UTILIZATION STATUS AND DEVELOPMENT PROSPECT OF MAGNESIUM RESOURCES FROM SEAWATER AND BRINE IN CHINA

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Abstract: The utilization status of magnesium resource from seawater and brine in China was introduced. And it was analyzed that the disparity on the utilization and development of magnesium resources existed between China and other countries. Meanwhile, the exploiting and utilizing prospect of magnesium resource from seawater and brine was proposed. It was pointed out that only by means of persistent technical advancement and expanding market, China would change from a big magnesium resource manufacture country to a great power exploitation and utilization country.

Key words: Brine; Magnesium Sulfate; Functional Materials

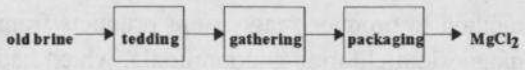
1. INTRODUCTION

China is abundant in magnesium resource from seawater and brine, mainly distributed in seawater and salt lake. In seawater, magnesium chloride reserves 4.493×1015t and magnesium sulfate reserves 3.570×1015t. The reserves of magnesium is 4.816 ×109t in salt lake, in which magnesium chloride reserves 3.143×109t and magnesium sulfate reserves 1.673×109t. Comparing with land resources, magnesium resources in salt lake, which mainly comprised magnesium chloride and magnesium sulfate, have the advantages of high quality, great reserves, low harmful impurity and easy-exploitation. However, the development about magnesium resource from seawater and brine still stayed the research of industrial raw material such as magnesium chloride and magnesium sulfate, which was low fringe value and could not bring good economic benefit. Therefore, it is essential to increase the utilization ratio of magnesium and economic efficiency of productive enterprises by developing novel products and new technology, adjusting the structure of products and enhancing the fringe value of products.

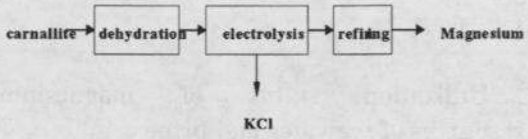
2. Utilization and exploitation of magnesium from seawater and brine in China

2.1Utilization of magnesium resource in Salt Lake

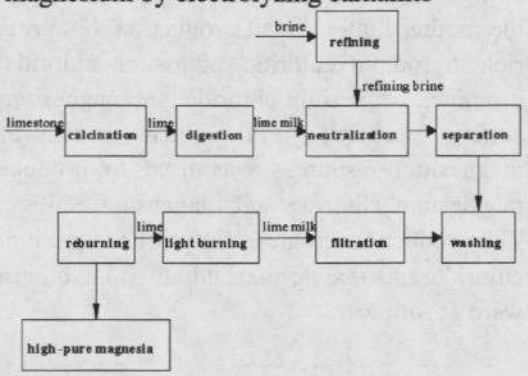
Until now, it was already realized industrialization that using the tedding method to produce magnesium chloride and magnesium products from carnallite at Qarhan Salt Lake. The national scientific and technological key tackling projects of the 10th Five-Year Plan "Study on the engineering and equipment of producing anhydrous magnesium chloride with bischofite from QingHai Salt Lake" had been completed. Here, the flow diagrams about the utilization of magnesium resources from Salt Lake were as follows.



Process flow diagram of preparing magnesium chloride by the tedding method



Process flow diagram of preparing magnesium by electrolyzing carnallite



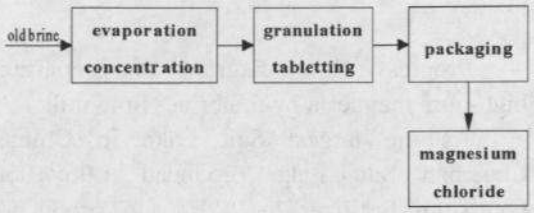
Progress flow diagram of preparing high-pure magnesia by the brine- lime milk

