PROCESSES OF VANADIUM CONTAINING WASTE TREATMENT BY CHEMICAL AND ELECTROCHEMICAL METHODS

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One of the most vital environmental problems of Belarus is the problem of manipulation with waste products. The situation in the system of manipulation with waste products in Belarus leads to their significant accumulation in places of accommodation of waste products and territories of enterprises. The level of utilization of waste products in our country remains low.

World consumption of vanadium reaches nearby 50 thousand tons a year nowadays. Development of vanadium containing components extraction methods from secondary vanadic raw materials has an actuality due to the absence of the ore deposits containing more than 1–2% of vanadium and providing profitability of its extraction. Such kinds of raw materials are solid wastes of black oils burning concern on power installations of thermal power stations, and also the spent vanadic catalysts (SVC) of sulfuric acid production in which the content of vanadium oxide (V) is in limits of 5–15% and 5–10% accordingly.

At present the Republic of Belarus has no enterprises to utilize spent vanadic catalysts. Components of spent vanadic catalysts have a great value and can be used in various technological processes of the Republic of Belarus. The other reason is that deposit and storage of spent vanadic catalysts is very harmful to the environment because of the toxicity of vanadium compounds.

Practical value of research work is the possibility to extract vanadium pentoxide from spent vanadic catalysts by very simple and effective methods. This extracted product can be used further. The cost of regeneration of vanadium components is much lower than that of mining these compounds from ores. Although vanadium is widely dispersed and relatively abundant in the earth's crust, deposits of ore-grade minable vanadium are rare. The bulk of vanadium production is derived as a by-product or co-product in processing iron, titanium, phosphorus and uranium ores. Vanadic catalysts are used mainly in production of sulfuric acid and every year 40–70 tonns of spent vanadic catalysts are produced.

All methods of vanadium components extraction from spent vanadic catalysts are based on hydrometallurgical processes which consist in leaching by water, by solutions of acids and salts. The solutions received after leaching of vanadium containing raw materials, depending on a method of extraction can simultaneously contain various connections of vanadium (2 +, 3 +, 4 +, 5 +). For extraction of vanadium from solutions in the form of a commodity product – vanadium pentoxide or vanadium salts - it is necessary to provide oxidation of vanadium to V^{5+}. Further extraction of vanadium pentoxide from solutions is carried out full enough at boiling its sated solutions.

Researches on vanadium compounds extraction from spent vanadic catalysts have been carried out. The method of spent vanadic catalysts processing includes [1, 2]:

- crushing;
- vanadium compounds leaching in solutions of sulfuric acid (primary leaching) with ultrasonic processing;
- regenerative (secondary) leaching in sodium sulfite solutions;
- solid residue separation after leaching;
- thermahydrolitic extraction V_2O_5 from solutions, using oxidizer (hydrogen peroxide);
- V_2O_5 separation from solution.

Use of the offered method allows to increase degree of V_2O_5 extraction to 97 % from its initial content in spent vanadic catalysts. Residual quantity V_2O_5 in spent vanadic

catalysts solid residues after leaching does not exceed 0,28 % from total mass that allows to use them in various industrial productions without any ecologically adverse consequences. Besides, offered method of processing allows to solve problems of resource saving and import substitution in the industry of Belarus.

In order to intensify the separate stages of the proposed method, including the redox processes, have been carried out complex electrochemical studies of vanadium containing electrolytes and leaching solutions of SVC.

Studies have shown the advisability of using electrochemical methods in the complex processing of SVC for the following applications: combining the stages of primary and reductive leaching and increase the extraction of vanadium-containing components in the process of electrochemical leaching SVC compare with water leaching, cathodic reduction of vanadium-containing components of the working electrolytes directly in the process of leaching, electrochemical oxidation for hydrolysis solutions, the anodic separation V_2O_5 from leaching solutions SVC [3, 4].

Using the electrochemical method allows to select components with high vanadium content of V_2O_5, conforming to specifications for this reagent.

For the purpose of complex use of all components of spent vanadic catalysts possibility to make glasses directly with use spent vanadic catalysts, and also the solid residues after vanadium components leaching is investigated.

With use of leaching solid residues a series of 10 structures of glazes glasses, having a wide range of components is developed. Making of glasses has been carried out, their physical and chemical properties, structure and phase structure have been defined. The comparative analysis of properties of the glasses received from spent vanadic catalysts and from leaching solid residues has carried out [5].

The developed color glazes can be used as a commercial product for the enterprises for production of oven tiles, majolica and products of art ceramics.

The received results allow to use in a complex all components of spent vanadic catalysts and to provide economic efficiency of process of their processing. Extracted V_2O_5, and also color glasses and glazes, which structure it is developed, can be used as a commercial product for the enterprises of Belarus of a various profile.

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