TECHNOLOGIES FOR OBTAINING MAGNESIUM OXIDE FROM SERPENTINIT

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Abstract

This article presents the main technologies for processing serpentine in order to obtain magnesium oxide. Acid processing methods are presented, such as sulphate, nitrate and hydrochloric acid methods. Also, for the sake of completeness, lesser known methods, such as sintering with ammonium sulphate and processing salt waste, are presented in this paper. The mechanism of action of each of the methods is briefly described, as well as the advantages and disadvantages of each of them. A review of the methods for producing magnesium oxide from magnesium-containing raw materials revealed that the development of new reagents and optimization of the equipment used to improve the quality of the resulting product are required, and the main areas of application of magnesium oxide are described.

Keywords: serpentine, magnesium oxide, applications, nitric acid leaching, hydrochloric acid leaching, sulphate method, fusion with sulphate.

Serpentine is a rock that includes serpentine Mg6[Si4O10](OH)8 as the base element, constituting at least 50% of the total rock volume, as well as talc Mg3Si4O10(OH)2, pyrrhotite FeS, enstatite MgSiO3, fatality (Fe0.94Mg0.06)2SiO4, minerals with the general chemical formula FexOy, as a rule, it is magnetite Fe3O4, less often hematite Fe2O3 [1]. Serpentinite is the cheapest raw material for obtaining such an important compound as magnesium oxide, which, in turn, finds its application in many industries, as it has many valuable properties [2]. The main field of application of magnesium oxide is the production of refractory materials, while about 65% of all magnesia produced is used in the production of steel, 15% in the cement industry, 7% in the production of refractories for other (special) purposes, and about 13% of magnesia is used in other areas of application [3]. There are more than 80 such applications. Therefore, there are many methods and technologies for processing serpentinite in order to isolate magnesium oxide from it.

Acid processing methods

Over the past few decades, many technologies for processing serpentine raw materials have appeared. But all of them are based on the same chemical processes: leaching with acids (sulphuric, hydrochloric, nitric) and sintering. The first of the methods presented in this paper consists in acid leaching of magnesite by treatment with nitric acid, followed by treatment of the resulting solution with ammonia to precipitate impurities, separation of the precipitate of impurities, precipitation of magnesium hydroxide with ammonia, its separation from the mother liquor, drying and calcination of the resulting precipitate to magnesium oxide [4]. When this precipitation of magnesium hydroxide is carried out at pH 10.0-10.5; after separating the precipitate, it is washed from the mother liquor in such a way that the calcium content in magnesium hydroxide in this operation varies within 0.030.25 wt. %. The disadvantage of this method is that during its implementation a significant amount of nitric

acid and ammonia is irretrievably consumed, and the resulting precipitate of impurities is itself a waste of this production. Also known is a method for producing magnesium from silicon-containing wastes, including grinding wastes and separating them into fractions, leaching with a hydrochloric acid solution to obtain a magnesium chloride suspension, separating a solution and a precipitate, purifying and concentrating a solution, multi-stage dehydration of a solution to obtain anhydrous magnesium chloride raw materials for electrolysis, electrolysis to obtain magnesium, chlorine and electrolyte, the conversion of chlorine to obtain hydrogen chloride and its direction at the stage of preparation of raw materials for electrolysis, the return of the electrolyte to the stage of preparation of raw materials for electrolysis [5]. New in the method is that the precipitate after separation of the solution is washed from chlorine ion and dried to obtain a silica concentrate, the solution is purified in two stages: first to pH 3.54.0, then to pH 10.0-11.0, after that, the suspension is filtered to obtain a solution of magnesium chloride and iron-nickel cobalt concentrate. As silicon-containing waste, coarse-grained dressing or crushed stone is used, which is formed during the production of asbestos fiber from serpentinite, the amount of waste generated during the production of magnesium from silicon-containing waste is reduced, the process is simplified and new marketable products are obtained from waste [8-12].

Sintering method with sulfate

The method of extracting MgO from serpentinite is that the latter is alloyed with ammonium sulfate at 250 - 400C [6]. The fusion product is leached with water, after which impurities Ca, Fe, Ni, Co, Si, Ca, etc. are removed from the resulting magnesium sulfate solution by precipitating them in the form of hydroxides by fractional neutralization. The precipitate is separated by filtration, and Mg (OH) 2 is first precipitated from the filtrate by treating it with ammonia at pH 10.0 - 10.5, and then magnesium carbonate is precipitated at pH 11.0 - 11.5 with ammonium carbonate [13-16]. After that, both precipitates are washed from the sulfate ion and subjected to heat treatment at 750 C to obtain magnesium oxide. At the same time, the (NH4)2SO4 solution obtained at the stage of precipitation of Mg(OH)2 is evaporated, granulated and sent to the stage of sintering with serpentinite, and the ammonia released at this stage is condensed and recycled to the stage of precipitation of Mg(OH)2 Degree of precipitation of Mg(OH) 2 is 98 - 100%. The process goes in a closed cycle [21-28]. Closest to the described method in terms of technical essence is the method of fusing serpentinite with ammonium sulfate at 300-400 ° C - leaching with water and filtering the sinter, subjecting the filtrate to fractional neutralization with the release of magnesium hydroxide, nickel and cobalt. The disadvantage of this method is that the ammonia released during fusion with ammonium sulfate is not captured, not used and can form explosive compounds with air [17-20].

Conclusions

The main technologies for processing serpentinite-containing raw materials in order to obtain magnesium oxide, namely: nitric acid leaching, hydrochloric acid leaching, sulfuric acid method, fusion with sulfate, processing of salt waste are considered. The simplest technologies are acid ones. In particular, the sulfuric acid method, which is the most economical due to the low cost of sulfuric acid.

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