As the largest Salt Lake in China, Chaerhan Salt Lake produced 1.96×106t potassium fertilizer in 2007, and produced 3.2×107t Bittern per annum as byproducts, in which the amount of magnesium chloride is 1.1×107t. However, owing to the low technology and high production cost, there were only number tons of primary products such as magnesium chloride that had been produced per year. And the products can not be utilized widely and has a low price because of its low quality. During the 7th Five-Plan, based on the theory of the high-pure magnesia preparation using lime precipitation, the lime precipitation factory was built and its yearly production was 5,000 tons. Because of its high energy consumption, hard controlling of the quality of products, the enterprise could not run normally since it has been built. Meanwhile, Qinghai Minhe magnesium factory selected the technology of carnallite dehydration-electrolysis to prepare magnesium, but its throughput can not endure to exploit magnesium resource from brine on a large scale. Until now, the industrial chain of utilizing magnesium resource on a large scale had not yet formed; as a result, millions of tons of magnesium chloride had been discharged into salt lake again every year. The enrichment of magnesium of salt lake brought

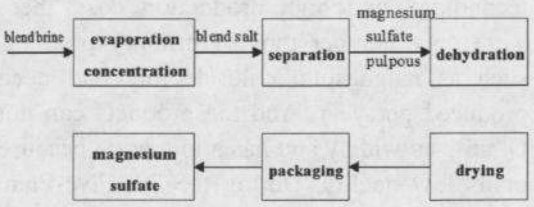
seriously consequence and had a negative effect on the development of potassium from salt lake.

2.2Utilization status of magnesium resources of seawater and brine

China is the largest country whose annual output of sea salt was 23, 000, 000 tons. As the mother liquid of salt production, bittern is rich in sodium chloride, potassium chloride, bromine, magnesium chloride and magnesium sulfate resources, in which most of magnesium resources was used to produce magnesium chloride and magnesium sulfate. The production progress flows of magnesium chloride and magnesium sulfate from bittern were as follows.



Process flow diagram of producing magnesium chloride



Process flow diagram of producing magnesium sulfate

According to the amount of sea salt that was 2.3×107 tons every year, the by-product, bittern was 2×107 m3 annual year in China, in which magnesium chloride and magnesium sulfate resource were 3.792×106 tons and 1.752×106 tons separately. Confined to the distribution of bittern resource and the scale of salt chemical enterprises, the annual output of magnesium chloride and magnesium sulfate were 4×105~5×105 tons and 3×104 tons respectively in China, where the utilization ratio was as low as 20%. The salt chemical enterprises based on bittern can not gain high economic efficiency because its main product such as magnesium chloride and magnesium sulfate were just primary chemical product, which had low appending value.

3. DEVELOPMENT OF MAGNESIUM PRODUCTS IN HOME AND ABROAD

The magnesium products from seawater and brine can be divided into magnesium hydroxide and magnesia with various grades, magnesium salts including magnesium chloride, magnesium sulfate and other organic/inorganic magnesium salt, functional materials based magnesium, and so on. The magnesium products of our country were mainly primary products, otherwise, the development countries were emphasized on the production of further processing products with good quality and high appending value.

3.1Magnesium hydroxide and magnesia

As an environmental-friendly and safely neutralization reagent, pulpous magnesium hydroxide was utilized widely in flue gas desulfurization, heavy metal removal and treatment of waste water field in development countries. Magnesium hydroxide modified by surface treatment was added into plastic and rubber as the inorganic fire retardant. In the late 1990s, the consumption of pulpous magnesium hydroxide was more than 300,000 tons annual year in Japan, meanwhile, the consumption of that in America was more than 600,000 tons. The consumption of magnesium hydroxide in the U.K. was more than 50,000 tons every year and it rose quickly at a rate of 10%. In development countries, half of plastic fire retardant is inorganic fire retardant, in which magnesium hydroxide accounts for 30%. In China, the production of pulpous magnesium hydroxide yet reached a large scale. All the enterprises of magnesium hydroxide were so small, which was below 1,000 tons annual year that these yearly capacity of magnesium hydroxide fire retardant were only 13,000 tons. And these factories mainly selected the hydrothermal method to produce magnesium products from magnesium chloride and ammonia, which had much defects such as small scale, high energy-consumption and high production cost.

