The Process of Obtaining Nickel from the Composition of Nickel Waste Research Technological Parameters

Farmanov B. I., Tavashov Sh. X.
Karshi Engineering and Economics Institute, Uzbekistan, Karshi

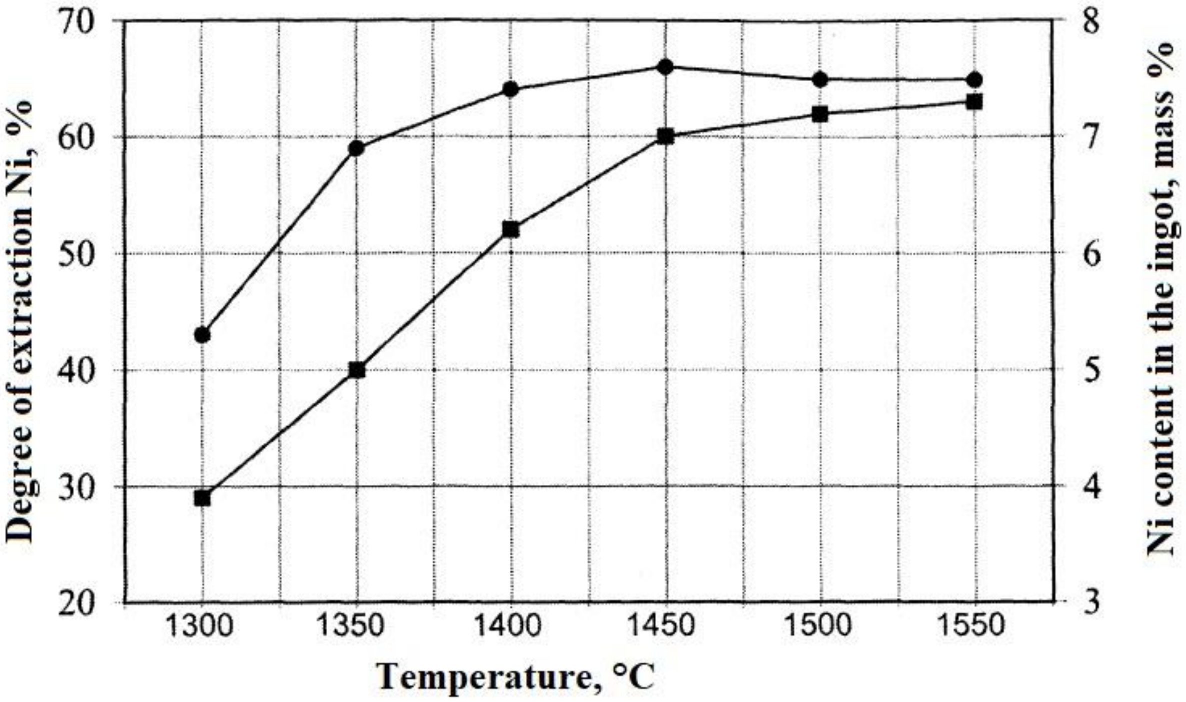
Introduction. Expansion of the production of high-quality metal alloys will lead to the consumption of large amounts of rare and expensive alloying elements in the metal trade. This leads to the development of new technologies that save efficient resources. Nickel is imported for the production of steel and chromium cast iron alloys containing 2% high-quality nickel. However, in the petrochemical and chemical industries of the Republic, more than 1,000 tons of catalyst waste and precious metals (Ni, Mo, Cu, Cr, Zn and others) containing 5% to 50% are wasted annually. The recycling of waste alloys and the use of used catalysts will save the currency spent on precious metals in the manufacturing industry, as well as reduce the harmful effects of waste on the environment.

Catalysts used in the chemical industry are widely used, including nickel.GIAP-8 (8% NiO, 92% Al_2O_3);GIAP-16 (25% NiO, 57% Al_2O_3, 8% MgO, 9% CaO, 1% BaO);NKM-4A (35% NiO, 65% Al_2O_3);ReforMAX-330 (10% NiO, 69.1% Al_2O_3, 7.6% CaO, 10.3% MgO, 3% Bosch), TO-2 (38% NiO, 12% Cr_2O_3, 50% Al_2O_3).

