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ANALYSIS OF RHENIUM METAL IN MAN-MADE WASTE CAKES IN THE PROCESS OF EXTRACTING MOLYBDENUM METAL AND STUDYING THE PROCESS OF EXTRACTING RHENIUM METAL

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Abstract:
To determine the amount of rhenium metal contained in man-made waste cakes during the extraction of molybdenum metal and to give instructions for the extraction of rhenium metal.

Keywords: Soot, sorption, regeneration, molybdenum, nitric acid, sulfur, sodium carbonate, selective dissolution, precipitation, ammonia, solution, precipitation, filter, ammonium pernate, filter press, agar.

Introduction:

It is no secret to all of us that in today's rapidly developing technological age, the demand for all rare, rare and rare metals is increasing day by day. At the same time, we should use our resources sparingly for the next generation and, if necessary, extract the rare, scattered and rare metals contained in man-made waste cakes.

In particular, we are witnessing that rhenium metal, which belongs to the rare scattered group, is obtained in the state of pernate ammonium in the conditions of Uzbekistan at "Almaliq Mining Metallurgical Combine" and the product is obtained up to rhenium. But we should be concerned that molybdenum remains in man-made waste cakes during the extraction process. Because the need for this element is based

on the physico-chemical properties of rhenium metal, we know that its cost is high due to its wide range of applications. Taking into account these factors, a complete study of the technological process, how much rhenium metal is in the residual cakes and how to extract it

We set the goal of learning. The sequence of molybdenum extraction process and the amount of rhenium metal in man-made waste cakes.

The ore containing molybdenum metal is enriched and dehydrated during the flotation process, and after the drying process, it is mixed with clay and burnt to make it in a favorable state for oxidation. Ammonium pernate is separated by burning after receiving, it is sent to the scientific center for the production of hard alloys of rare rare metals in the state of carbon black.

In order to oxidize molybdenum to Mo, add 15 m^3 of water to the reactor that dissolves molybdenum soot (agar), add 25-35% of sodium carbonate Na_2CO_3 compared to molybdenum soot (agar), and wait until the temperature of the melting reactor rises to 800^{0}C. Then, the process continues for 1:30 hours in the ready solution reactor, that is, molybdenum goes into solution. Molybdenum passes into the solution up to 70%. The reason is the presence of sulfur, the more sulfur, the less molybdenum in the solution.

The solution is sent to the filter pris. A solid phase remains in the cake, the solution is lowered to pH-3-3.5 using nitric acid. The molybdenum is sent to the sorption column for sorption of the preservative solution, absorption into the resin. 2.5 m^3 of resin (smoala) is placed in sorption columns. The resin (smoala) is charged and has a pH of 3.3.5. The amount of molybdenum in the solution involved in the sorption process is around 25%. When the amount of molybdenum in the solution leaving the boiler is 0.01%, the boiler is stopped and desorbed with 12-15% ammonia. In the process of regeneration, the amount of molybdenum in 1 m^3 of ammonia solution corresponds to approximately 80-90 grams.

Nitric acid is added to the solution and molybdenum precipitates, dehydrated in a vacuum, and the precipitate is dried. The dry precipitate is sent to the workshop for reduction of molybdenum oxide MoO_3 with hydrogen.

After collecting the remaining cake in the filter press, the process is repeated again, and it is loaded into the reactor for dissolving with water and sodium carbonate Na_2CO_3. After the temperature reaches 800^{0}C, it is melted for 1 hour. Molybdenum Mo content in the solution is around 15-17%. This process is continued up to 6 times, that is, until molybdenum is completely removed from the agar. In subsequent processes, it decreases to 9-10%, 6-5%. At the end, the cakes are collected and burned

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at a temperature of 7000⁰C. The purpose of incineration is to melt away the sulfur and re-melt the remaining molybdenum.

The amount of rhenium in the liquid phase of the cakes formed during the process of transfer to the solution and after the sorption process was examined by X-ray (fluorescence) and chemical analysis.

1-The liquid and solid phases released in the solution transfer device in the initial process for molybdenum dissolution were chemically analyzed and the composition of the cake remaining in the filter press was analyzed and the experimental result was written in the table.

