# DEVELOPMENT OF A COMPLEX TECHNOLOGY FOR OBTAINING IMPORTED BRUCITE BASED ON DEHKHANABAD DOLOMITE MINERAL AND OBTAINING MAGNESIUM BINDERS BASED ON THEM

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***Abstract.*** *This article presents a complex laboratory technology for the production of expensive imported magnesium hydroxide (Brucite) from cheap dolomite, which is a local raw material in Uzbekistan, as well as gypsum, alabaster, and mineral fertilizer - ammonium sulfate, which is used in construction, and the obtained raw material. The oxide composition of the material brucite was determined. The influence of pH on the chemical composition of the quenched solutions of dolomite and the level of precipitation of magnesium hydroxide was studied. The filtration rate of magnesium hydroxide is 180.60 kg/m2c based on dry deposition.*

***Keywords:*** *dolomite, brucite, hydro module, complex technology, alabaster, gypsum, mineral fertilizer, hygroscopicity.*

**Introduction.** As the development of science is the main criterion of economic development, along with the rapid development of scientific and technical potential in the world, the intellectualization of the main factors of production is also growing, in the implementation of the huge task of forming an economy based on knowledge, innovation and human capital. creation of the legal ground should ensure that it has a strong place in the world community. After all, it helps to speed up production in various fields, to update it technically and technologically, and to increase the competitiveness of manufactured products. In accordance with the tasks carried out by Uzbek scientists who are engaged in the comprehensive study of the technologies of obtaining chemical compounds based on local raw materials, the creation of completely new substances and materials with predefined properties, the development of new technological processes that meet the requirements of modern production, and the improvement of existing ones working on it. Dolomite is mainly used as building aggregate, cement production, calcified stone for lime production, sometimes oil and gas reservoir, magnesia source for chemical industry, agricultural treatment, metallurgical flux, etc. used [1-2]. The use of dolomite flour is a convenient way to reduce the acidity of the soil. It is a crystalline mineral with a light color (gray or white, less reddish) and a characteristic luster.

The purpose of the study. Currently, in Uzbekistan, extracting the magnesium mineral *BRUCITE* reagent, which is a substitute for imports, obtained from dolomite, which is considered a local raw material, and developing its complex technology. Production of expensive *BRUCITE* reagent at JSC "Navoiazot" to reduce the hygroscopic properties of mineral fertilizers.

**Research material and methods.** It was analyzed using a high-power energy dispersive X-ray fluorescence spectrophotometer - Japan, Rigaku NEX CG EDXRF Analyzer with Polarization in set - 9022 19 0000.

a) b) c)

***Figure 1 a) Dekhkanabad dolomite and b, c) appearance of brucite minerals***

**Experimental results and discussion.** Currently, in Uzbekistan, extracting the magnesium mineral *BRUCITE* reagent, which is a substitute for imports, obtained from dolomite, which is considered a local raw material, and developing its complex technology. Production of expensive *BRUCITE* reagent at JSC "Navoiazot" to reduce the hygroscopic properties of mineral fertilizers. Brucite is widely used in the world to obtain magnesium oxide (magnesia), magnesium metal, complex fluxes, as a binder in the production of glass and cement, and in pharmaceuticals. Problems related to the process of extracting this reagent exist not only in our Republic, but all over the world. Brucite powder 66% is mainly used as flame retardant. The heat absorbed by the reaction acts as a retarder, delaying the setting of the binder. The released water dilutes any flammable gases and prevents oxygen from aiding combustion. Brucite has strong adsorption capacity, high activity and low corrosion. These advantages can shorten the process and time of magnesium hydroxide treatment of acidic wastewater, and reduce equipment investment. Therefore, magnesium hydroxide can be widely used in the treatment of acidic wastewater. Brucite has high whiteness, good peel, strong viscosity and poor water absorption [3-4]. The papermaking process can be changed from an acid process to an alkaline process using calcite as a filler, and pollution of the pulp water can be reduced.