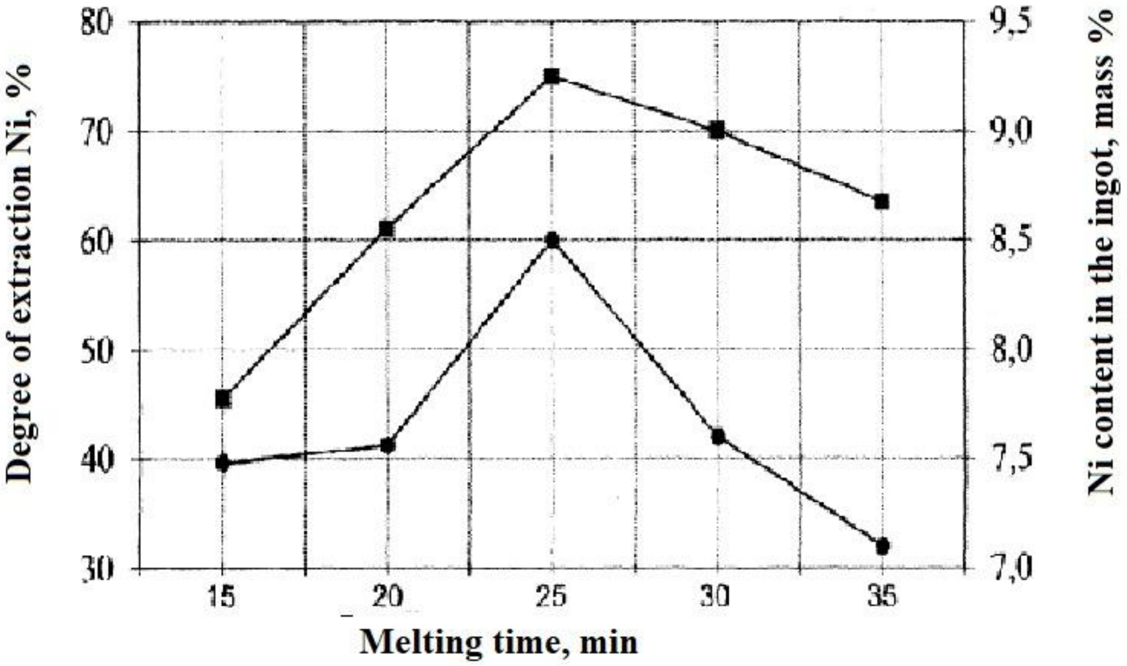
The purpose of the study. Extraction of nickel from waste catalysts in the industry of the Republic. A number of experiments were carried out, in which the extraction of nickel from the laboratory waste catalyst was carried out.The composition of catalysts used in industry is GIAP-8 (5% NiO, 93% Al_2O_3, 2% other), GIAP-16 (21% NiO, 57.6% Al_2O_3, 9% CaO, 8% MgO, 1% BaO, 3.4% waste), ReforMAX-330 (8% NiO, 67% Al_2O_3, 4% CaO, 18% MgO, 3% waste).

The result of the experiment. In the preheated oven, the sample mixture was loaded at a pre-set temperature, melted and held for a certain period of time. The sample was then removed from the furnace and cooled, and the chemical composition of the alloy and slag was then spectrally analyzed. Various technological parameters (process temperature, conduction time, effect, amount of nickel oxide in the sample) were studied in the laboratory during the melting process.

Picture1 shows the effect of the melting temperature of nickel on the waste catalyst and its recovery from the spent catalyst. The melt was carried out in a quartz furnace, the holding time was 20 min. Charge 40% spent catalyst, 40% cast iron alloys, 16.6% car slag, 2% electrode dust, 0.8% sediment and 0.6% other mixtures. Analysis of the results shows that it helps to increase the temperature and increase the activity of nickel, but the heating of the solution above 1450-1500 ° C is not effective. The results of experiments on the recovery rate of nickel and its effect on the composition of pig iron are shown in Picture2. It shows the composition of the waste catalyst at a temperature of 1450 ° C, the effect in the melting furnaces.



