

UCHTUT DOLOMITE MINERAL OF MINERALOGICAL PROPERTIES, CHEMICAL COMPOSITION AND EXTRACTION OF MAGNESIUM CHLORIDE

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ABSTRACT

The European standard EN 13274-8 provides a test method for the determination of dolomite dust occlusion for respiratory protective devices. In our country, this standard was published by the Turkish Standards Institute (TSE) under the following name: TS EN 13274-8 Respiratory protective equipment - Test methods - Part 8: Test for dolomite dust suppression. Dolomite is a type of limestone. Dolomite, rich in magnesium and calcium carbonates, also contains minor minerals. It is used in the chemical industry in acid neutralization, stream restoration projects, and as a soil conditioner. Two schemes for the production of magnesium chloride are briefly described below. The choice of one or another scheme depends on the availability of cheap hydrochloric acid or ammonia nearby.

Keywords: Dolomite mineral, Chemical formula $\text{CaMg}(\text{CO}_3)_r$, Magnesium and calcium carbonates, acids, Calcite hardness, Magnesium hydroxide, Dolomite dust test, insoluble compound and mineral composition.

INTRODUCTION

Dolomite (from the French mineralogist Dolomite Dolomye) is a mineral belonging to the class of carbonates. Chemical formula $\text{CaMg}(\text{CO}_3)_r$. Small amounts of iron, manganese, cobalt, sometimes copper, barium, lead, etc. will be. Syngonia is trigonal. It occurs in rhombic, granular, kidney-shaped forms. The color is gray-white, yellow, gray-green. Vitreous luster. Hardness 3.5-4. Density 2.9 g/cm³. Widely distributed in nature. There are dolomite deposits in Russia (Urals), Ukraine. In Uzbekistan, dolomite hydrothermal, polymetallic deposits (Khondiza, Uchkuloch, Korgoshinkon, etc.) formed veins with quartz, barite, pyrite, sphalerite, galena. There are thick layers of dolomite in the sedimentary rocks of the Silurian period in the Zirabulok and Ziyovuddin mountains, and in the Devonian sedimentary rocks in

the Chatkal, Kurama and Nurota mountains. Dolomite is used in metallurgy, chemical industry as a flux, thermal insulation material and in construction[1 end 2].

Dolomite - ($\text{CaMg}(\text{CO}_3)_2$) - as a refractory material and flux in metallurgy, as an insulating material in magnesia cement and construction, as a weighting agent in drilling, as well as in rubber, cable, leather, paper, glass and chemical industry[3]. Currently, the scientists of the above institute are developing a new technology for obtaining magnesium oxide MgO and magnesium hydroxide $\text{Mg}(\text{OH})_2$ from paleogene dolomites of Uzbekistan (Vaush deposit). The technology is aimed at the production of a new type of commodity product that replaces imports - magnesium oxide and magnesium hydroxide[4].

Dolomite is a type of limestone. Dolomite, rich in magnesium and calcium carbonates, also contains minor minerals. It is used in the chemical industry in acid neutralization, stream restoration projects, and as a soil conditioner[5].



Dolomite is a source of magnesium and is used as a feed additive in livestock, as a sintering agent in metal processing, and as an ingredient in glass, brick, and ceramic production.

Dolomite is the main constituent of sedimentary rocks known as dolostone and metamorphic rocks[6]. Dolomite reacts very weakly to cold and dilute hydrochloric acid. But if the acid is warm or if the dolomite is in powder form, a much stronger acid reaction is observed. Powdered dolomite is easily produced by drawing on a linear plate[7].

Dolomite is very similar to the mineral calcite. Calcite is calcium carbonate and dolomite is calcium magnesium carbonate. These two minerals are one of the most common pairs that cause difficulty in mineral identification[9]. The best way to tell these two minerals apart is to consider their hardness and acid reactions. The hardness of calcite is 3, and the hardness of dolomite is from 3.5 to 4. Calcite is strongly reactive with cold hydrochloric acid, while dolomite foams weakly with cold hydrochloric acid[8].

