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Obtaining Magnesium Hydroxide From Dolomite Of The Dekhkanabad Deposit

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Abstract – The results of a study of the effect of pH on the chemical composition and degree of precipitation of magnesium hydroxide from clarified nitric acid extracts of dolomite decomposition are presented. It was found that the main amount of magnesium is precipitated by neutralizing the clarified extract from the dolomites of the Dekhkanabad field with gaseous ammonia to pH 11-12. The filtration rate of magnesium hydroxide on dry sediment is 181.80 kg/m^{2}h. All solutions have acceptable rheological properties.

Keywords –Magnesium Hydroxide, Dolomite, Dekhkanabad Deposit.

I. Introduction

Dolomite rocks are one of the most widespread and underdeveloped varieties of mineral raw materials. A mixture of magnesium and calcium oxides in certain proportions is a semi-finished product for the production of magnesium. Inorganic magnesium compounds are used in the production of refractories, metallurgy, energy, the construction industry, the production of fertilizers, defoliants, feed additives, as fillers for polymer materials, etc. [1-3].

The production of magnesium compounds is based not only on high-quality magnesite, but also on the processing of seawater, brines and salt deposits [4].

Uzbekistan does not have rich deposits of magnesite compounds, and the demand for magnesium compounds is growing from year to year. In connection with these facts, there is an acute problem of chemical processing of dolomite raw materials, brine from lakes Karaumbet, Barsakelmes and other magnesium-containing sources of raw materials [2, 5]. However, the organization of production is constrained by insufficient knowledge and development of the available deposits of magnesium compounds. Dekhkanabad (Kashkadarya region) dolomite deposit is one of the industrially developed ones [2].

There are insufficient data in the literature to solve the problem of acid processing of dolomites in Uzbekistan; there are no acceptable technologies that exclude preliminary heat treatment [6, 7]. The problem arises of a detailed study of the known chemical reactions, properties of solutions and pulps of the process of obtaining magnesium hydroxide and processing mother liquors. Since magnesium hydroxide is the main intermediate compound in the production of magnesium oxide and its salts [8].

II. Research methods

Dolomite from the Dekhkanabad deposit was used for research with the following composition (weight %): MgO - 13,57; CaO - 37,55; CO_2 - 44,43; n.o. – 0,56.

Previously, studies were carried out to establish the optimal technological parameters for the decomposition of dolomites with solutions of nitric acid and the production of clarified solutions of calcium and magnesium nitrates [9-10]. The precipitation of magnesium in the form of hydroxide was carried out with gaseous ammonia from clarified nitric acid extracts obtained at a rate of 40% nitric acid of 100 and 110%. Chemical analysis of the initial, intermediate, and final products was carried out by known methods [11, 12].

Results and its discussion. Further, the effect of pH on the chemical composition of solutions of calcium and magnesium nitrates and the degree of magnesium precipitation was studied. The data obtained are shown in Table 1 and Figure 1.

Table 1. Effect of pH on the composition of the liquid phase of nitric acid extract at a rate of 40% nitric acid 100% and 110%

pH	Chemical composition of the liquid phase, weight %				
	MgO	CaO	Al_2O_3	Fe_2O_3	NH_4^+
The norm of nitric acid is 100%					
-1,1	3,60	9,81	0,073	0,022	0,00
4	3,58	9,59	0,071	0,022	2,36
7,5	3,35	9,53	0,071	0,021	3,00
9	2,62	9,52	0,071	0,021	3,17
10	0,45	9,48	0,071	0,021	3,50
11	0,13	9,32	0,069	0,021	5,23
12	0,10	9,03	0,067	0,020	8,65
The norm of nitric acid is 110%					
-1,2	3,45	6,45	0,069	0,021	0,00
4	3,43	6,30	0,067	0,021	2,52
8	3,35	6,26	0,067	0,020	3,20
9	2,42	6,24	0,067	0,020	3,35
10	0,51	6,20	0,066	0,020	4,12
11	0,17	6,09	0,065	0,0200	6,00
12	0,12	5,92	0,063	0,019	8,87

As can be seen from the table, with an increase in pH in the composition of the liquid phase at pH 10-12, the content of magnesium sharply decreases, and the content of other components is insignificant, which is explained by the introduction of ammonia. At high pH values, almost all magnesium is precipitated.

As can be seen from the figure, when the extract is neutralized to pH 7.5-8, the degree of de-magnetization does not exceed 3-7%. With an increase in pH to 10, about 85-87.5% of magnesium passes into a precipitate, at a pH of 11-12, 96.52-97.22% of magnesium is precipitated.