In addition, the dolomite flour produced as a result of the experiments can be used in many areas, including the use of dolomite flour is a convenient way to reduce the acidity of the soil. The substance is a crystalline mineral with a light color and characteristic brightness. The basis of dolomite flour is calcium, which affects the growth of plants, improves the root system, and directly participates in magnesium, which is part of chlorophyll and participates in photosynthesis. Fractions of dolomite flour: 0-2.5 mm, the allowed residue is used on a sieve from 3 to 5 mm, from 1 to 7%, depending on the class and brand. There are A, B, C grades of dolomite flour. Dolomite flour is used for decontamination of agricultural soils according to GOST 14050-93. Many plants have problems with growth and development in acidic soils. Without dolomite flour, other fertilizers are not even fully absorbed. The introduction of dolomite flour into the soil reduces acidity, which leads to better plant growth, and also significantly increases the effectiveness of additional fertilizers.

*Metamorphism of dolomite*. Rocks composed of various minerals retain their original state for a long time. As a result of the movements of the earth's crust, new physico-chemical conditions are created, rocks and the minerals contained in them change, and new types of minerals and rocks are formed. As a result, over time, these rocks recrystallize under the influence of pressure and temperature. The process of dolomite being formed like limestone under the influence of heat and pressure is re-formed when the temperature rises. During the formation of dolomite, the size of dolomite crystals increases and its clear crystalline appearance is formed. If granule dolomite is carefully studied, it can be determined that it consists of easily recognizable dolomite crystals. Coarse crystalline texture is a sign of formation of crystallization, which usually occurs due to metamorphism. Dolomite, which has become a metamorphic rock, is called "dolomite marble" [5-7].

Dolomite has very few uses as a mineral. However, it is used to neutralize acid in the chemical industry, in stream restoration projects, and as a soil conditioner. Dolomite is used as a source of magnesia (MgO), a feed additive for livestock, an admixture and flux in metal processing, and in the production of glass, bricks, and ceramics. Dolomite serves as the host rock for many lead, zinc and copper deposits. These sedimentary layers are formed through a fracture system where hot, acidic hydrothermal solutions move up from depth, colliding with dolomitic rocks. These solutions react with dolomite, causing the pH of the solution to drop, which causes metal precipitation.

Dolomite also serves as an oil and gas producing rock. During the conversion of calcium to dolomite, the volume decreases. This results in cavities in rivers and mountainsides that can be filled with oil or natural gas as they break away from other rocks. This makes dolomite a reservoir and a target for oil and gas drilling.

It is one of the countries rich in mineral and raw material reserves in the Republic of Uzbekistan. Currently, more than 1,717 mines, about 1,000 different prospective minerals have been identified, 118 of which are various mineral raw materials. Of these, more than 60 are involved in production. 155 promising fields for oil and gas condensate, natural gas, more than 40 for precious metals, and more than 40 for non-ferrous, rare and radioactive metals are processed and used as finished and semi-finished products at production enterprises, and some are exported are being exported to countries [8].

***Table 1.***

| Available mines | Constituent components, % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | CaO | MgO | $SiO_2$ | MnO | $Al_2O_3$ | $Na_2O$ | $K_2O$ | $SO_3$ | $CO_2$ |
| Dekhqonobod | 34,2 | 20,3 | 0,842 | 0,01 | 0,414 | 0,062 | 0,0603 | 0,149 | 43,12 |
| Shorsu | 31,48 | 19,17 | 2,87 | 0,01 | 0,32 | 0,05 | 0,15 | 0,30 | 45,01 |
| Karnab | 30,02 | 19,63 | 2,74 | 0,01 | 0,39 | 0,27 | 0,12 | 0,39 | 45,40 |
| Kermanchi | 30,35 | 19,56 | 2,12 | 0,04 | 0,36 | 0,06 | 0,11 | 0,42 | 45,20 |
| Navbahor | 28,01 | 24,60 | 2,14 | 0,03 | 0,38 | 0,17 | 0,12 | 0,20 | 44,2 |

Chemical composition of dolomite found in various studied deposits

In our research, the goal is to extract brucite (magnesium hydroxide), which is imported from abroad and is expensive for export, from dolomite, which is a cheap local raw material available in Uzbekistan. Many scientists obtain brucite through other technologies and methods. Our process envisages the creation of a new waste-free, resource-efficient complex technology for extracting gypsum and alabaster used in construction and applying them to their production.