Dolomite is not widely used as a mineral. However, dolostone has a wide range of uses. The most common field of use is the construction industry. It is used as road, base material, aggregate, railway ballast and filler. However, recently, companies looking to manufacture

protective masks, which are in great demand, use dolomite dust as a filter material. Dolomite powder, with its long-lasting and strong anti-clogging structure, is an effective solution in this area[12].

The European standard EN 13274-8 provides a test method for the determination of dolomite dust occlusion for respiratory protective devices. In our country, this standard was published by the Turkish Standards Institute (TSE) under the following name: TS EN 13274-8 Respiratory protective equipment - Test methods - Part 8: Test for dolomite dust suppression[11].

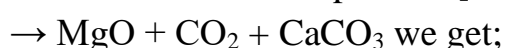
Protective masks tested against dolomite dust provide full protection for at least 8 hours. Masks that have passed this test are labeled with a "D" label, which means that the mask meets the requirements for clogging with dolomite powder[10].

Our organization provides dolomite dust testing services for protective masks to demanding healthcare organizations and manufacturers in a wide range of testing, measurement, analysis and evaluation activities under national and international standards, trained and expert. provides personnel and advanced technological equipment[23].

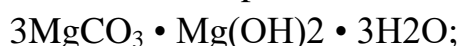
About 20,000 tons of magnesite ($MgCO_3$) worth 13.8 million US dollars is imported into the country every year, which can be saved by developing the Waush mine. For information, magnesium oxide (MgO)[25] content: in dolomite - 21.6%; in magnesite - 47%; brucite - 69%. Brucite has a wide range of uses and can be used as a substitute for imported magnesite[24].

The process of obtaining the final product is carried out in the following stages:

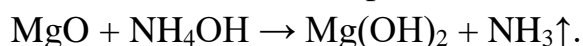
After adding $CaMg(CO_3)_2$ (dolomite, crushed with a fraction of 0.0-1.0 mm) + 0.5% reagent (1) and mixing, calcination is carried out at low temperature[26]



$MgO + CO_2 + CaCO_3$ + addition of 50% reagent (2) in aqueous solution $\rightarrow CaCO_3$ (precipitate) + solution; Evaporation of the solution at a temperature of 90-100°C \rightarrow



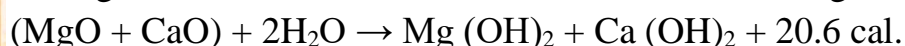
$3MgCO_3 \cdot Mg(OH)_2 \cdot 3N_2O + 300-350^\circ C \rightarrow 4MgO + 3CO_2\uparrow + 4N_2O\uparrow$ heat treatment for 1-2 hours at room temperature;



Thus, after adding 50% reagent from 1 ton of dolomite, 1.4 tons of chemically pure $CaCO_3$ chalk and 100 kg of MgO [19] can be obtained in the form of a precipitate. At the same time, all added reagents are produced in Uzbekistan, and their price is low, one ton does not exceed 500-600 thousand soums. The manufactured import substitute product is several times cheaper than the imported analogue[22].

Two schemes for the production of magnesium chloride are briefly described below. The choice of one or another scheme depends on the availability of cheap hydrochloric acid or ammonia nearby[20].

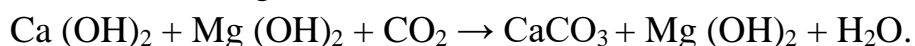
The first scheme. Crushed dolomite is baked in rotary kilns. If a gas with a high concentration of CO₂ is required, for example, when combining the production of magnesium chloride with the ammonia-soda process, dolomite is burned in shaft furnaces. Burnt dolomite is quenched in quenching drums with classifiers and turbo mixers[13 end 15]. During quenching, hydrates of magnesium and calcium oxides are formed according to the reaction.



Quenching is carried out continuously at 95-100°C. The pulp is heated with live steam. Maximum magnesium hydroxide recovery and larger crystals are obtained when the pulp contains 17% solids and the temperature is constant[17end 18].

