EXTRACTION AND UTILIZATION OF VALUABLE COMPONENTS FROM SPENT CATALYSTS AS A CURRENT PROBLEM IN MODERN CHEMICAL INDUSTRY

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Abstract. The processing of spent catalysts with the recovery of non-ferrous and rare metals is an important area of resource conservation and environmental safety in the chemical industry. The paper presents developed technologies for the extraction of zinc, vanadium, and nickel from spent catalysts of the nitric and sulfuric acid industries. The efficiency of the proposed methods and the possibility of reusing the extracted components for the synthesis of new catalysts are demonstrated.

Keywords: spent catalysts, zinc, vanadium, nickel, recycling, resource conservation, circular economy.

In the modern world, hundreds of thousands of tons of spent catalysts containing significant amounts of valuable metals (Zn, V, Ni, Mo, Co, etc.) are generated annually. Their utilization not only reduces the environmental burden but also substantially expands the raw material base of the chemical industry [1, 2].

The processing of spent zinc, vanadium, and nickel catalysts, widely used in gas purification processes and the production of sulfuric and nitric acids, is of particular relevance.

Extraction of Zinc from Spent Zinc Oxide Absorbents

One of the mass wastes of the nitric acid industry is spent zinc oxide absorbents used for the removal of sulfur compounds from natural gas. The developed technology includes the following main stages:

-grinding of the spent material;

-acid leaching;

-solution purification;

-precipitation of basic zinc carbonate;

-filtration, drying, calcination, and grinding of the final product.

The resulting active zinc oxide contains 96–97% of the main component and is successfully used in the preparation of new sulfur absorbents and the production of paints. The technology has been implemented on a pilot-industrial scale. The use of secondary ZnO makes it possible to exclude the stages of carbonization and calcination in the synthesis of fresh absorbent, which significantly reduces energy costs [3].

Extraction of Vanadium Pentoxide from Spent Vanadium Catalysts

Spent contact mass SVD from sulfuric acid production was used for V_2O_5 extraction. The technological process includes the following stages:

-acid leaching;

-two-stage precipitation of vanadate sediment;

-filtration, drying, and calcination;

-aqueous leaching and repeated processing.

The optimal process parameters ensure vanadium recovery at the level of 95%. At pH 5.0–5.5, up to 75% of vanadium is precipitated with a V_2O_5 content of 68% in the sediment. The remaining vanadium is precipitated at pH 8.0–8.5. Aqueous leaching increases the V_2O_5 concentration to 95%.

A catalyst sample was prepared from the obtained concentrate, which in terms of catalytic activity in the SO_2 oxidation reaction is not inferior to the fresh SVD catalyst. A pilot-industrial plant has been designed, installed, and put into operation, and a technological regulation for V_2O_5 production has been developed [4, 5].

Extraction of Nickel from Spent Nickel-Containing Catalysts

Nickel extraction was carried out by dissolution in nitric acid. The total degree of nickel recovery exceeds 92%. The obtained nickel nitrate solution meets the requirements of GOST 4055-78 and is recommended for the synthesis of a fresh catalyst of the GIAP-8 brand. The technology has been successfully mastered at the catalyst shop of JSC “Maxam-Chirchiq”.

Conclusion

The developed technologies for the extraction of zinc, vanadium, and nickel from spent catalysts make it possible to effectively solve the problems of resource conservation and reduction of environmental impact. The obtained secondary products are not inferior in quality to primary analogues and can be used for the production of new catalysts. The implementation of these technologies contributes to the transition to the principles of a circular economy in the chemical industry of Uzbekistan.

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