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Studying the possibility of obtaining vanadium pentoxide from different raw materials

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Today, the problem of increasing the development of the processing of technogenic raw materials is important for the mining industry and includes the saving of mineral resources that are not renewable in nature. According to the diluted stock of vanadium-containing ore is sufficient for the production of large-scale industrial production. in the proposed development of a technology for extracting vanadium from ore, the technology of initial roasting of ore and subsequent leaching of vanadium from the cinder was taken as a basis. The technology developed in way is based on the roasting of vanadium ore in order to convert vanadium into water-soluble sodium vanadate ($NaVO_3$) and subsequent leaching of the metal using sulfuric acid with an increase in the extraction of vanadium from 85.6 to 96.2%. as a result, the technology makes it possible to organize the production of vanadium. The technology for obtaining vanadium pentoxide from spent vanadium catalysts, developed and mastered in the sulfuric acid production shop of the Northern RU, does not provide the required amount of V_2O_5. Therefore, refractory vanadium-containing ores can become a source of obtaining vanadium in NMMC. One of these deposits is the Madani (Rudnoye) deposit.

At the beginning of the research, we studied the chemical, mineralogical and semi-quantitative composition of the objects of study. Before sampling for technological research, the laboratory took 9 samples from different parts of the deposit and analyzed for the content of vanadium. The content of vanadium in the samples was in the range of 2600-9950 g/t [1. P.70]. The chemical analysis of the R-9 sample is presented in Table 1.

Table 1 - Chemical composition of vanadium ores

Compound	V_2O_5	Cu	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	S_{total}	S_S	C_{total}	C_{org}
Quantity, %	0,93	0,28	80,5	5,1	3,5	0,8	1,6	0,5	0,1	1,1	1,0

The mechanism of roasting vanadium-containing ores with NaCl or Na_2CO_3 is as follows. At a temperature of 700-750 ^{0}C in an oxidizing atmosphere, a reaction takes place, as a result of which sodium peroxide Na_2O is formed.

The study begins with the decomposition of sodium-containing salts. gaseous chlorine will be removed. The resulting peroxide Na_2O reacts with vanadium according to the reaction [2. pp.23-25]:

$$2NaCl + 0.5O_2 = Na_2O + Cl_2$$

$$Na_2O + V_2O_5 = 2NaVO_3$$

The sodium vanadate formed as a result of the reaction is highly soluble in water. the firing process was carried out in different temperature conditions 600-650 and 700-750^{0}C. According to laboratory experience, it was determined that the optimal conditions for firing are 700-750^{0}C for 4-5 hours and the flow rate of the NaCl reagent is 8-10%. At temperatures above 7500C, the mixture melts due to the formation of insoluble vanadium silicates. Below 700^{0}C, the output of vanadium decreases [3. pp.16-33].

For the experiment we prepare the charge: 100 gr. Ore supplement 5 gr. Technical soda and mix. We substitute it on a muffle furnace and carry out firing in different temperature conditions of firing from 700^{0}C to 750^{0}C for 2-5 hours. The firing results are shown in Table 2.

It can be seen from the table that the optimal parameter for roasting vanadium ores is 700 ^{0}C, at which it is well associated with technical soda with the formation of sodium vanadate [4. pp.67-72].

After firing, the resulting product - sodium vanadate according to technological schemes is dissolved in aqueous solutions, after which the insoluble part - the residue is dissolved already in a sulfuric acid solution in order to completely transfer vanadium into the solution.

Table 2 - The results of the kinetics of firing vanadium-containing raw materials.
Initial content of vanadium 6400 g/t; t=700 ^{0}C. Consumption of technical soda Na_2CO_3 50 g/kg^3.

№	Burning time, min	Quality and mass of the burden		Quality Na_2CO_3, gr/kg	Mass of the cinder	
		Mass of the burden , gr	[V] mg/kg		Mass of the cinder, gr	Cinder out, %
1	50	100	6,400	5	98,5	93,8
2	150	100	6,400	5	95,7	91,1
3	200	100	6,400	5	93,8	89,3
4	240	100	6,400	5	92,6	88,1
5	300	100	6,400	5	91,3	86,9

With the simplicity and efficiency of the water leaching scheme, it has one drawback - a relatively low extraction of vanadium into the solution during the leaching operation (40-45%) [5.p.30-36].

Samples of the first aqueous and sulfuric acid leaching dissolved and the results of the leaching are shown in table 3.

