Taking it into account, the aim of this work was to create a genetic construction containing the gene encoding keratinase from Bacillus licheniformis.

The keratinase gene kerA was isolated by polymerase chain reaction (PCR) from the genomic DNA of the bacterium B. licheniformis and inserted into the plasmid pET42a (Invitrogen, USA) using the method of ligation independent cloning [3], also known as the method of continuous extension PCR (CE-PCR).

The plasmid and gene kerA were amplified by PCR and recovered using a commercial PCR Purification Kit (Jena Bioscience, Germany). The resulting PCR amplification products were annealed on each other, and amplification was performed using the CE-PCR method.

Since complementary regions to the pET42a plasmid were inserted into the gene kerA, it has enabled to create a genetic construction represented by a pET42a plasmid containing the nucleotide sequence encoding keratinase from B. licheniformis. The obtained plasmid was checked by restriction analysis and sequencing to verify the correct nucleotide sequence of the target gene.

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CALCULATION AND EXPERIMENTAL STUDY OF BORIC ACID SOLUBILITY IN STEAM AT BOILING

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The droplet ablation processes of soluble materials by steam during the operation of nuclear power plants have a great impact on the ecological situation. This effect can be expressed in growth of the moisture of the surrounding air by using evaporative cooling towers or affecting the possibility of cooling the reactor core in the accident event.

To study these processes in Institute for Physics and Power Engineering, a calculation and experimental study of the solubility of boric acid in steam was carried out. The main results of research are presented in this paper.

Keywords: boric acid, solubility, steam, reactor, accident, calculation, environment.

Ensuring the safety of modern NPP projects in order to prevent accidents that can have a negative ecological impact on the environment is one of the most urgent tasks facing modern nuclear engineering. In Russian Federation the advanced project of nuclear power plant WWER-TOI (Water-Water Energetic Reactor Typical Optimized Informatized) has been developed. This project of NPP with WWER-1200 water pressurized reactors was created according to the international nuclear and radiation safety requirements. Construction of reactor units under the WWER-1200 project are currently underway in many countries of the world: the Republic of Belarus, Hungary, Finland, Egypt, Bangladesh, etc.

WWER-TOI project is developed on the basis of the design documents worked-out for AES-2006 project, considering in maximum experience gained by industry organizations while development of the recent NPP projects based on WWER technology (Novovoronezh NPP-2). WWER-TOI project takes into account experience in construction and operation of NPP with WWER both in Russia and abroad.

Within the framework of the WWER-TOI project, special attention is paid to ensuring reactor safety in case of beyond-design accidents with a rupture in the main circulation line and loss of all AC sources within 72 hours. This task is solved by the functioning of passive safety systems that provide core cooling for a consecutive feed to the reactor solution of boric acid with a concentration of 16 g / kg from the system of hydraulic capacities. As is known, the core is at this time in a boiling state, correspondingly, taking into account the low acid concentration in the vapor phase, it is possible to increase the amount of boric acid in the core coolant and to achieve the conditions for its crystallization on the outer surface of the fuel rods, which can lead to deterioration of the heat sink. Removal of boric acid from the reactor with steam or as a result of drip entrainment can significantly reduce the risk of its crystallization. Consequently, the study of the processes of entrainment of boric acid from the core
is of great practical importance for the calculation of emergency regimes at nuclear power plants with water-cooled reactors of a new generation.

In this regard, in the IPPE, calculation and experimental studies of the processes of entrainment of boric acid due to solubility in steam were carried out. The experiments were performed at the test facility at a steam pressure of 0.2 MPa, which corresponds to the pressure in the WWER-TOI reactor in the event of an accident with a break in the main circulation circuit. The concentration of boric acid in the experiments varied in the range 16–380 g / kg H₂O. The computational modeling of the processes of solubility of boric acid in steam and droplet entrainment made it possible to evaluate the influence of these processes on the rate of accumulation of boric acid in the reactor in case of an accident.

The results obtained will help to substantiate the safety of new NPP projects with WWER reactors in order to ensure that a small accident does not develop into a serious one with the possible release of radioactive fission products into the environment and causing great ecological damage.

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ENVIRONMENTAL PROBLEMS RELATED TO MULTI LAYERED PACKAGING WASTE

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Modern packaging has made life easier in many ways: food preparation and storage, longer shelf life for products, medicines, frozen foods, processed foods, takeaway foods. Unfortunately, such convenience has come at an environmental price. Multi-layered packaging has been producing since the '70s and are commonly comprised of layers of PET, Al, PP, PE, etc. Over 80m tonnes of multilayered packaging are produced globally, per annum, of which the EU contributes more than 20m tonnes, with an expected growth of ~7%.

Keywords: Environmental problems; Multilayer Packaging; Waste.

Currently, Multilayer packaging is widely used for the preservation and distribution of food, beverages, pharmaceuticals, and other consumable products; the plastic packaging used for this purpose represents 40% of the total production of plastic in the EU and requires more than 19 million tons of oil and gas to produce, with an estimated annual increase of 5–7% [1–2].

Multilayer packaging consists of various polymers such as PE/PA or PP/PET as well as aluminum layers. Such composite materials fulfill functions that monomaterials do not offer. For example, they protect food and consumer goods from light or oxygen [Fig. 1]. For recycling though, the individual materials of the packaging must first be separated. However, this has not simply process, which is why such a waste stream has not been considered recyclable and instead is thermally recovered, which can produce gas and ash exhausts that also have a negative environmental impact. Or disposal on the landfill. On the contrary, the recycling of single-layer films, such as PE, PP, PVC, PS, or PET films, is technically solvable and currently there are many companies working in the processing of these films and remanufacturing them into new products [3, 4, 5].

Fig. 1. – Basic components of multilayer flexible packaging