1-Table

№	1	2	3	4	5	6	7	8	9	10	11	12	13
Element	Mg	Al	Si	S	K	Ca	Ti	Cr	Mn	Fe	Co	Ni	Cu
Quantity%	**1.78**	**4.42**	**9.30**	**6.08**	**0.253**	**0.525**	**0.123**	**0.0253**	**0.0143**	**18.8**	**0.0555**	**0.0073**	**5.81**

№	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Element	Zn	Ge	As	Se	Sr	Y	Zr	Mo	Ag	Sb	Re	Pb	Po	U
quantityi%	**0.213**	**0.0035**	**0.0287**	**0.070**	**0.073**	**0.0065**	**0.228**	**26.0**	**0.0163**	**0.0538**	**0.0224**	**0.724**	**0.0068**	**0.0019**

2- The liquid and solid phases released during the second dissolution of the first process cake for molybdenum dissolution were chemically analyzed again in the felt press, and the result of the experiment was written in the table.

2-table

№	1	2	3	4	5	6	7	8	9	10	11	12	13
Element	Mg	Al	Si	S	K	Ca	Ti	Cr	Mn	Fe	Co	Ni	Cu
Quantity i%	**1.93**	**5.24**	**12.2**	**4.63**	**0.237**	**0.484**	**0.170**	**0.0451**	**(0.0049)**	**24.2**	**0.0659**	**0.0059**	**6.14**

№	14	15	16	17	18	19	20	21	22	23	24
Element	Zn	Ge	As	Se	Sr	Y	Zr	Mo	Ag	Sb	Ba
miqdori %	**0.218**	**0.0412**	**0.0081**	**0.0082**	**0.0068**	**0.231**	**20.8**	**0.0187**	**0.0891**	**0.0054**	**(0.0088)**

№	25	26	27	28	29
Element	Re	Au	Pb	Po	U
quantity%	**0.0303**	**(0.0039)**	**0.826**	**0.0043**	**(0.0010)**

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3. The liquid and solid phases removed from the cake dissolving device for the second time to dissolve molybdenum were chemically analyzed and the remaining cake content was analyzed in the felt press, and the result of the experiment was recorded in the table.

3-table.

№	1	2	3	4	5	6	7	8	9	10	11	12
Element	Mg	Al	Si	S	K	Ca	Ti	Cr	Mn	Fe	Co	Ni
Quantity %	**1.97**	**5.46**	**12.08**	**4.91**	**0.209**	**0.602**	**0.180**	**0.0522**	**(0.0077)**	**25.3**	**0.0697**	**0.0078**

№	13	14	15	16	17	18	19	20
Element	Cu	Zn	As	Se	Sr	Y	Zr	Mo
Quantityi%	**6.47**	**0.227**	**0.0411**	**0.0066**	**0.0082**	**0.0061**	**0.234**	**19.7**

№	21	22	23	24	25	26
Element	Ag	Sb	Re	Au	Pb	Po
Quantity%	**0.0196**	**0.0856**	**0.0234**	**(0.0038)**	**0.868**	**0.0065**

4- all the processes carried out to transfer molybdenum to the solution, the available metals in the liquid phase were determined using a X-ray fluorescence chemical analysis device and shown in the table.

№	1	2	3	4	5	6	7	8	9	10	11	12
Element	S	Al	Mo	Zr	P	Si	K	Fe	Cu	Ca	Dy	Re
Quantityi%	**1.18**	**0.253**	**0.219**	**0.0414**	**0.0278**	**0.0266**	**0.0185**	**0.0150**	**0.0087**	**0.0083**	**(0.0019)**	**0.0010**

№	13	14	15	16	17	18	19	20	21	22	23
Element	Cr	Mn	Zn	Ag	Hf	Tb	Sr	Rh	U	Pa	Ge
Quantity %	**0.0008**	**(0.0007)**	**0.0006**	**0.0005**	**ND**	**ND**	**0.0002**	**ND**	**(0.0002)**	**(0.0001)**	**(0.0001)**

The first, second, and third process man-made waste cakes and liquid waste composition are arranged sequentially in the form of fluorescent chemical analysis.