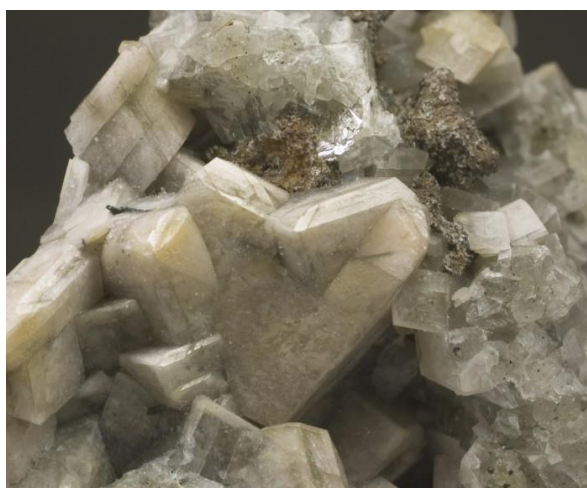
Pulp from quenchers is diluted to 11% solids. This reduces the viscosity of the slurry, which helps to better separate the waste rock and nedopala during further classification. The pulp is then cooled to 60°C, which is necessary for better gas absorption during carbonization. The cooled pulp enters intermediate boilers, from which it is pumped to pressure tanks that feed the carbonizers.

The pulp undergoes carbonization to convert the calcium hydroxide into an insoluble compound, calcium carbonate. Thus, when the hydrate is neutralized with hydrogen chloride, the magnesium is converted into magnesium chloride, which can then be isolated. Carbonization proceeds according to the reaction



As can be seen from the figure. 15, the maximum rate of carbonization is achieved at 40-60°C. Carbonization is carried out in two stages. Between the first and second carbonizations, the pulp is centrifuged and the cake is stirred to increase the extraction of the magnesium component of the dolomite. In some zones, the rate of neutralization exceeds the rate of dissolution of magnesium hydroxide. This causes partial dissolution of calcium carbonate due to local excess of acid. To neutralize excess acid, the cake is mixed with a recycled discharge from thickeners containing a certain amount of calcium ions.

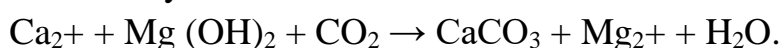
The pulp is carbonized in iron boilers at normal pressure. Carbonizers are grouped together in series. The pulp from the pressure vessel enters the first carbonizer. The exhaust gas from the furnaces containing 30% (v/v) CO₂ is fed to the carbonizers via turbo blowers from below. The pulp from the last carbonizer of each group enters the intermediate tank, from which the centrifuges are fed. To avoid carbonization of magnesium hydroxide, the degree of carbonation of calcium hydroxide should not exceed 99.9%.



The completeness of carbonization is evaluated by the change in the electrical conductivity of the pulp. Direct current is supplied to the control bath, through which a portion of the carbonized pulp passes. After the carbonization of calcium hydroxide is complete, the carbonization of magnesium hydroxide begins with the formation of basic carbonate. Currently, the electrical conductivity and viscosity of the pulp increases sharply, which is explained by the high solubility of CaO compared to MgO. Due to a sharp increase in viscosity, the hydraulic resistance of the pulp column increases strongly and the gas supply stops.

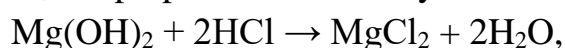
Carbonization control is automated. A device for recording electrical conductivity is connected to a valve that regulates the supply of pulp to the final carbonizers.

The carbonized pulp, which contains about 17% solids, is sent to a centrifuge, after which the solids content is increased to 55%. The cake is returned for resuspension with the recycled solution. Fluff cake is secondary carbonized to remove calcium ions according to the reaction



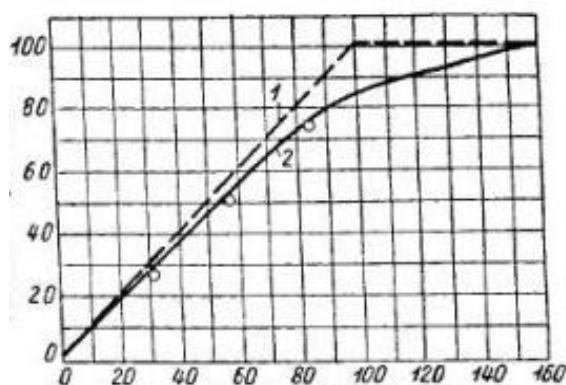
Secondary carbonation is also carried out in three carbonizers connected in series with mixers. Periodic titration of a sample of the solution from the last carbonizer determines the completeness of the removal of calcium ions.

