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Influence of Temperature and Duration of the Process on the Degree of Nickel Extraction

Bekhzod Farmanov Ilkhomovich

Senior Teacher of the Karshi Engineering and Economics Institute, Uzbekistan

Tavashov Shakhzod Khujaxmatovich

Assistant of the Karshi Engineering and Economics Institute, Uzbekistan

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Annotation: To date, in the global industry, special attention is paid to the synthesis of high-strength, with low hydraulic resistance, improved geometric and increased specific surface area of catalyst granules. In this aspect, an important task is to develop a technology for the production of our own highly efficient and durable catalysts based on the processing of spent industrial catalysts. To do this, it is necessary to substantiate a number of scientific solutions, including in the following areas: development of nickel extraction technology from spent industrial catalysts of the GIAP-8 series, technology for obtaining high-strength aluminum oxide carriers and scientific bases for obtaining a nickel-containing catalyst on an aluminum oxide carrier.

Keywords: spent nickel-containing catalyst GIAP-8, nitric acid, degree of extraction, temperature, concentration, time.

Studies of the effect of the extraction process temperature and duration on the degree of nickel extraction from the spent nickel-containing catalyst GIAP-8 were carried out using 30% nitric acid at a rate of 100% of stoichiometry.

The effect of the norm of 30% nitric acid on the degree of nickel extraction was studied at a temperature of 30 ℃ and the duration of the process was 4 hours with constant stirring. The results obtained are shown in Table 1.

Table 1. *Wagging of the norm of 30% nitric acid on the chemical composition of the liquid phase and the degree of nickel extraction from the spent catalyst GIAP – 8 at a temperature of 30 ℃.*

№	Standard HNO_3, %	S:L	Chemical composition, mass. %			Degree of extraction, %
			NiO	$N_{nitr.}$	HNO_3	
1	80	1:0,30	16,76		7,69	74,56
2	80	1:0,30	16,99		7,40	75,52
3	80	1:0,29	17,14		7,50	75,43
4	90	1:0,34	15,74		6,40	78,82
5	90	1:0,34	15,76		6,39	78,86
6	90	1:0,32	15,72		6,71	77,97
7	100	1:0,37	14,56		5,72	81,05
8	100	1:0,37	14,65		5,59	81,49
9	100	1:0,36	14,72		5,71	81,25
10	110	1:0,41	13,46		5,28	81,49
11	110	1:0,41	13,65		5,25	82,51
12	110	1:0,39	13,49		5,31	82,49
13	120	1:0,45	13,65		2,63	91,28
14	120	1:0,45	13,67		2,61	91,35
15	120	1:0,43	13,75		2,64	91,30

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16	130	1;0,49	12,64	2,53	91,62
17	130	1:0,49	12,66	2,51	91,68
18	130	1:0,47	12,73	2,53	91,68

The table shows that with an increase in the rate of 30% nitric acid from 80% to 130% of stoichiometry for the nickel oxide content in the liquid phase available in spent catalysts decreases from 16.76-17.14% at the acid rate of 80% to 14.56-14.72% at the rate of 100% and to 12.64-12.73% at the rate of 130%. At the same time, the degree of nickel extraction increases from 74.56-72.52% at a rate of 80% nitric acid to 81.05-81.49% at a rate of 100% and to 91.62-91.68% at a rate of 130%.

The nickel oxide content in the liquid phase and the degree of nickel extraction practically do not depend on the samples of the spent catalyst GIAP – 8. Thus, at a rate of 30% nitric acid, the nickel oxide content in the liquid phase is 14.56% for sample No. 1, 14.65% for sample No. 2 and 14.72% for sample No. 3. At the same time, the degree of nickel extraction is 81.05%, 81.49% and 81.25%, respectively.

With an increase in the rate of nitric acid in the solid phase, the content of aluminum oxide decreases slightly. So, for sample No. 1, the content of aluminum oxide decreases from 86.05% at an acid rate of 80% to 84.82% at a rate of 100% and increases to 85.40% at a rate of 130%.

The nickel oxide content under these conditions increases from 10.36% at a rate of 86% to 11.64% at a rate of 100% and decreases to 11.04% at a rate of 130%.