The following reactions take place in this process:

$$CaCO_3 \cdot MgCO_3 + 2\,H_2SO_4 \rightarrow MgSO_4 + +2CO_2 + CaSO_4 \cdot 2H_2O$$

$$CaSO_4 \cdot 2H_2O \rightarrow CaSO_4 \cdot 0{,}5H_2O + 1{,}5H_2O$$

$$MgSO_4 + 2NH_3 \cdot H_2O \rightarrow Mg(OH)_2\downarrow + (NH_4)_2SO_4$$

We carried out the process of obtaining brucite from dolomite in laboratory conditions as follows:

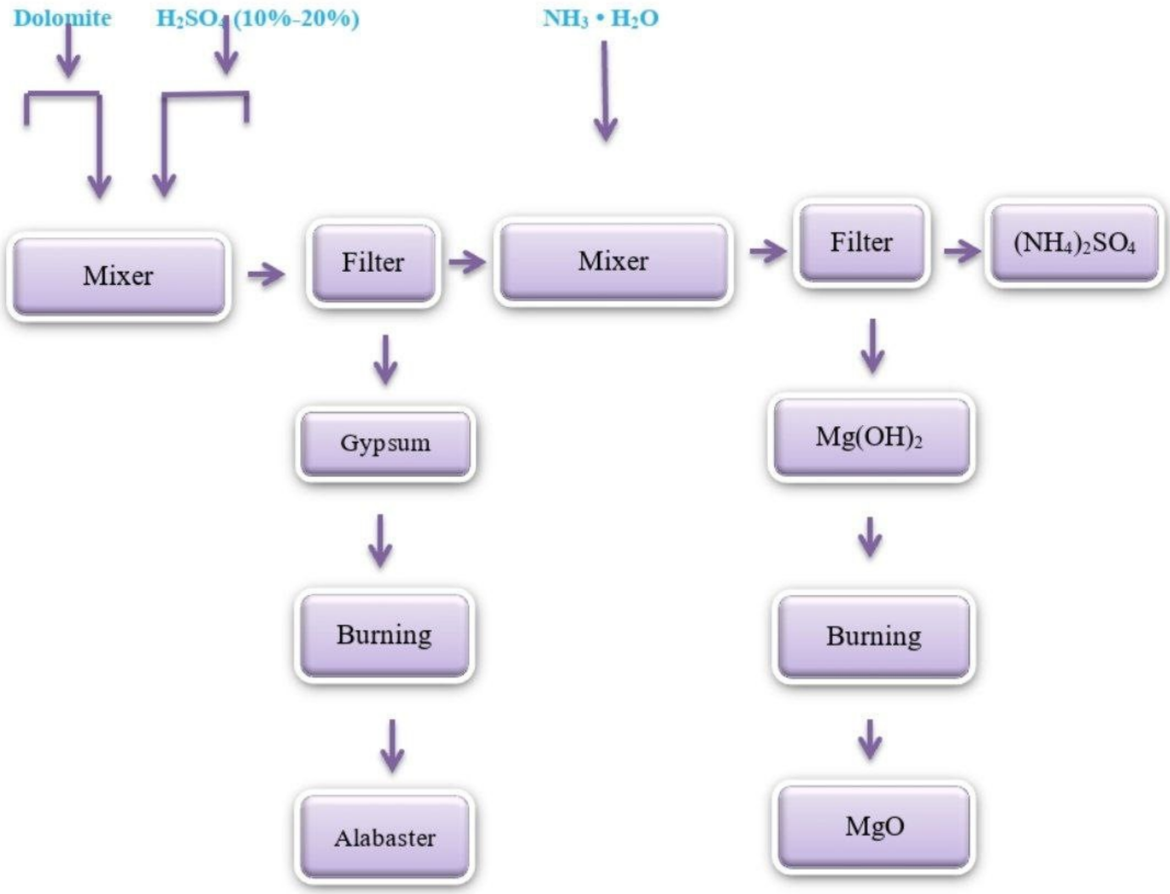


***Figure 2. Separation schemes in the laboratory for the extraction of brucite***

One of the main points in the proposed technology is the hydro module in the process of decomposing dolomite with a sulfuric acid solution, the process of filtering the resulting gypsum, the hydro module of the precipitation process of brucite, and the technological optimal conditions of the brucite filtration process were determined in laboratory conditions and the first accurate results were obtained [9] .

Initially, an aqueous solution of sulfuric acid of a certain concentration is put into a reactor with a silicate enameled interior and a mixer device, and crushed dolomite in the amount of recipe is fed through a tape feeder in a working mixer at a certain time (depending on the production capacity). Dolomite and 20-30% sulfuric acid are added to the mixer and thoroughly mixed for 2 hours. In this process, the relationship between solid and liquid substances is important [10]. In all known technologies, the exact hydromodule unit differs from each other, and this value is set separately for different raw materials. Physicochemical properties of magnesium hydroxide obtained from dolomite decomposed in sulfuric acid are presented in the results of this study.

Figure 3 shows the X-ray diffraction pattern of $Mg(OH)_2$ The XRD patterns correspond to the X-ray diffraction patterncrystalline $Mg(OH)_2$. It shows broad peaks of high intensity Maximum peak of $Mg(OH)_2$ crystallites Broadening which peaks indicate that the particles are small It was further confirmed by HRTEM analysis. Thus, the data presented in Figure 3 and discussed above suggest a successful preparation of the required materials.

Imported magnesium hydroxide, i.e. brucite, is an additional raw material for obtaining ammonium nitrate in Uzbekistan. This mineral is imported at the NAOIAZOT JSC production enterprise and is used to reduce the viscosity of nitrogen fertilizer. 4390 tons of brucite were used in 1 year (2021 calculation). It was exported from Russia for $253 per ton.