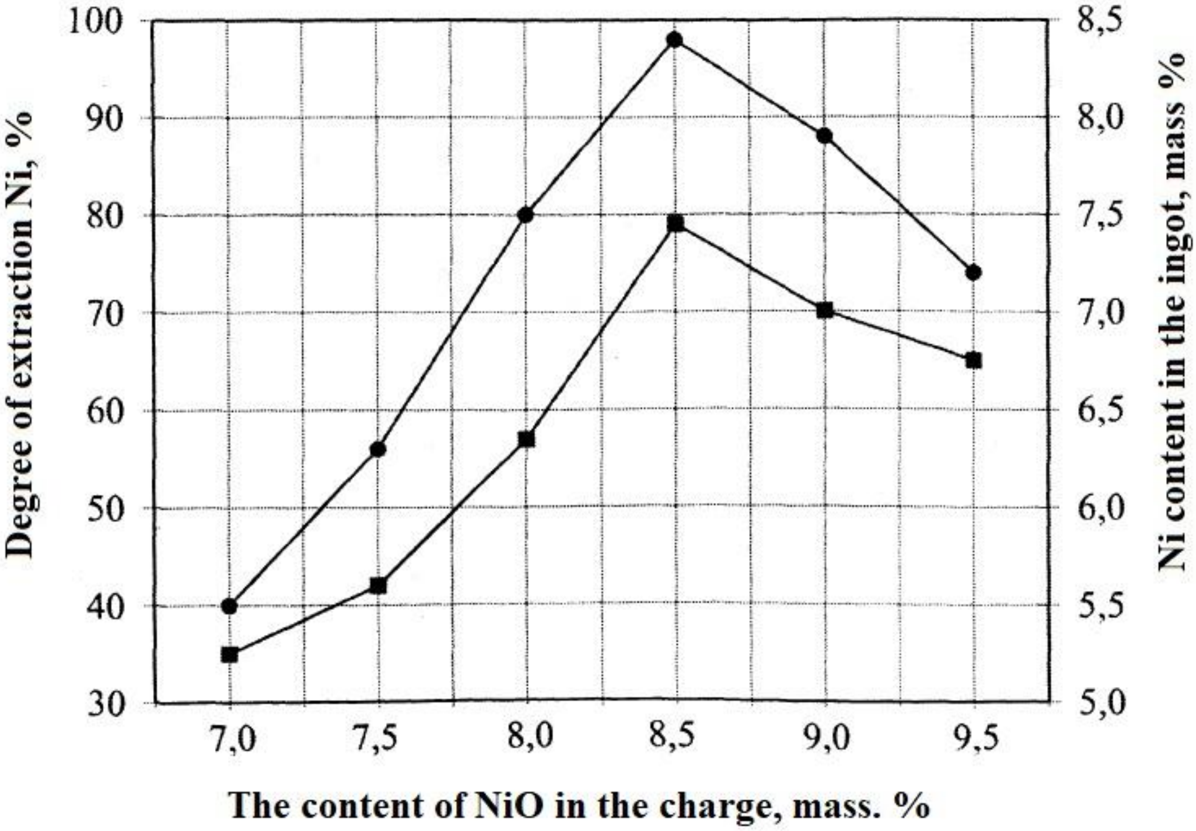
Picture1.Dependence of nickel content on the spent catalyst and the amount of nickel in the process temperature:■ - degree of nickel extraction;• - nickel.



Picture2.Diagram of nickel separation during the melting of nickel preservatives and waste catalysts. ■ —the degree of nickel separation;• - nickel-containing alloy.