Development countries mainly produced high-pure magnesia from seawater and brine. The yearly capacity of high-pure magnesia of America was about 1.5×106 tons, 90% of these were produced from seawater and salt lake's brine. The yearly producing capacity of Japan was about 1×106 tons, most of which were produced from seawater. In the world market, the quality index of high-pure magnesia is MgO > 98%, B2O < 0.07%, volume density > 3.4g/cm3. High-pure magnesium of Japan is MgO>99.5%.

In China, most of magnesia was produced from magnesite through ore progress. Here, low grade magnesite as raw material and immature technology impaired the quality of magnesia, in which the content of MgO is lower than 95%. Recently, through introducing and studying the advanced technology of development countries, the quality of magnesium was improved but most of factories still produced low-grade magnesia which had about 95% MgO. The quality of magnesia was already increased at most of the enterprises introducing advanced technology and devices, but the content of MgO is also around 95% and it is difficult to reach 98%. Now, super-high-pure magnesia with 99% MgO can not direct produce using sintering process and it is a new field that the production of high-pure magnesia in China. It is an important factor to result high energy consumption, low production efficiency and high production cost that the short service life of steel stove made of low quality magnesia. The unit consumption of magnesia is 23 kilogram every ton steel, whereas that is 7 kilogram in development countries such as Japan, America.

3.2Magnesium salt and magnesium functional materials

There were various magnesium salts in the world and these had a widely application. As medium element fertilizers, the quality standard of magnesium salt and magnesium sulfate is already established. For example, NFU42-001-1992 prescribed the types, quality parameter of magnesium and sulfate fertilizers, the compulsory and optional content standard which need labeled. According to the soil condition and the necessary of crop growth, magnesium and magnesium sulfate fertilizers had a widely application in development countries. In China, the production of magnesium fertilizers focused on the primary industrial magnesium chloride and magnesium sulfate. The low field of other kinds of magnesium salt for special use is a problem that wants to solve for many years. Now, the study and development of magnesium fertilizers and magnesium sulfate is still in a blank. There are generally lower in automatization and economic efficiency for the production enterprises of magnesium salt in China. Moreover, the product variety of the enterprises was unitary.

Magnesium functional materials include magnesium oxide whisker, magnesium borate whisker, magnesium oxysulfate whisker and magnesium oxychloride whisker. Until now, many scientists and specialists had made a great quantity study on the synthesis of the functional materials. And the synthesis technology and the quality of synthesis products already reached the international advanced level. The application study of magnesium borate whisker and magnesium oxychloride whisker also reached the international advanced level. However, It had been not reported that the application study of magnesium oxide whisker and magnesium oxysulfate whisker in our country yet.

4. DEVELOPMENT PROSPECT OF MAGNESIUM RESOURCES FROM SEAWATER AND BRINE IN CHINA

4.1magnesium hydroxide and magnesia

As the green environment neutralizer, pulpous magnesium hydroxide was utilized widely at these fields such as wastewater neutralization, heavy metal treatment and flue gas desulfurization in overseas. Recent twenty years the production and application of pulpous magnesium hydroxide had made a great progress. Some scientific research institution carried out the research on the production and application of pulpous magnesium hydroxide. Followed the advanced technology at home and abroad, the institute of Tianjin seawater desalination and multipurpose utilization State Oceanic

Administration accomplished the research on the preparation technology of magnesium hydroxide using one step method from dolomite and seawater(brine). Especially the study on the anti-flocculating and anti-descending agent laid a foundation for the production and application of pulpous magnesium hydroxide. According to the estimated value by reference of the demand of development countries in 1990s, the actual using amount of pulpous magnesium hydroxide should be 1.8×106 tons. However the production and application of pulpous magnesium hydroxide was still almost in blank. It is very necessary to carry out the key tackling projects of magnesium hydroxide industrialization and to expand the application market. Based on the breakthrough of the key tackling projects, the industrial demonstration unit can be built up and produced pulpous magnesium hydroxide which can be applied to the environmental protection industry. It would help to realize the optimal allocation of magnesium resources and to improve the economic efficiency of magnesium resources application enterprises. Furthermore, it would be of benefit to the treatment of environmental pollution.

