
Methods for Obtaining Magnesium Oxide and Other Forms of Magnesium

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Abstract: One of the main directions of the ecological development of the Republic of Uzbekistan is the development of natural resources, their integrated use and the creation of competitive import-substituting products based on local raw materials [1].

One such important product is magnesium and its compounds.

The need of the national economy of the Republic of Uzbekistan for magnesium compounds is huge and has an intersectoral character: chemical, metallurgical, glass, textile, energy, pharmaceutical and other industries need this product. The need for them is satisfied only through imports, which is associated with huge foreign exchange costs. Such costs for raw materials eventually affect the cost of finished products, significantly increasing its cost and, accordingly, the market value. The high cost makes the products uncompetitive not only in the external, but also in the domestic market. At present, metallic magnesium and its compounds are not produced in the Republic.

The most acceptable sources of raw materials for the production of magnesium and its salts are the salt deposits of the Barsakelmes and Karaumbet lakes, containing up to 17% magnesium salts.

Each deposit is characterized by a specific chemical and mineralogical composition. To do this, for each deposit, it is necessary to develop a new technology that ensures economic profitability, taking into account the mineralogical composition of raw materials. An acceptable technology for the production of magnesium and its salts from domestic raw materials - the brines of the lakes Barsakelmes and Karaumbet has not yet been developed.

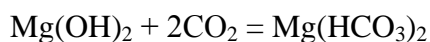
Thus, the development of the production of metallic magnesium and its compounds is very relevant and promising.

There are many ways to produce magnesium oxide and other forms of magnesia [2]. Heavy forms are obtained by firing magnesite and dolomite, thermal decomposition of magnesium sulfate and hydrolysis of magnesium chloride. Magnesias with varying degrees of activity are obtained by precipitation from solutions of magnesium hydroxide and basic magnesium carbonates and their subsequent heat treatment. Heavy forms of magnesia from magnesite and dolomite. By firing high-grade magnesite at relatively low temperatures (~700 °C), magnesia is obtained containing all the impurities that were present in magnesite.

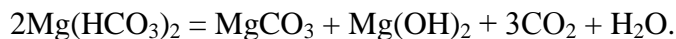
By further chemical processing of the products of burning magnesite and dolomite, light forms of magnesia can be obtained from them. One of the methods of such treatment is the transfer of inactive magnesium oxide into a solution in the form of magnesium bicarbonate,

followed by precipitation of active magnesia from it. Magnesium oxide, obtained by firing magnesite, is ground and quenched with water.

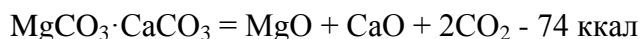
This produces a solution of magnesium bicarbonate.



which, after separation from solid impurities during further boiling, hydrolytically decomposes: c



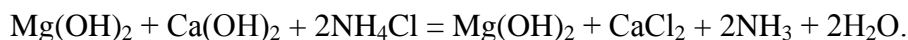
Magnesia is also obtained from dolomite in a similar way. During firing, the dissociation of dolomite



Proceeds in two stages. The decomposition of MgCO_3 of dolomite occurs at $\sim 730^\circ\text{C}$, i.e., $\sim 80^\circ\text{C}$ higher than the decomposition of MgCO_3 of magnesite. This is due to the thermal effect of $\text{CaMg(CO}_3)_2$ formation.

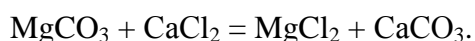
Dolomite is fired at $700\text{--}800^\circ\text{C}$ or $1100\text{--}1250^\circ\text{C}$, depending on the purpose of the resulting product. With incomplete firing, only MgCO_3 decomposes and the so-called half-fired dolomite is obtained. It can be obtained, in particular, by rapidly heating dolomite in the closed zone of a rotary kiln to $750\text{--}800^\circ\text{C}$ in a CO_2 atmosphere for 15 min and further cooling to 500°C for 30 min [3].