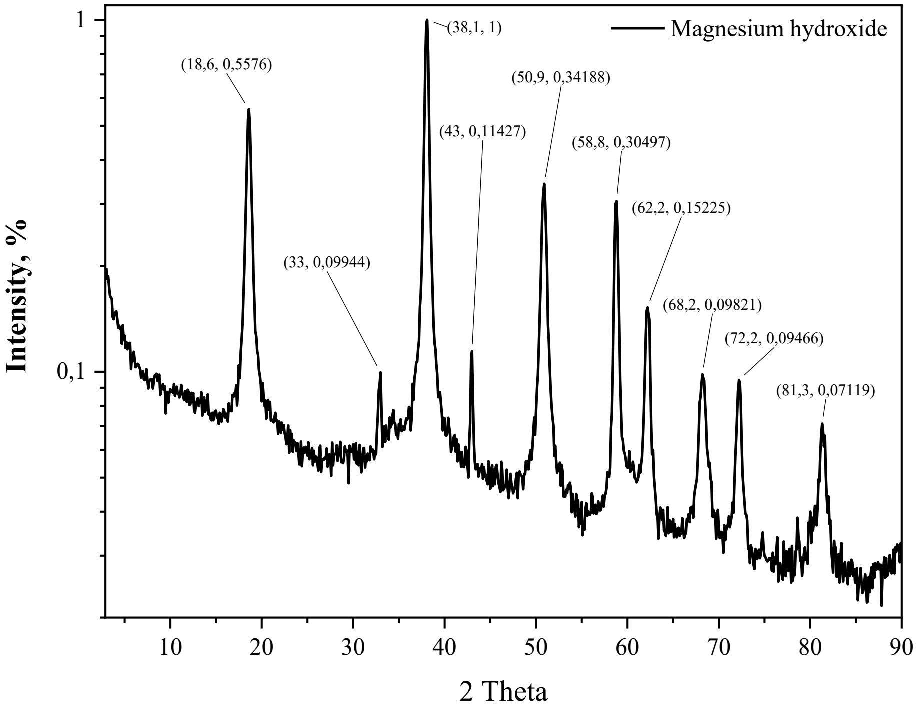


***Figura 3 Powder X-ray diffraction of magnesium hydroxide provides information about the states of atoms on the surface solid sample results.***

This substance is dissolved in $HNO_3$ and its viscosity can be reduced using the following methods: use of mineral additives; use of surfactants; use of organic reagents, use of brucite mineral. Therefore, the developed new technology is of great importance for our Republic in obtaining products with high economic efficiency and even ready for export, as well as in the development of agriculture and construction industry (including cement).

Research results and their analysis. As a result of these scientific studies, it is expected to achieve new scientific achievements in the development of a complex resource-efficient technology for obtaining brucite and alabaster obtained by new methods and conducting experimental tests at production enterprises. Therefore, the developed new technology is of great importance for our Republic in obtaining products with high economic efficiency and even ready for export, as well as in the development of agriculture and construction industry (including cement).

According to the results of the analysis, brucite obtained by splitting dolomite with sulfuric acid mainly consists of magnesium oxide. If the amount of magnesium oxide is 82.0% (it should be at least 60%) and sulfur (VI) oxide is calculated from 2.20%, then the product obtained is a mixture of magnesium hydroxide and magnesium sulfate salt. . That is, in magnesium sulfate, 82.0% of magnesium oxide and 2.20% of sulfur oxide, 0.0103% of chlorine and 0.0016% of copper oxide were formed.