Table 3 - Results of the kinetics of sulfuric acid leaching of cinder. Experimental conditions: H_2SO_4 = 55 g/l, S:L= 1:3, α_{ref}(V)=6400 g/t.

№	Leaching time, min	Incoming product		Amount of solution after leaching	
		[V], g/t	pH	V, mg/l	E, %
1	30	6400	5,4	2785,6	43,5
2	60	6400	5,9	3592,3	56,1
3	80	6400	6,0	4389,7	68,6
4	100	6400	6,5	4987,9	77,9
5	120	6400	6,8	5385,9	84,2

It follows from the table that after firing at 650-700^{0}C, the cinder is leached under conditions of 40-55^{0}C and in a phase ratio S:L = 1:3, in acidic solutions - with a sulfuric acid content H_2SO_4 = 55 g/l.

In laboratory studies, the optimal leaching parameters were determined and the process time was 2 hours. At the same time, it was found that the degree of vanadium solubility (E, %) increases by 42.1% due to sulfuric acid leaching of the cinder, compared with water leaching, and at the same time, the through extraction of vanadium (E, %) reached up to 84.2%. The results of sulfuric acid leaching of the cinder are presented in table 3.

To determine the optimal conditions for the leaching of metal and residual vanadium from three tailings with a residual vanadium content, a sample of tailings with a residual vanadium content of 0.51% (5100 g/t) was produced. the sample was produced under the established optimal conditions for roasting the ore and subsequent water leaching of the cinder [6. pp.221-224].

According to the developed technology and the results of this work, the following conclusions can be drawn:

- researched and developed a simplified technology for the extraction of pentoxyvanadium;
- the optimal reagent mode of dissolution of vanadium cinder by the sulfuric acid method was determined;
- the initial aqueous leaching of the cinder followed by sulfuric acid leaching increases the degree of extraction of vanadium to 42.1%, while the through extraction of vanadium is achieved up to 84.2%;

- selective precipitation of vanadium with ammonium hydroxides followed by calcination ensures the production of purified V_2O_5 with a purity of 98-99% that meets the requirements of GOST;

- a deep hydrometallurgical purification of the resulting vanadium pentoxide has been developed;

- a new technological scheme has been developed for the processing of mineral and industrial raw materials to obtain a finished product.

References:

1. Санакулов К.С., Петухов О.Ф., Василёнов О.П. «Перспективы развития ванадиевого комплекса за рубежом и в Республике Узбекистан». Горный вестник Узбекистана №3 (70) 2017г.
2. Киндяков П.С. Химия и технология редких и рассеянных элементов. –М.: Высшая школа. 1976- Том 3. с.23-25).
3. Киндяков П.С., Коршунов Б.Г., Фёдоров П.И., Кисляков И.П. Химия и технология редких и рассеянных элементов, - М.: Высшая школа. - 1978,- с. 16-33.
4. Хасанов А.С., Вохидов Б.Р., Арипов А.Р., Мамараимов Ғ.Ф., Нарзуллаев Ж.Н. “Ўзбекистон шароитида ванадий ва палладий ажратиб олишнинг технологик жараёнларини тадқиқ қилиш”. Научно-техническая журнал «Композитционные материалы» №1/2019г. Ст. 67-72.
5. Вохидов Б.Р., Арипов А.Р., Мамараимов Ғ.Ф., “Research of technological process of vanadium distribution in Uzbekistan” XI International correspondence scientific specialized conference “International scientific review of the technical sciences, mathematics and computer science” Boston. USA. June 10-11.2019 p. 30-36.
6. Вохидов Б.Р., Мамараимов Ғ.Ф., “Ванадий бойитмасини ажратиб олишда куйдириш жараёнининг афзалликлари” XVI Республиканской научно-технической конференции “Современные проблемы и перспективы химии и химико-металлургического производства” 22 ноября 2018г. Ст. 221-224.
7. Вохидов Б.Р., Мамараимов Ғ.Ф., “Ванадий ажратиб олишда замонавий танлаб эритиш усулларининг афзалликлари” XVI Республиканской научно-технической конференции “Современные проблемы и перспективы химии и химико-металлургического производства” 22 ноября 2018г. Ст. 165-167.
8. Хасанов А.С., Вохидов Б.Р. Қайта ишлатилган электролитдан соф палладий кукунини ажратиб олиш усулини илмий тадқиқ этиш // Композицион материаллар. Ташкент, 2019 - №2. С. 63-66.