Table 2. *The effect of the norm of 30% nitric acid on the chemical composition of the solid phase of the spent catalyst during nickel extraction at a temperature of 30 ℃.*

№	Standard HNO_3, %	Chemical composition of the aqueous phase, mass. %		
		Al_2O_3	NiO	H_2O
1	80	86,05	3,59	10,36
2	80	84,89	3,71	11,40
3	80	84,77	3,62	11,61
4	90	85,84	3,58	10,58
5	90	84,71	3,71	11,59
6	90	85,14	3,64	11,22
7	100	84,82	3,54	11,64
8	100	84,63	3,70	11,67
9	100	84,62	3,61	11,77
10	110	84,98	3,54	11,47
11	110	84,52	3,70	11,78
12	110	85,29	3,65	11,06
13	120	85,00	3,55	11,45
14	120	84,78	3,71	11,52
15	120	84,63	3,61	11,76
16	130	85,40	3,56	11,04
17	130	84,47	3,69	11,84
18	130	85,35	3,65	11,00

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The humidity of the solid phase varies from 10.36% to 11.84%.

The effect of the temperature of the nickel extraction process from the spent catalyst with 30% nitric acid on the degree of extraction at the acid rate of 100% and the duration of the process of 4 hours was studied (Fig. 1).

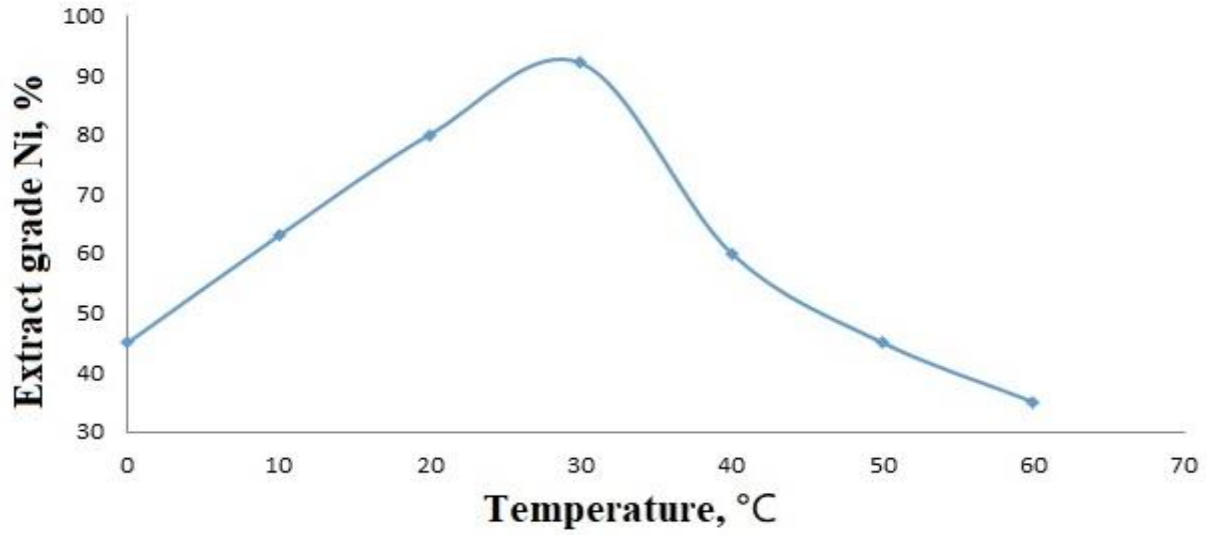

Fig. 1. The effects of the concentration of 30% nitric acid on the degree of nickel extraction at the acid rate of 100% and the duration of the process of 4 hours.

The results obtained indicate that the optimal conditions for nickel leaching are a norm of 30% nitric acid 100%, a temperature of 30-35 ° C and a process duration of 4 hours, at which a degree of zinc extraction of 92.07% is achieved.

The effect of the concentration of nitric acid at a rate of 100% on the degree of nickel extraction from the spent catalyst GIAP – 8 at a temperature of 30 ℃ and the duration of the process of 4 hours is shown in Figure 2.

