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Investigation of Methods for Processing Sludge Liming Sewage Hydrometallurgical Production of Vanadium Pentoxide

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Abstract

The sediment of neutralization of drain waters, or the sediment of liming, is obtained by processing with lime milk solutions of hydrometallurgical production of vanadium pentoxide containing sulfuric acid, followed by filtration. A scheme of processing to obtain vanadium concentrate is proposed.

Keywords: sludge liming sewage, vanadium pentoxide, leaching, filtration, washing, deposition, concentrate

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Hydrometallurgical production of vanadium pentoxide is characterized by the formation of significant quantities of solid waste - of 5.16 tons per 1 ton of vanadium pentoxide containing 1-6% V_2O_5 [1].

The technological scheme of production of vanadium pentoxide includes the following stages: preparation of vanadium-containing raw materials, oxidative firing, leaching and deposition of vanadium compounds.

Waste hydrometallurgical production of vanadium pentoxide are dumping sludge, formed after leaching of vanadium from the burnt furnace residue neutralization drain water. The sediment of neutralization of drain waters, or the sediment of liming, is obtained by processing with lime milk solutions of hydrometallurgical production of vanadium pentoxide containing sulfuric acid, followed by filtration [2].

In Russia, the vanadium pentoxide is produced by two enterprises – "EVRAZ Vanadium Tula" and "Chusovskoy metallurgical plant". In "EVRAZ Vanadium Tula" produces about 80 thousand tons per year of sludge materials [3], in "Chusovskoy metallurgical plant" - more than 20 thousand tons [4]. At present, sludge and lime sludge are used in small volumes – sludge is added to the charge containing converter slag and limestone at the firing stage, lime sludge is used in the cement industry.

The purpose of the work is to study the possibility of expanding the scope of liming sludge by its hydrometallurgical processing to obtain marketable products.

Chemical and phase analyses of samples of lime sediment produced by “EVRAZ Vanadium Tula” were carried out. Chemical composition of liming sludge, wt. %: 2,02 V_2O_5; 58,6 CaO; 3,14 FeO; 1,86 SiO_2; 0,22 TiO_2; 9,78 MnO; 2.31 MgO; 0,47 Al_2O_3; 0,33 Cr_2O_3; 8,2 S. Phase composition, wt. %: 33 gypsum ($CaSO_4 \cdot 2H_20$); 23 calcite ($CaCO_3$); 10 Bentonit ($Ca_6(Cr,Fe)_2(SO_4)_3(OH)_{12} \cdot 26H_2O$); 8 portlandite ($Ca(OH)_2$).

Hydrometallurgical methods based on selective leaching of vanadium pentoxide by sulfuric and hydrochloric acids have been studied for the processing of this sample.

Sample leaching and filtration were carried out in a 5 l glass nutch filter (DIEHM, Germany) with electric heating and a propeller-type stirrer.

The effect of concentrations of H_2SO_4 and HCl solutions (5 - 25%) on the extraction of V_2O_5 and MnO from the liming sludge at different process temperatures and solid-liquid ratio. The maximum degree of extraction of V_2O_5 (≈62%) and MnO (≈53%) is achieved by leaching H_2SO_4 under the following conditions: H_2SO_4 concentration 20%; temperature 90 ° C; solid-liquid ratio 1:5. During HCl leaching, the maximum degree of V_2O_5 extraction into the solution was ≈97%, MnO ≈99% at a concentration of HCl 20% and solid-liquid ratio 1: 5. An increase in the process temperature during hydrochloric acid leaching slightly affects the recovery of the target components.

When developing a scheme for processing lime sediment, preference was given to hydrochloric acid leaching, since this technique allows for more complete extraction of vanadium and manganese (Figure 1).

Concentrates were obtained (see Figure 1, *1* and *2*) the following chemical composition, wt.%: 1 – 29,0 V_2O_5; 45,35 MnO; 3,01 CaO; 2,09 Al_2O_3; 7,63 SiO_2; 5,65 FeO; 2,68 Cr_2O_3; 2 – 10,84 V_2O_5; 36,79 MnO; 37,27 CaO; 1,06 Al_2O_3; 2,65 SiO_2; 2,16 FeO; 0,93 Cr_2O_3.

The results showed the possibility of processing sludge liming sewage hydrometallurgical production of vanadium pentoxide to obtain vanadium concentrates. The use of the obtained concentrates as charge materials will allow obtaining vanadium-manganese alloys by known metallothermic methods.

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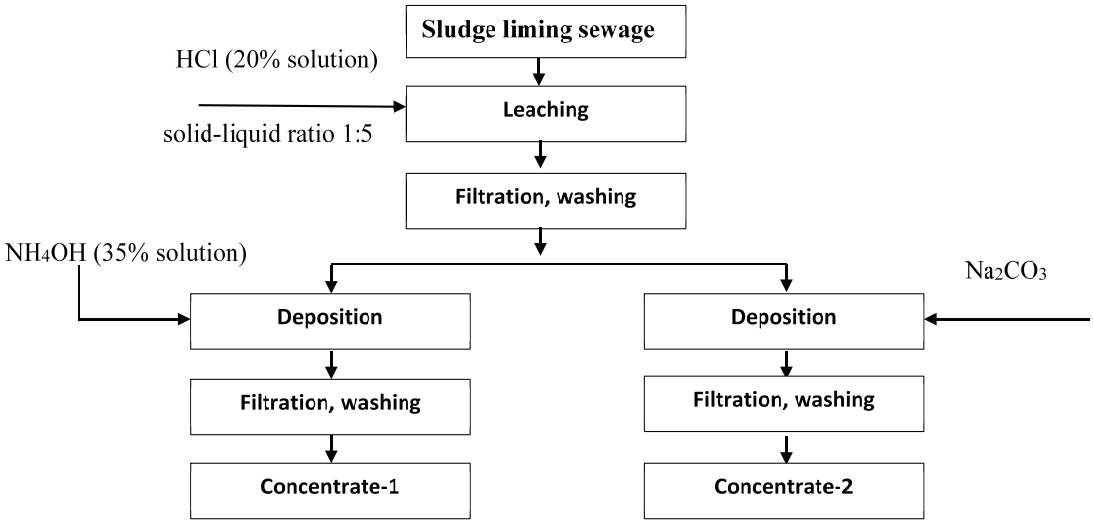

Figure 1: Scheme of hydrochloric acid leaching of sludge liming sewage.

References

[1] Zayko, V. P., *et al*. (2004). *Technology of Vanadium-containing Ferroalloys*. Moscow: Akademkniga.

[2] Mizin, V. G., Rabinovich, E. M. and Sirina, T. P. (2005). *Complex Processing of Vanadium Raw Materials: Chemistry and Technology*. Ekaterinburg: UrO RAS.

[3] Vygovskaya, I. V. (2002). Development of Physicochemical Principles and Utilization of Technogenic Vanadium-Containing Waste in the Lime-Sulfuric Acid Manufacture Vanadium Pentoxide. (PhD dissertation, Tula state University, 2002).

[4] Kudryavsky, Y. P., *et al*. (2000). Hydrometallurgical Processing of Vanadium-Containing Waste. *Tsvetnaya metallurgiya*, issue 1, pp. 25-29.