material slows down over a certain time interval. This is most likely caused by phase transitions in the lead layer.

It was also found that the presence of lead increases the intensity of erosion of the oxide component of sacrificial material. Thus, the depth of side wall erosion turned out to be maximum on the side containing lead and minimal on the side without lead.

As a result of the destruction of the oxide part structure of the sacrificial material, its active introduction into the composition of the corium occurred. It was noticed that the layer of solidified corium melt near the contact boundary with the ceramic material had a dense homogeneous structure, different from the structure of the corium in the rest of the section, which was characterized by porosity and presence of round metal inclusions.

Thus, the experiment showed the perspective of the proposed combination of sacrificial materials for the core catcher. During future materials research, the processes of interaction between corium and the proposed sacrificial material will be studied in detail and conclusions will be drawn about the possibility of its use in melt traps of a light water reactor.

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