Studies have been carried out on the separation of magnesium hydroxide by filtration. Due to the fact that during neutralization of the clarified nitric acid extract with ammonia its temperature rises, the influence of two parameters was investigated: the temperature of the pulp and the rate of nitric acid on the filtration rate on the solution and on the dry residue (the concentration of nitric acid taken for the decomposition of the sludge was 57.5 %, pH of the pulp before filtration - 11). Filtration rate data are shown in Figure 2.

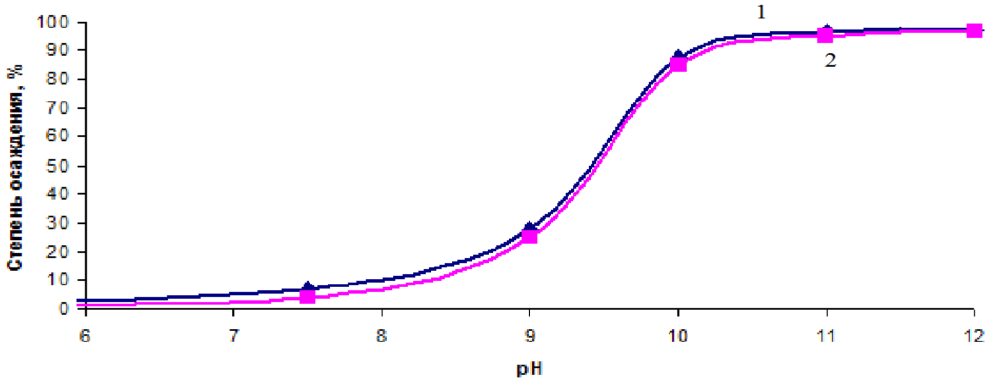

Figure 1. Effect of pH on the degree of precipitation of magnesium: 1 - the rate of nitric acid 100 and 2 - 110%

The analysis of the figure shows that with an increase in the rate of nitric acid, the filtration rates for the solution and for the dry residue increase, the filtration rates for the solution and the dry residue at a nitric acid rate of 100% are 890.21 and 181.80 kg/m^2 h, respectively.

As can be seen from Figure 2, with an increase in the pulp temperature, the filtration rate increases, which is explained by a decrease in the pulp viscosity. Compared to the filtration rate for solution and dry residue at 20 ° C on average with an increase in temperature by 20 ° C, filtration rates for solution and dry residue increase, respectively, by 19.43 and 90.52% with an increase in temperature from 20 to 40 ° C and by 122.93 and 51.48% with an increase in temperature from 40 to 60 ° C.

Thus, from the point of view of the filtration rate, it should be carried out at a higher temperature. The optimum temperature is 50-60 ° C. Due to the high viscosity of the slurry, the settling process for the separation of magnesium hydroxide was not considered.

In connection with the high intensity of the centrifugation process for phase separation, the influence of the centrifugation time on the L: S ratio in the condensed part was studied. The phase separation process during centrifugation is fast enough. The most intensive centrifugation takes place in the first 6 minutes. In this case, the thickening after 6 minutes is 91.86% of the original, after 10 minutes - 95.66%, and after 15 minutes - 97.15%.

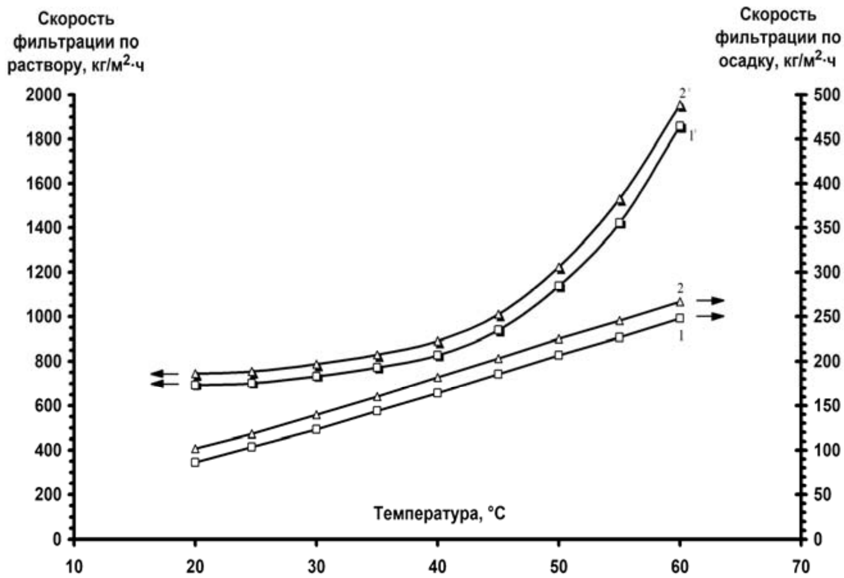

Figure 2. Influence of nitric acid rate and temperature on the filtration rate of magnesium hydroxide

Thus, the studies carried out have shown that both filtration and centrifugation are quite acceptable methods for separating magnesium hydroxide precipitate.