Thus, at first, natural dolomite mineral is thoroughly washed, separated into solid-liquid parts in a filter press. The obtained purified dolomite is placed in a mixing reactor covered with silicate enamel, with a sulfuric acid solution in the prescribed amount, portion by portion in the technological mode at the specified time and in the prescribed amount. At the end of gas separation in the process, the reaction mass is fed to a centrifuge device or a filter press in order to separate gypsum and magnesium sulfate solution from each other. The resulting gypsum is calcined and passed through a tunnel furnace at a temperature of 180-190$^0$C to obtain alabaster, and depending on the results of the alabaster analysis, it is sent to the packaging department through a conveyor belt.

Analyzed result(FP method, Scatter)

| No. | Component | Result | Unit | Stat. Err. | LLD | LLQ |
|---|---|---|---|---|---|---|
| 1 | Cl | 0.0103 | mass% | 0.0001 | 0.0001 | 0.0004 |
| 2 | MgO | 82.0 | mass% | 0.0800 | 0.0291 | 0.0873 |
| 3 | Al2O3 | 0.130 | mass% | 0.0040 | 0.0044 | 0.0132 |
| 4 | SiO2 | 0.174 | mass% | 0.0027 | 0.0022 | 0.0067 |
| 5 | SO3 | 2.20 | mass% | 0.0042 | 0.0023 | 0.0068 |
| 6 | CaO | 0.0290 | mass% | 0.0011 | 0.0013 | 0.0040 |
| 7 | MnO | 0.0094 | mass% | 0.0004 | 0.0006 | 0.0018 |
| 8 | Fe2O3 | 0.0057 | mass% | 0.0003 | 0.0005 | 0.0016 |
| 9 | CuO | 0.0016 | mass% | <0.0001 | 0.0001 | 0.0004 |
| 10 | ZnO | 0.0022 | mass% | <0.0001 | <0.0001 | 0.0003 |
| 11 | As2O3 | 0.0023 | mass% | <0.0001 | <0.0001 | 0.0001 |
| 12 | ZrO2 | 0.0703 | mass% | 0.0007 | 0.0002 | 0.0005 |
| 13 | Ag2O | 0.0003 | mass% | <0.0001 | <0.0001 | 0.0002 |
| 14 | Ta2O5 | 0.0011 | mass% | 0.0001 | 0.0003 | 0.0010 |
| 15 | Eu2O3 | (0.0040) | mass% | 0.0009 | 0.0025 | 0.0075 |
| 16 | Tb4O7 | 0.0037 | mass% | 0.0004 | 0.0010 | 0.0030 |
| 17 | Dy2O3 | 0.0026 | mass% | 0.0003 | 0.0008 | 0.0023 |

