

SORPTION OF RADIOACTIVE IONS FROM AQUATIC MEDIUM USING COMPOSITE BIOSORBENT

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Environmental problems have become more relevant all over the world due to the tremendous industry upgrowth. Particularly, in Russia a modern nuclear-energy complex was based on using a nuclear fuel cycle, i.e. the extraction of ore and its concentrate production, uranium dioxide production, enrichment and fuel element manufacturing [1]. This causes water pollution with dangerous industrial effluents, which contain heavy and radioactive metal ions. Exploitation of nuclear power stations (NPS) is another cause of producing radioactive wastes— products of electric energy industry

bent. Fungi were grown in the Sabouraud's medium. Then dispersed nanoparticles of Fe_3O_4 were put in the mycelium. As a result, we obtained 3 types of the composite biosorbent: *A. niger*+ Fe_3O_4 , *P. piniphilium*+ Fe_3O_4 и *Mucor*+ Fe_3O_4 . Investigations were carried out using the model solutions of uranium nitrate with the primary concentration of uranium ions of 1200 mg/l. The exposition time lasted from 1 to 48 hours. The residual concentration of uranium was measured with the spectrofluorometer «Fluorarat-02-2M». The sorption degree of the composite biosorbent was measured using these data (table 1).

Table 1. Concentration of uranium ions after the sorption with different composite biosorbents

Time, hour	1	2	4	8	24	48
Type of the sorbent	Uranium ion concentration, mg/l					
<i>Aspergillusniger</i> + Fe_3O_4	774.2	729.4	704.73	660.8	617.4	610.3
<i>Penicilliumpiniphilium</i> + Fe_3O_4	890.7	847.4	840.4	818.8	807.1	786.4
<i>Mucor</i> + Fe_3O_4	925.8	885.6	861.8	818.6	808.9	797.6

[2]. Uranium ions are the most widespread nuclear industry wastes. That is why one of main problems is considered to be the processing of liquid radioactive wastes [3]. Every isotope of uranium-containing products represents danger for human health. Moreover, chemical uranium toxicity is more dangerous than its radioactivity. The maximum allowable concentration for soluble uranium compounds is 0.1 mg/l, uranium is referred to the first dangerous class [4].

The aim of the research work is to analyze the sorption activity of different types of fungi, as a part of the composite biosorbent, and to define optimal exposition time in model solutions of uranium nitrate.

In the work we used three different types of the biosorbent – fungi *Aspergillus niger*, *Penicillium piniphilium* and *Mucor*. Nanoparticles of iron oxide (Fe_3O_4) were a second part of this composite biosor-

It was found that fungi *A. niger* have the largest sorption activity of uranium ions. This parameter exceeds the sorption activity of *P. piniphilium* and *Mucor* 1.6 and 2 times respectively.

We also determined the optimal time of exposition, when the maximum amount of uranium was sorbed. We found that the optimal exposition time for uranium sorption by *A. Niger* is 2 hours. During this period *A. niger*+ Fe_3O_4 sorbed nearly 4 mg of uranium, and next 48 hours – only 1.5 mg.

Thus, the sorption activity of 3 types of the composite biosorbent was defined in this investigation. In the composition of the sorbent nanoparticles of iron dioxide Fe_3O_4 were added as the nanomaterial. The biological part was fungi *Aspergillusniger*, *Penicilliumpiniphilium*, *Mucor*. It was found that the most effective uranium ion sorbent is the composite biosorbent *Aspergillusniger*+ Fe_3O_4 and the time of exposition is 2 hours.

References

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centration (MPC) of chemical substances in water”.

HIGH-TEMPERATURE SYNTHESIS ACTIVATORS FOR REFRACTORY SILICATE COMPOUNDS

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Cordierite-containing ceramics are widely used in science and technology because of a distinctive feature, its low coefficient of thermal expansion, which causes high heat resistance. Cordierite synthetic problems ($Mg_2Al_4Si_5O_{18}$) are constantly paid much attention. The effectiveness of cordierite synthesis depends on many factors, including the properties of raw materials and the introduction of adjuvants. The aim of this work was to study the influence of the raw material mixture composition and blank forming method on the efficiency of the cordierite phase synthesis [1].

The raw materials for the cordierite synthesis were the chromite ore enrichment waste (the main mineral – serpentine), clay, alumina and bauxite. Aluminum nanopowder was added to one of the mixtures as an aluminum-containing raw material and a sintering activator. Unlike conventional powder aluminum nanopowder gives highly active alumina while heated in air and promotes an immediate reaction to form more complex compounds, in this case cordierite, without forming melt drops. Batch composition (B1, B2, B4) was calculated based on 100% yield of cordierite phase. Samples were prepared by semi-dry and moist plastic mass (30% water) molding and then sintered in air to a temperature of 1200 °C and held at the final temperature for 2h.

The X-ray analysis was applied to study the composition structure after firing.

The cordierite phase formation in the sample B4 with the addition of active alumina nanopowder had almost the same efficiency using any type of forming. In other samples, the intensity of reflections of cordierite in ceramic, obtained by plastic molding, resulting in increased contact area of the

reacting species, is higher. The biggest difference was observed in sample B3 (twice higher intensity), containing as the compensator the missing part of bauxite Al_2O_3 .

Significant growth of cordierite phase was detected applying the temperature range from 1200 to 1250 °C. The amount difference of cordierite phase obtained by sintering at 1250 °C and 1300 °C, is significant only for mixture B4. The cordierite phase growth applying this temperature range was 23%. The best results for cordierite phase formation at 1250 °C were achieved using a mixture serpentine-clay-bauxite (B2).

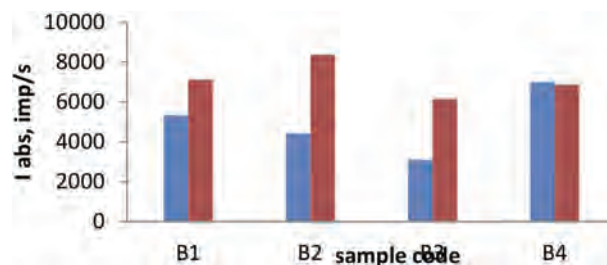


Fig. 1. Comparative analysis of the cordierite phase formation at various kinds of molding $T_{sint.} = 1200\text{ °C}$

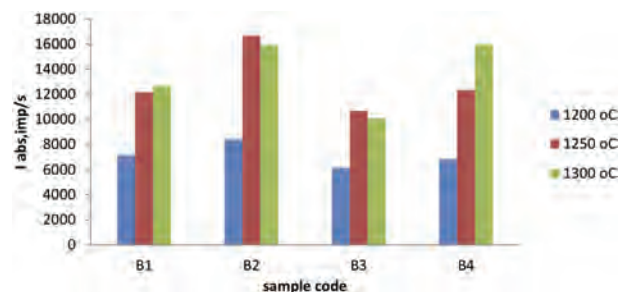


Fig. 2. Effect of heat treatment on the cordierite phase formation in plastic molding blanks