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Analyzed result

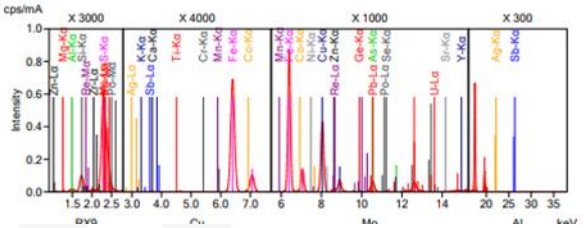
Sample Information

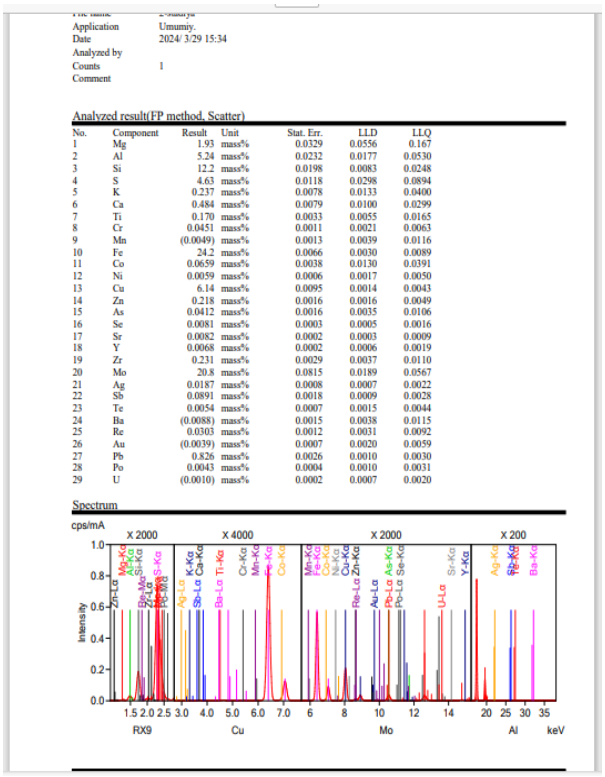
Sample name	1-stadiya
File name	1-stadiya
Application	Umumiy.
Date	2024/ 3/29 15:24
Analyzed by	
Counts	1
Comment	

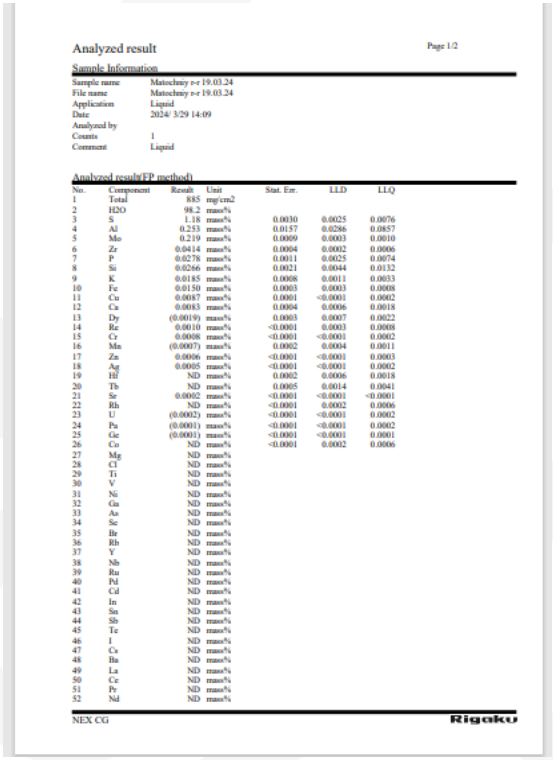
Analyzed result(FP method, Scatter)