Spectrum

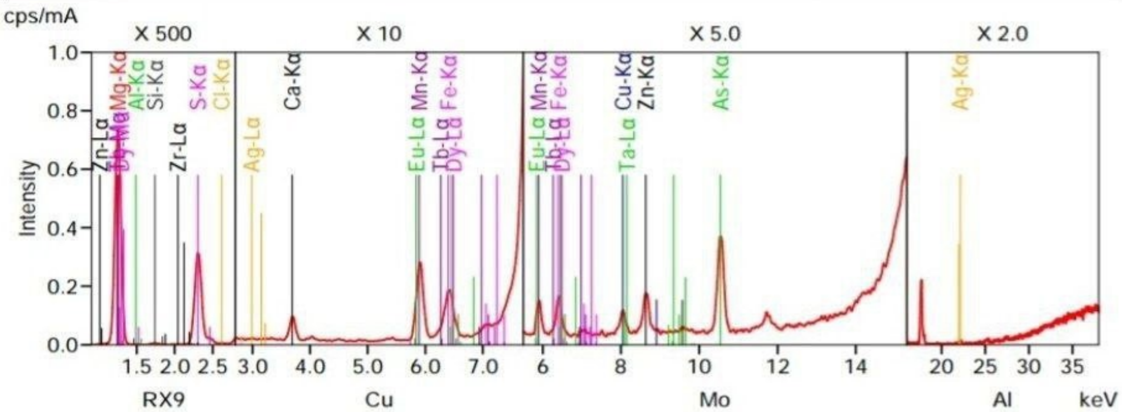


*Figure 4. Oxide composition of isolated brucite reagent*

The magnesium sulfate solution is taken into a reactor equipped with a cooling system with a mixer, and ammonia water is added to it in the prescribed amount, the process is carried out with cooling for forty minutes. The mixture is separated into solutions of magnesium hydroxide and ammonium sulfate by centrifugation or press filtration. The magnesium hydroxide is transported by a conveyor belt through the tunnel furnace and sent to the packing plant. Ammonium sulfate solution is returned to the beginning of the cycle, i.e., to the process of decomposing dolomite with sulfuric acid solution, cycling is carried out until a saturated solution of ammonium sulfate solution is formed at 20-25$^0$C. Ammonium sulfate solution that has reached the saturation level is removed from the technological system and sent to the packaging department. All packaged products are stored in special warehouses. The process is controlled by input, intermediate and final control. Such controls are performed by laboratory assistants and discussed by leading experts.

In the test sample of magnesium hydroxide, CaO, MgO, $Fe_2O_3$, $Al_2O_3$, $-SO_4^{2-}$, $H_2O$, $CO_2$, $Cl^-$, fire loss indicators were determined. The results of the analysis are shown in Table 2. For comparison, we show in Table 2 the composition of Agromag brucite developed by RF and the norm of magnesium hydroxide extracted from dolomite from Dekhkhanabad dolomite mine[11].

In addition, magnesium-containing raw material samples were tested during the preparation of nitric acid extract corresponding to the concentration of nitrate salts and free $HNO_3$ of the verified magnesium hydroxide ammonium nitrate production rules.