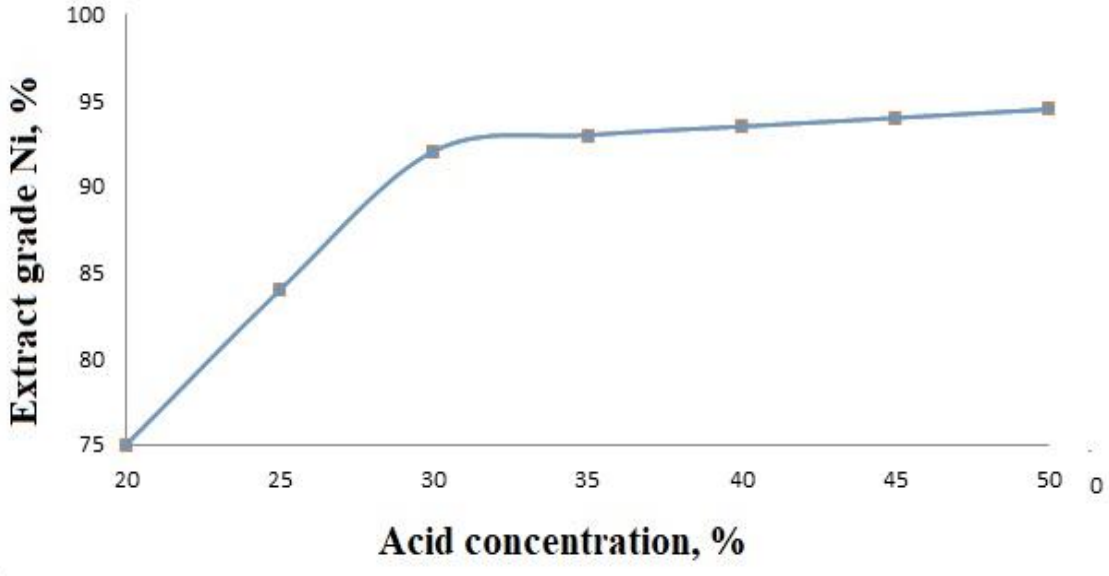

Fig. 2. The effect of the leaching temperature on the degree of nickel extraction at a rate of 100% nitric acid of 30%, the duration of the process is 4 hours.

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For further research, we stopped at a concentration of 30% nitric acid.

Thus, the conducted studies have shown the possibility of extracting nickel from the spent nickel-containing catalyst GIAP-8. The optimal parameters of the leaching process mode are the norm of 100% nitric acid 30%, temperature 30 °C, duration of the process 4 hours. At the same time, the degree of zinc extraction is 92.07%.

Figure 3 shows the results of studies of the effect of the duration of the nickel extraction process from the spent catalyst GIAP – 8 at a rate of 30% nitric acid 100% of stoichiometry at a temperature of 30 ℃.

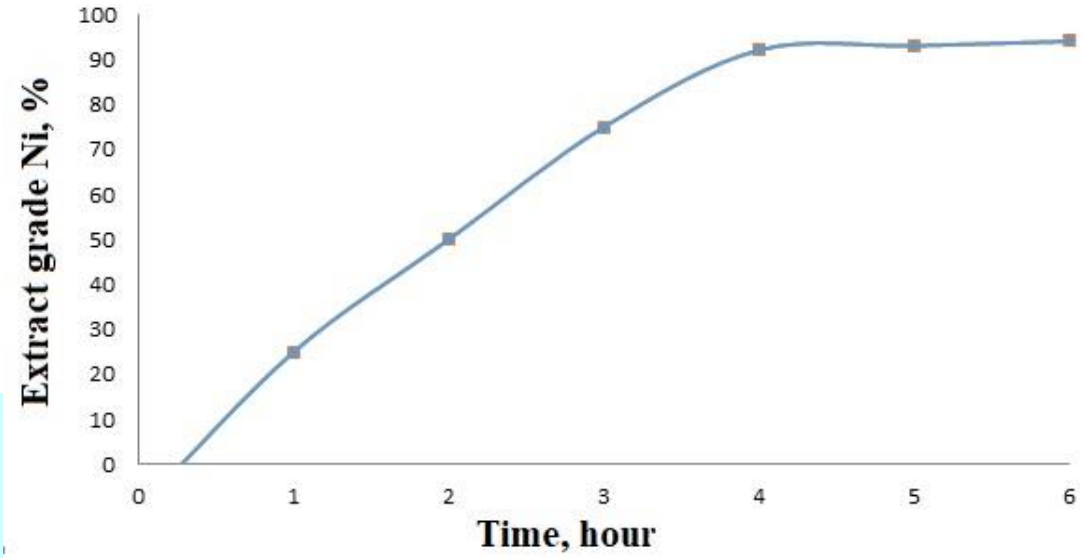

Fig. 3. The effects of the duration of the leaching process on the degree of nickel extraction at a temperature of 30 ° C, the norm of 40% nitric acid 100%.

The figure shows that with an increase in the duration of the extraction process from 30 minutes to 4 hours, it contributes to an increase in the degree of nickel extraction from 10.05% to 92.07%. A further increase in the duration of the leaching process to 6 hours increases the degree of nickel extraction to 92.29%, that is, by 0.22%. Therefore, for further research, the duration of the leaching process was limited to 4 hours.

Spent industrial catalysts are secondary raw materials for the production of metal salts. The conducted studies on the extraction of nickel from spent catalysts with nitric acid solutions have shown the possibility of extracting nickel from the catalyst for the steam conversion of methane GIAP-8. The influence of the norm of nitric acid concentration of temperature, duration of the extraction process at room temperature has been studied.

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