Through digesting and absorbing the advanced technology overseas, the enterprises producing magnesia developed technical innovation and studied the technology of extracting high-pure magnesia from ores which has a copyright owned by itself. Meanwhile, it is significant to introduce and digest the advanced technology of extraction magnesia from seawater and brine of development countries. The disparity would gradually reduce by means of developing the industry of producing high-pure magnesia from seawater and brine and utilizing the abundant seawater and salt lake resources of our country. Here, the brine amount after producing salt from seawater in China occupied the first place in the world. It will be accelerated the development of comprehensive utilization of chemical resources from brine and be of benefit to the development of oceanic chemical industry of our country that utilizing the brine to product magnesia.

4.2Magnesium salt and magnesium functional materials

It is important to expand market at home and abroad for magnesium salt enterprises. Until now, magnesium chloride was utilized mainly as building materials and packing materials in our country. Advanced snowmelt agent prepared with magnesium chloride and other salts were mostly exported to overseas. With the rapid development of our country's traffic, the huge potential market for snowmelt agent should be developed. The annual output of magnesium sulfate was 1.8×105~2×105 tons, 70% of which were exported to Southeast Asia. As the important medium elements, sulfate and magnesium were arose agricultural specialists' great attention. On the basis of soil general survey data in China, it was found that most of soil in China exist the serious status of magnesium deficiency. There was 5.533×108 hektare with the magnesium deficiency, account for 6% of cultivated area of our country. If the current soil of magnesium deficiency was fertilized 75 kilogram magnesium sulfate per hektare, the demand of magnesium sulfate was 4.15×105 tons every year. The total demand of magnesium sulfate will reach 5.15×105 tons every year plus to 1×105 tons magnesium sulfate fertilizer every year that was fertilized at the planting of others crops. Nevertheless, the amount of magnesium sulfate fertilizer used estimated to less than 2×104 tons every year, which was 4% of the total demand. Magnesium sulfate fertilizer was produced by the metathetical reaction and tedding method from magnesium chloride in Chaerhan salt lake and sodium sulfate in Chaidamu basin. Furthermore, the production of magnesium sulfate was an important way to eliminate magnesium harm of salt lake.

With the advantages of raw material cheap and easy to get, mild conditions, low production and good environmental benignity, the fabrication of magnesium functional materials has become a research focus at home and abroad. There has little disparity in the synthesize research of magnesium functional materials between China and other countries. Some research achievements of our country already reached the international advanced level. Based on the synthesize research, combining with the scientific and research department of material industry, synthesize

and application of blend materials was carried out in China, which was favorable to open up market and expand the application ranges of magnesium functional materials. The development of magnesium functional materials will increase greatly the technology level and economic efficiency of magnesium resources application enterprises.

5 CONCLUSION

China is abundant in magnesium resources and is a big production country of magnesium products. But there was an obvious disparity between China and the other countries for the production technology level of magnesium products. Through making technology progress and expanding markets, China will be developed from a big magnesium production country to a great power utilization nation. The development of home market for magnesium chloride and magnesium sulfate would be of benefit to eliminate "magnesium harm" and to accelerate the exploitation of magnesium resources from salt lake. It would provide reliable safeguard for national economical sustainable development that carrying out the technological research and opening up application market of magnesium hydroxide industrialization along with increasing economic efficiency of production enterprises. At the same time, it will of benefit to environmental protection and control. At present, magnesium functional materials had the properties of low product cost and high appending values. Developing the study of industrial technology and application research about magnesium functional materials and expanding market would not only increase greatly economic efficiency of production enterprises but also promote the development of material industry.

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