After secondary carbonization, the pulp is neutralized by reaction



CaCO₃ remains in the precipitate.

Pulp neutralization is carried out in turbomixer reactors. Hydrochloric acid is fed into the reactor from above through a distribution ring. To ensure the selective neutralization of Mg(OH)₂ in the presence of CaCO₃, the pH value of the solutions should remain in the range of 7-8. In this case, the rate of neutralization of Mg(OH)₂ should be kept equal to the rate of its dissolution. In practice, it is difficult to observe precisely. At acid inlets, the rate of neutralization exceeds the rate of dissolution of alkali, and the pH of the solution decreases, which leads to partial dissolution of CaCO₃ (Fig. 3).

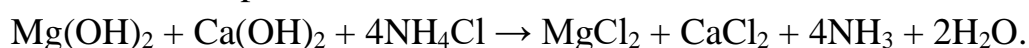


Calculated and actual neutralization curves show that, in practice, CaCO_3 dissolves significantly. During secondary carbonation, about two-thirds of the dissolved calcium precipitates, and the rest of the calcium ions interact with the sulfate ions present in the hydrochloric acid to form gypsum. The final purification from sulfate ions is carried out after evaporation. The slurry entering the reactors is periodically analyzed and the acid supply adjusted accordingly. After neutralization, the pulp is compressed. The clarified solution contains 16% MgCl_2

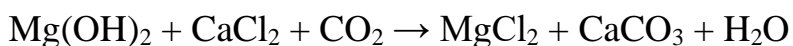
Two-thirds of it is returned to the cake splash. A third is re-compressed. The drainage of the second seal enters the reserve tanks, from which it is sent for evaporation if necessary.

The compressed pulp enters the vacuum filters. The cake from the filters is mixed and sent to settling tanks. The treated water from the clarifiers is returned to production

The second scheme. Dolomite is burned and extinguished as in the first scheme. However, in this case, shaft furnaces are preferred for roasting to obtain gas with maximum CO_2 content. After quenching and classification, the pulp is sent to reactors for exchange with ammonium chloride solution - soda ash production waste;



The released ammonia is returned to soda production. After exchange decomposition, the pulp is carbonized according to the reaction



The magnesium chloride solution is removed from the CaCO_3 precipitate in a system of seals and filters similar to that described above.

The second scheme is a good example of combining magnesium production with other chemical production, because the chloride ion produced in the ammonia-soda process is used with great efficiency.

Various variants of the schemes described above are possible. They are based on selective carbonization of magnesian-lime pulp, converting calcium ion into an insoluble compound and separating it from MgCl_2 solution.

In the USA, the method of heating MgO with ammonium chloride is used to obtain anhydrous MgCl_2 for soda production. "Dow Chemical Co" has patented in several countries the methods

of production of $MgCl_2$ aqueous solution with ammonia in the presence of NH_4Cl for continuous production of high-quality $MgCl_2$ (99.5% $MgCl_2$). The separated magnesium chloride hexaammonia is separated and subjected to thermal decomposition by regeneration of ammonia. The concentration of ammonia in the reaction mixture is kept until it is 36-65% at a temperature from $-200^\circ C$ to $+100^\circ C$. The process is carried out in a system of continuously operating reactors according to a two-stage scheme.

The yield of magnesium chloride hexaammonium is 70%.

The washed and filtered precipitate is calcined for 4 hours at $400^\circ C$.

There are other known options, for example, dehydration of $MgCl_2 \cdot 2H_2O$ with gaseous ammonia in a boiling bed at 2 atm pressure and $200^\circ C$; the resulting ammonia is decomposed into $MgCl_2$ and NH_3 at a pressure of 1 atm and a temperature of $400^\circ C$ in the 2nd zone of the apparatus.

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