Table 2 shows data on the chemical composition of the liquid phase. after separation of magnesium hydroxide. obtained at a pH of 10.5-11 depending on the norm of 40% nitric acid.

Table 2. Influence of the norm of nitric acid on the chemical composition of the liquid phase ammoniated to pH 10.5-11 after the separation of magnesium hydroxide

Norm, % relatively	Chemical composition of the liquid phase, weiht %					
	CaO	MgO	Al_2O_3	N_{NH3}	N_{NO3}	N_{total}
100	7,49	0,00	0,080	8,14	7,26	15,40
105	7,19	0,00	0,079	8,03	7,24	15,27
110	6,87	0,00	0,079	7,91	7,19	15,10
115	6,53	0,05	0,079	7,76	7,11	14,87
120	6,21	0,24	0,076	7,66	7,05	14,71
125	5,88	0,37	0,073	7,54	6,96	14,50
130	5,58	0,45	0,069	7,42	6,88	14,30
135	5,36	0,50	0,065	7,32	6,83	14,16
140	5,15	0,50	0,062	7,22	6,78	14,00
145	4,95	0,48	0,059	7,12	6,72	13,84
150	4,70	0,43	0,056	6,99	6,60	13,59

The table shows that with an increase in the norm of nitric acid for the decomposition of dolomite, the contents of all components, except for magnesium oxide, decrease. The content of magnesium oxide decreases from 7.49% at a rate of 100% nitric acid to 6.87% at a rate of 110% and to 4 , 70% at a rate of 150%. The content of aluminum at these parameters will decrease from 0.080% to 0.079% and to 0.056%. The content of nitrate nitrogen is 7.26-6.60%, ammonium is 8.14-6.99% with a total nitrogen form 15.40-13.59%.

At low 100-110% rates of nitric acid, magnesium is absent in the liquid phase. With an increase in the acid rate from 115% to 130%, the content of magnesium oxide increases from 0.05% to 0.45% and subsequently remains at approximately one level of 0.48-0.50%.

Table 3 shows the density and viscosity of the liquid phase after the separation of magnesium hydroxide, depending on the rate of nitric acid for the decomposition of dolomite and temperature.

Table 3. Influence of the rate of nitric acid and temperature on the density and viscosity of the liquid phase

Norm, % relatively	Density, g/cm^3				Viscosity, cPa			
	20°C	40°C	60°C	80°C	20°C	40°C	60°C	80°C
100	1,213	1,129	1,040	0,965	2,169	1,444	1,091	1,026
105	1,204	1,121	1,032	0,958	2,153	1,433	1,083	1,018
110	1,196	1,113	1,025	0,951	2,139	1,424	1,076	1,012
115	1,187	1,105	1,018	0,944	2,123	1,413	1,068	1,004
120	1,179	1,097	1,011	0,938	2,108	1,403	1,060	0,997

125	1,170	1,089	1,003	0,931	2,093	1,393	1,053	0,990
130	1,162	1,082	0,996	0,924	2,078	1,383	1,045	0,983
135	1,153	1,073	0,989	0,917	2,062	1,373	1,037	0,976
140	1,145	1,066	0,982	0,911	2,048	1,363	1,030	0,969
145	1,136	1,057	0,974	0,904	2,031	1,352	1,022	0,961
150	1,128	1,050	0,967	0,897	2,017	1,343	1,015	0,954

With an increase in the norm of 40% nitric acid for the decomposition of dolomite and an increase in temperature, the density and viscosity of the liquid phase decrease. At a temperature of 20°C, an increase in the acid rate from 100% to 150% of the density of solutions decreases from 1.213 g / cm^3 to 1.128 g / cm^3, and the viscosity from 2.169 cPa to 2.017 cPa.

As the temperature rises from 20 ° C to 80 ° C, the densities decrease to 0.897-0.965 g / cm3, and the viscosity to 0.954-1.026 cPa.

III. Conclusion

Thus, the studies carried out have shown the possibility of processing dolomites from the Dekhkanabad field with the release of magnesium hydroxide and obtaining liquid nitrogen-calcium fertilizers.

To isolate magnesium hydroxide from clarified solutions of nitric acid extract of decomposition of dolomites, ammonization must be carried out with gaseous ammonia to pH 10.5-11, followed by filtration of the suspension or centrifugation.

Stock solutions can be used as liquid nitrogen-calcium fertilizers saturated with ammonia.

Initial, intermediate and final solutions have acceptable rheological properties.

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