However, for ease of comparison of test results, the loading of magnesium-containing raw materials was calculated for the same amount of nitric acid, taking into account the small excess required for complete decomposition of the raw materials.

In the experiments, the same duration (15 minutes) of raw material dosing to the nitric acid solution was determined.

Magnesium hydroxide, which we extracted from dolomite for laboratory testing and comparison, has a white powder.

Decomposition of magnesium hydroxide with 46.0% nitric acid (powder dose 15 minutes), the maximum temperature of the mass reached 70 °C, during the decomposition of brucite (manufacturer LLC Vyazma-Brucite, RF), 74°C under similar conditions. Strong foaming was not observed.

The composition of the nitric acid extract of magnesium hydroxide extracted under laboratory conditions at TSTU: the sum of MgO and CaO in terms of MgO is 150.7 g/1; $HNO_3$ 44.8 g/l; no $Cl^-$; $SO_4^{2-}$ 0.41%; Sum of $Fe_2O_3$ + $Al_2O_3$ 0.23% including $Fe_2O_3$ 0.017%. The composition of brucite extract: the sum of MgO and CaO by MgO is 140.8 g/l; $HNO_3$ 31.6 g/l; $Fe_2O_3$ 0.27 g/l. (producer LLC Vyazma-Brucite, Russian Federation).

Additive based on crushed brucite MgO (100-130) g/dm3, $HNO_3$ (25-50) g/dm3; Fe (1.2-1.6) g/dm3 (crushed brucite according to TU1517-001-59074732-05).

Brushite obtained in laboratory conditions at TDTU was also tested with magnesium hydroxide, and no oily or tarry substances were found.

The mass of the insoluble precipitate after 16 hours of precipitation in the sample:

- when magnesium hydroxide is obtained under laboratory conditions - 3.2436 g.
- with bursitis (producer LLC "Vyazma-Brusit", RF) - 2.58 g

The precipitate formed was separated from the nitric acid solutions by filtration through a blue tape filter paper.

The results of the analysis showed that the magnesium hydroxide sample provided by the Tashkent State Technical University contains 1.39% sulfates.

Sulfates are undesirable for the production of ammonium nitrate, because insoluble deposits formed in the evaporators during the evaporation of the solution can cause the evaporators to shut down due to poor heat transfer.

In the 23rd workshop of "Navoiyazot" JSC, crushed brucite without sulfates is used for the production of ammonium nitrate with magnesium addition.

Test results of magnesium hydroxide samples of Tashkent State Technical University The test results are shown in Table 2.

For comparison, the table also shows the results of the analysis of crushed brucite according to TU 1517-001-59074732-05 and brucite of the Agromag brand.

***Table 2***

| Indicator name | Norms for crushed brucite according to TU 1517-001-59074732-05 (with 1-5 rotations) | Analysis results | |
|---|---|---|---|
| | | Brucite TSTU | Brucite "Agromag" |
| Appearance | - | White powder without visible impurities | White powder without visible impurities |
| Mass fraction loss on calcination, %<br>including $CO_2$<br>- hygroscopic $H_2O$ | -<br>-<br>not more than 0,5 | 29,56<br>4,19<br>4,19 | 30,40<br>2,10<br>0,26 |
| Mass fraction, %<br>-$SiO_2$ | - | 0,66 | 4,83 |
| - amount of iron oxide ($Fe_2O_3$) and ($Al_2O_3$), %<br>including $Fe_2O_3$ | -<br>not more than 0,5 | 1,18<br>0,13 | 1,29<br>0,21 |
| -CaO | not more than 0,4 | 1,25 | 2,51 |
| -MgO | more than 60.0 | 68,51 | 60,06 |
| $-SO_4^{2-}$ | - | 1,39 | No |
| - $Cl^-$ | - | 0,008 | 0,01 |
| Mass fraction of particle size fractions:<br>Greater than 0.2 mm, %<br>From 0.16 to 0.2 mm, %<br>From 0.06 to 0.16 mm, %<br>Less than 0.063 mm, % | Sieve residue, size in maximum fraction, Not more than 18% | 52,81<br>29,9<br>17,28<br>0,01 | - |
| Decomposition temperature with nitric acid, $^0C$ | - | $70^0C$ | $70^0C$ |