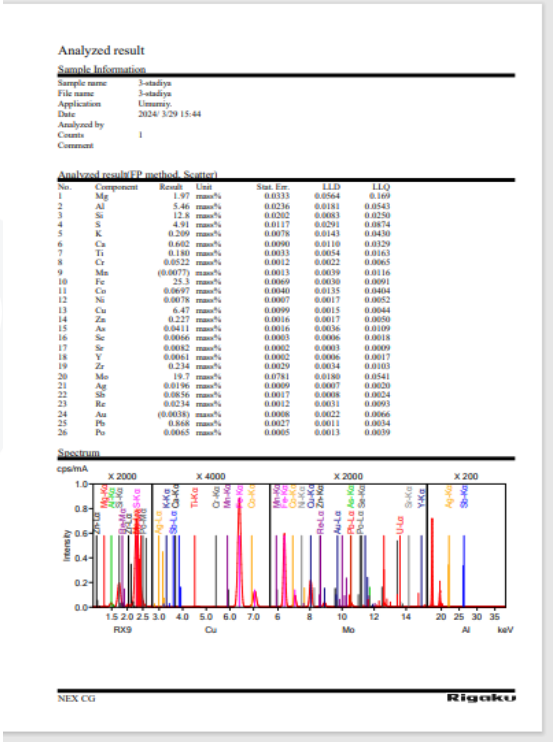
No.	Component	Result	Unit	Stat. Err.	LLD	LLQ
1	Mg	1.78	mass%	0.0337	0.0610	0.183
2	Al	4.42	mass%	0.0225	0.0197	0.0591
3	Si	9.30	mass%	0.0184	0.0098	0.0294
4	S	6.08	mass%	0.0137	0.0341	0.102
5	K	0.253	mass%	0.0078	0.0134	0.0401
6	Ca	0.525	mass%	0.0080	0.0097	0.0292
7	Ti	0.123	mass%	0.0027	0.0046	0.0138
8	Cr	0.0253	mass%	0.0009	0.0019	0.0058
9	Mn	0.0143	mass%	0.0012	0.0031	0.0094
10	Fe	18.8	mass%	0.0051	0.0029	0.0087
11	Co	0.0555	mass%	0.0032	0.0113	0.0340
12	Ni	0.0073	mass%	0.0006	0.0015	0.0045
13	Cu	5.81	mass%	0.0086	0.0018	0.0054
14	Zn	0.213	mass%	0.0014	0.0015	0.0044
15	Ge	0.0035	mass%	0.0003	0.0007	0.0022
16	As	0.0287	mass%	0.0014	0.0033	0.0099
17	Se	0.0070	mass%	0.0002	0.0005	0.0015
18	Sr	0.0073	mass%	0.0002	0.0003	0.0008
19	Y	0.0065	mass%	0.0002	0.0005	0.0016
20	Zr	0.228	mass%	0.0027	0.0036	0.0107
21	Mo	26.0	mass%	0.102	0.0201	0.0604
22	Ag	0.0163	mass%	0.0008	0.0009	0.0026
23	Sb	0.0538	mass%	0.0015	0.0013	0.0038
24	Re	0.0224	mass%	0.0011	0.0027	0.0082
25	Pb	0.724	mass%	0.0022	0.0013	0.0038
26	Po	0.0068	mass%	0.0004	0.0010	0.0031
27	U	0.0019	mass%	0.0002	0.0006	0.0019

Spectrum









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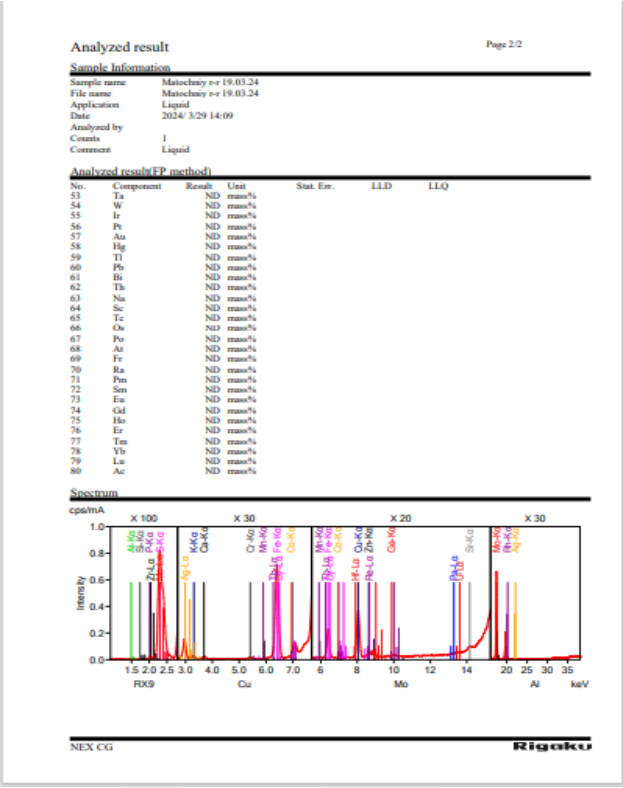
Analyzed result

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Sample Information

Sample name	Matochniy r-r 19.03.24
File name	Matochniy r-r 19.03.24
Application	Liquid
Date	2024/ 3/29 14:09
Analyzed by	
Counts	1
Comment	Liquid