Ammonia methods for obtaining magnesium. In Painesville, Ohio, USA, a large production of magnesium oxide from dolomite containing 20% MgO is combined with the production of soda ash. The gas obtained during the firing of dolomite in shaft furnaces and containing up to 40% CO_2 is used in soda production and for the processing of magnesium hydroxide. Dolomite milk is sent to the distillation station of the soda plant, where it interacts with an ammonium chloride solution (with a filter liquid). With a sufficient amount of dolomite milk, providing an equivalent ratio between CaO and NH_4Cl , magnesium hydroxide does not react, remains unchanged, and Ca(OH)_2 turns into CaCl_2 :



After the distillation of NH_3 , the suspension of Mg(OH)_2 in a solution of CaCl_2 thickens, magnesium hydroxide is filtered off, washed, and calcined to transform into magnesium oxide [4]. To obtain magnesium oxide in this way, which meets the requirements of the standard for metallurgical powder of the 2nd class, fine purification of lime-magnesia milk and work without excess calcium oxide is necessary [5].

A solution of magnesium chloride for the precipitation of magnesia is also obtained from dolomite. Dolomite fired at $800\text{--}900^\circ\text{C}$ is ground and treated with water. The resulting dolomite milk is carbonized by the gas coming out of the kilns. During carbonization, a mixture of magnesium and calcium carbonates is much more active than dolomite. This mixture is subjected to treatment with a solution of calcium chloride when heated in autoclaves under a pressure of about 4 atm., MgCO_3 is converted into MgCl_2 by the reaction



The resulting solution of magnesium chloride is separated from the CaCO_3 precipitate and processed into magnesia by precipitation with milk of lime. Precipitation of magnesia from solutions of magnesium chloride can also be carried out with dolomite milk containing Ca(OH)_2 :

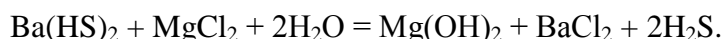


After separating the magnesium hydroxide, the solution containing calcium chloride can be used to treat pro-carbonated dolomite milk and converted into $MgCl_2$. The process of obtaining magnesium oxide from dolomite and spent liquors containing $CaCl_2$ from soda production has been studied [6]. The disadvantage of the lime method for producing magnesia is the contamination of the product with a significant amount of calcium oxide. To obtain $Mg(OH)_2$ with a low CaO content, freshly prepared diluted milk of lime should be used at a low temperature, and CO_2 should be removed from water and brine.

Hydrosulfide method for the production of magnesium hydroxide. The production of magnesia can be combined with the production of barium chloride from barium sulfide. When BaS is treated with a $CaCl_2$ solution, barium chloride and hydrosulfide are formed:

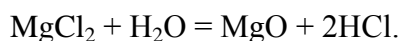


A solution of $BaCl_2$ and $Ba(HS)_2$ after separation of the $Ca(OH)_2$ precipitate is treated with a solution of $MgCl_2$:

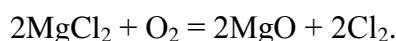


The filtered and washed precipitate of $Mg(OH)_2$ is converted by calcination to magnesia. To obtain a $Mg(OH)_2$ precipitate from BaS , which is easily separated from the solution, the pH of the solution is first reduced by saturating it with hydrogen sulfide.

Hydrolysis and oxidation of magnesium chloride. Magnesium oxide can be obtained from $MgCl_2$ by its hydrolysis



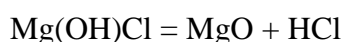
and oxidation.



When six-water magnesium chloride is heated to $500\text{ }^\circ\text{C}$, first, after partial dehydration of $MgCl_2$, $MgO \cdot 2MgCl_2 \cdot 2H_2O$ is formed, and then magnesium hydroxide $Mg(OH)Cl$:



Above $500\text{-}610\text{ }^\circ\text{C}$ $Mg(OH)Cl$ decomposes:



If $MgCl_2$ is heated in an inert gas flow and thus the evolved hydrogen chloride is removed, magnesium chloride will completely turn into magnesia.

Literature

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