***The results of studying the suitability of magnesium raw materials for the preparation of nitric acid extract***

***Table 3***

| Raw materials indicators | | Raw material name | |
|---|---|---|---|
| | | Brucite (TSTU), MgO 82% | Brucite ("Vyazma-Brusit" LLC, RF) MgO 60,0% |
| Upload | Raw material, g | 16,7 | 17,30 |
| | $HNO_3$, 46% ml | 62,0 | 48,0 |
| | GOV, ml | 20,0 | 24,0 |

<table>
<tr><td colspan="2">Dosing duration, min</td><td>15</td><td>15</td></tr>
<tr><td colspan="2">Maximum decomposition temperature, °C</td><td>70</td><td>74,0</td></tr>
<tr><td colspan="2">Coefficient of volume increase in solution foaming</td><td>1,0</td><td>1,3</td></tr>
<tr><td rowspan="3">Clarification of the solution per unit of time</td><td>for 6 hours</td><td>Clear</td><td>Clear</td></tr>
<tr><td>for 16 hours</td><td>Clear</td><td>Clear</td></tr>
<tr><td>for 72 hours</td><td>Clear</td><td>Clear</td></tr>
<tr><td rowspan="2">Solution analysis, g/l</td><td>The amount of MgO+CaO is due to MgO</td><td>150,7</td><td>44,8</td></tr>
<tr><td>Free $HNO_3$</td><td>140,8</td><td>31,6</td></tr>
</table>

In this table, the results of the analysis are presented, as well as the study processes of the magnesium hydroxide sample presented by us with bursite of "Vyazma-Brusit" LLC.

From the results of this work, a waste-free technology of brucite production will be created instead of imported magnesium oxide used in "NAVOIYAZOT" and "Fergana azot" LLC and "Polymer Pigment" private enterprise, and construction materials will be alabaster and gypsum, as well as mineral nitrogen fertilizer. It is planned to be launched.

One of the main points in the proposed technology is the hydro module in the process of splitting dolomite with a sulfuric acid solution, the process of filtering the formed gypsum, the hydro module of the sedimentation process of brucite, and the technological optimal conditions of the brucite filtration process were determined in laboratory conditions and the first clear results were obtained.

In our research, the goal is to extract expensive imported brucite from dolomite, which is a cheap local raw material available in Uzbekistan. Many scientists obtain brucite through other technologies and methods.

In our research, the processes are carried out in the following stages:

1. Creation of a technology for obtaining gypsum from dolomite in the presence of sulfuric acid and dissolving the released magnesium sulfate;

2. Development of a complex technology for obtaining alabaster from the obtained gypsum;

3. Development of a technology for producing brucite from additional magnesium sulfate and determination of its composition and physical and chemical properties.

**Conclusions.** Based on the obtained results, it can be concluded that the technology for extracting ammonium sulfate, alabaster and gypsum will be developed through this technology, which is made from cheap local raw materials.

One of the most important points in our technology is the hydro module in the process of decomposing dolomite with a sulfuric acid solution, the process of filtering the resulting gypsum, the hydro module of the precipitation process of brucite, and the optimal technological conditions of the brucite filtration process were determined in laboratory conditions and the first clear results were obtained. Initially, an aqueous solution of sulfuric acid of a certain concentration is put into a reactor with a silicate enameled interior and a mixer device, and crushed dolomite in the amount of recipe is fed through a tape feeder in a working mixer at a certain time (depending on the production capacity). Dolomite and 20-30% sulfuric acid are added to the mixer and thoroughly mixed for 2 hours. In this process, the relationship between solid and liquid matters. In all known technologies, exactly the hydro module unit differs from each other, and this size is set separately for different raw materials.

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