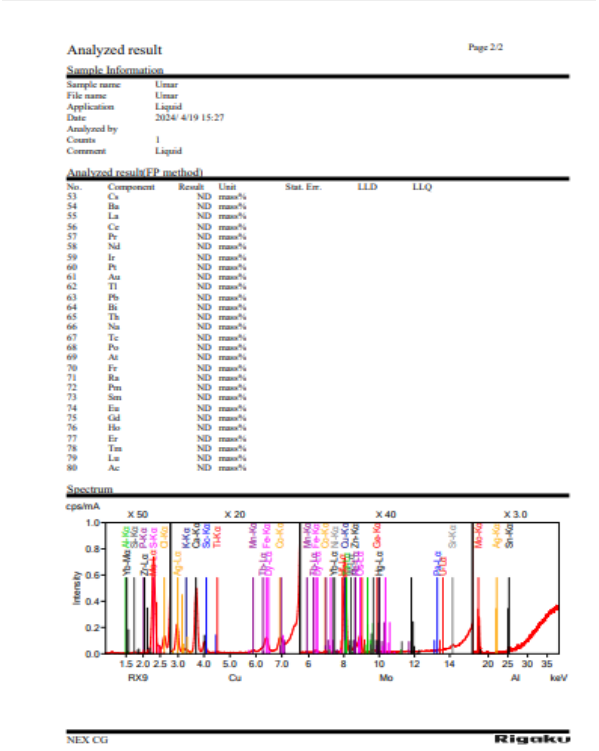
Analyzed result(FP method)

No.	Component	Result	Unit	Stat. Err.	LLD	LLQ
53	Ta	ND	mass%			
54	W	ND	mass%			
55	Ir	ND	mass%			
56	Pt	ND	mass%			
57	Au	ND	mass%			
58	Hg	ND	mass%			
59	Tl	ND	mass%			
60	Pb	ND	mass%			
61	Bi	ND	mass%			
62	Th	ND	mass%			
63	Na	ND	mass%			
64	Sc	ND	mass%			
65	Tc	ND	mass%			
66	Os	ND	mass%			
67	Po	ND	mass%			
68	At	ND	mass%			
69	Fr	ND	mass%			
70	Ra	ND	mass%			
71	Pm	ND	mass%			
72	Sm	ND	mass%			
73	Eu	ND	mass%			
74	Gd	ND	mass%			
75	Ho	ND	mass%			
76	Er	ND	mass%			
77	Tm	ND	mass%			
78	Yb	ND	mass%			
79	Lu	ND	mass%			
80	Ac	ND	mass%			

Spectrum

NEX CG

Rigaku


Analyzed result

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Sample Information

Sample name	Umar
File name	Umar
Application	Liquid
Date	2024/ 4/19 15:27
Analyzed by	
Counts	1
Comment	Liquid

Analyzed result(FP method)

No.	Component	Result	Unit	Stat. Err.	LLD	LLQ
53	Cs	ND	mass%			
54	Ba	ND	mass%			
55	La	ND	mass%			
56	Ce	ND	mass%			
57	Pr	ND	mass%			
58	Nd	ND	mass%			
59	Ir	ND	mass%			
60	Pt	ND	mass%			
61	Au	ND	mass%			
62	Tl	ND	mass%			
63	Pb	ND	mass%			
64	Bi	ND	mass%			
65	Th	ND	mass%			
66	Na	ND	mass%			
67	Tc	ND	mass%			
68	Po	ND	mass%			
69	At	ND	mass%			
70	Fr	ND	mass%			
71	Ra	ND	mass%			
72	Pm	ND	mass%			
73	Sm	ND	mass%			
74	Eu	ND	mass%			
75	Gd	ND	mass%			
76	Ho	ND	mass%			
77	Er	ND	mass%			
78	Tm	ND	mass%			
79	Lu	ND	mass%			
80	Ac	ND	mass%			

Spectrum

NEX CG

Rigaku

Summary Section

The results of the studies show that if we pay attention to the result of the first, second and third processes in the man-made waste cake, an increase in the amount of rhenium Re metal was observed due to the decrease in the amount of molybdenum. Based on the general analysis, it was 0.02%. However, the rhenium metal was hardly depleted during the process sequence. It was found that a very small amount of 0.01% passed into the solution. The amount of rhenium in the liquid phase of the entire process was found to be very low.

Default solution. Based on the results of the analysis of man-made waste from molybdenum metal extraction, it was concluded that rhenium metal should be extracted before incineration in order to get rid of sulfur in the last process. Because in the process of burning molybdenum at a high temperature and getting rid of sulfur, it was known that rhenium metal is combined with gases and dust and flies away.

Technological solution. Before burning the cake, it is necessary to carry out the process of selective melting, that is, it is necessary to selectively melt the rhenium metal. For this, of course, a selective melting device will have to be studied and adapted. The main parts of the selective melting device should be acid resistant. It will be necessary to put an acid-resistant sieve so that the cake itself does not pass directly through it. In the selective melting device, the main part, i.e., the part where

acid and cake are placed, should have a temperature of 2500^{0}C. It is advisable to set the procedure time to at least 2 hours. As a result, all kinds of metals, including rhenium metal, go into solution. Some of the metals contained in the solution can be electrolyzed using electric potential.

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