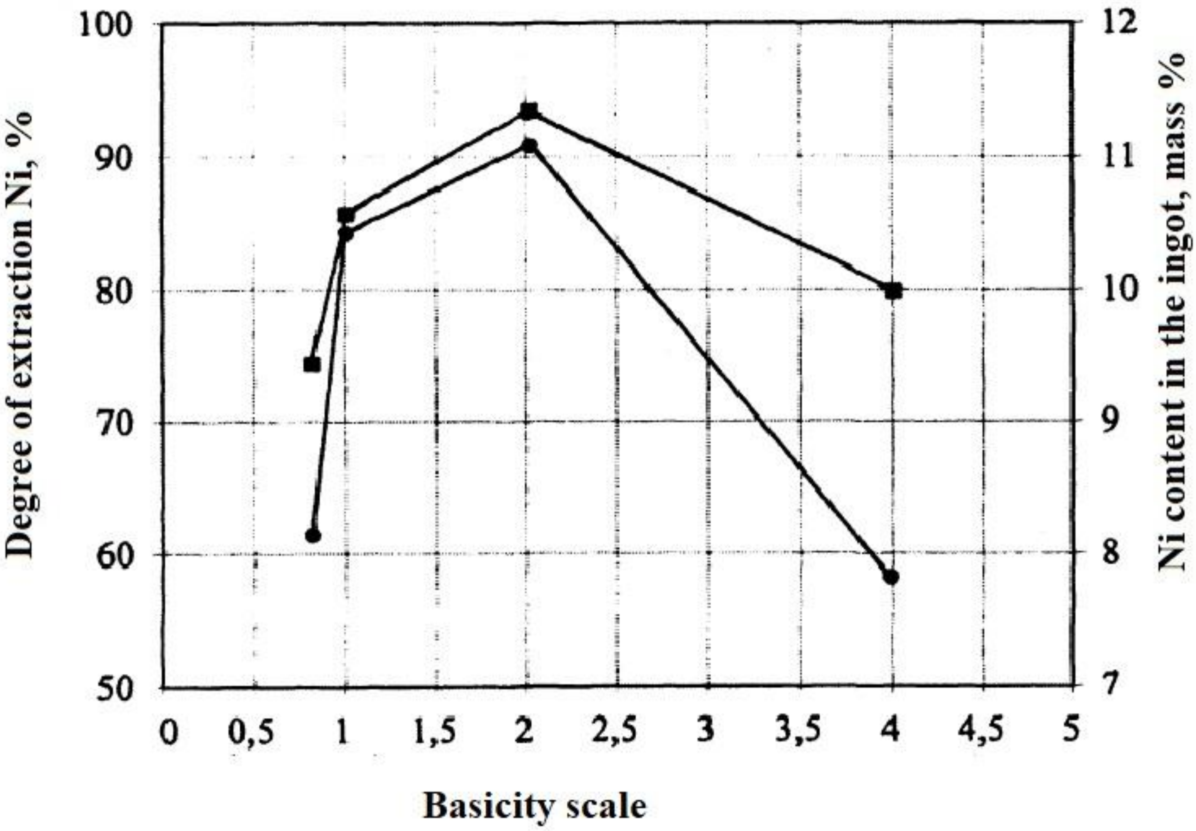
The analysis of the obtained results showed that the maximum level of nickel recovery (75%) is achieved within 25 minutes. Further increase in melting time leads to a decrease in the amount of nickel in the waste, which is associated with its oxidation and reversal of the slag (see table).

Melting time, min	In got chemical composition, %							
	Ni	C	Si	P	S	Cr	Mn	Fe
25	8,5	2,5	0,76	0,21	0,07	0,40	0,32	rest.
35	7,1	2,5	0,63	0,23	0,08	0,38	0,41	rest.



Picture3.Diagram of the effect of waste catalysts and nickel-containing catalysts on the degree of recovery: ■ - degree of recovery of nickel; - nickel alloy grade.*

Picture3 shows the experimental results of the study and the diagram of the effect of waste catalysts and nickel-containing catalysts on the degree of recovery. Melting was carried out in a quartz furnace. The alloy was kept in an oven at 1450 ° C for 25 min. As the amount of spent catalyst added to the slag phase increases (by NiO), the recovery rate of nickel increases. After reaching the nickel content of 8.5%, the opposite trend is observed. This is due to the fact that the content of Al2O3 from the catalysts increases, the amount of slag and the viscosity increase. This makes it difficult to separate the metal components. The effect of reducing the nickel oxide from the waste catalyst was studied. The CaO / SiO2 content of the slag was changed from 0.8 to 4.0 by increasing the CaO content and decreasing the slag content. Due to the fact that the melting point of the main slag is higher than that of the acid slag, the melting took place at a temperature of 1500 ° C for 25 minutes. The samples were carried out in acid smelting and neutral slag quartz furnaces.



Picture4.Influence of slag from the waste catalyst on the degree of reduction of nickel and the composition of nickel alloys: ■ - degree of nickel extraction; - the composition of nickel in the alloy*

Picture4 shows the results of the study of the effect of slag from the waste catalyst on the degree of separation of nickel and the nickel alloy composition. The maximum separation rate (91%) was separated by 2 slag slots. Errors from this boundary have led to an increase in slag accumulation, which has made it difficult to sediment the reduced nickel and has had a negative impact on slag recovery.

Conclusion. Analyzing the results, we came to the following conclusions:

- Preliminary recovery of NiO in the presence of electric furnaces from waste catalysts under production conditions is more than 90%;
- In order to accelerate the transition of nickel from the slag phase to the solution, it is necessary to add slag, cast iron chips and reducing agents (C, Si, Mn) to the catalyst and maintain the basicity of the slag mixture at 1.5-2.0.

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