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The developing strategy of Chinese magnesium and magnesium alloy

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Abstract: The status and developing strategy of Chinese magnesium industry are summarized in the present paper. The output and export of Chinese magnesium ingot have rapidly increased in the recent ten years, but the magnesium products with high value, such as the wrought magnesium alloys, and their applications are insufficient. Chinese magnesium industry should develop toward the direction of large scale, specialization and collectivization in the future. The enterprises should enhance the level of management and reinforce the international competing ability with the help of governmental policies.

Key words: magnesium ingot; magnesium alloy; developing strategy; Chinese magnesium industry

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1 Introduction

Resources and environment are the chief problems affecting the continuous development of human society in 21st century. Mineral resources on the earth are decreasing day by day along with the fast development of scientific technology, the rapid increase of metal wastages, and the appearance and wide use of the large scale producing technology. The fixed number of years for using some metals, such as iron, aluminum, copper, lead and zinc etc, is merely or less than one hundred years. Therefore, the strict requirements must be put forward to the traditional industries which consume a lot of resources and bring much environmental pollution. An important and urgent project, which the human beings are being confronted with, is to decrease the environmental pollution and to economize the limited resource on the earth.

Compared with other structural metals, the potential of magnesium, a light structural material, has not been sufficiently excavated. Its development and applications are far from maturation than that of steel, copper and aluminum. The special characteristics of magnesium, such as low density, high specific strength and stiffness, high damping capacity, excellent electronic shielding effect, easy cuttable ability and so forth make it be widely used as the shells of cell phone and mobile computer, the parts of automobile, space shuttle and some weapons. It is one of the important steps to rapidly develop and apply magnesium for the continuous development of Chinese society, because a lot of traditional metal minerals are drying up.

This paper summarized the status of Chinese magnesium industry, including magnesium products, applications, research and development. Some suggestions for developing Chinese magnesium industry have

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been proposed.

2 Status of Chinese magnesium and its alloys

China has rich magnesium resources, including magnesite, dolomite and salt lake in Qinghai province, which ensure the development and progress of Chinese magnesium industry. Along with innovation and market economy since the year of 90, 20 century, Chinese magnesium industry has rapidly developed. The total output of magnesium ingot in 2000 in China was 200,000t, occupied 40% of that in the world. It reached 354,000 t in 2003, occupied 66.7%, increasing 32.1% compared with that in 2002. Magnesium has become the fifth nonferrous metal in China after aluminum, copper, lead and zinc, and the Chinese output of magnesium ingot has become top in the world since 2000^[1,2].

Pidgeon is the main method to produce magnesium ingot in China. There are approximately 50 factories, of which the output is 5000t, and more than 20 factories, of which the output is 10,000t. These enterprises have attempted a lot to reconstruct technologically, to stabilize the quality of products and to develop new products. As a result, some technological and economic targets for producing magnesium ingot have been improved. For example, the average consumption for 1t magnesium ingot is as following: the dolomite decreased from 14.11 t in 1991 to 11 t in 2003, the ferro-silicon from 1.45 t to 1.10 t, the coal from 20.65 t to 10.0 t and the electric power from 2496 kWh to 1500kWh^[3-5].

The applications of magnesium primary products have also grown recently in China. The total consumption of magnesium in 2003 was 51200t, increased 27.18% in comparison with that in 2002, even though its total amount was not very large. Among these applications, used as additives in aluminum occupied 21000 t (41%), used for desulfurization in steel industry occupied 8000 t (15.6%), and used for diecasting occupied 10200 t (19.92%)^[2,6]. In addition, many Chinese enterprises have recognized the advantages of magnesium alloys. They have used magnesium diecasted products in automobile, auto-bike and 3C fields. For example, the up and low shells of transmission case in the cars made by Shanghai Volkswagen consume 2500 t magnesium alloys per year, the output of 3C parts used as the shells of cell phone, PDA, CD, MP3 DVD reached 2 000 000 pieces only in Qindao Meiye, a representative of diecasting factories^[7,8]. Moreover, a lot of diecasting factories for 3C parts have been established in Guangdong and Jiangsu Province, they were supported by many enterprises in Hongkong and Taiwan in terms of investment, technique, market and management.

However, the applications of wrought magnesium alloys in China are much more insufficient. The enterprises producing wrought magnesium alloy in China are relatively less. LuoTong, located in the city of Luoyang, is the main enterprise manufacturing magnesium sheets and strips as well as other wrought magnesium alloys. Research and application of wrought magnesium alloys and their parts are the developing direction of Chinese magnesium industry in future.

On the other hand, the export of magnesium products has also rapidly increased in China. It was 298,000 t in 2003, increased 42.6% in comparison with that in 2002. The export of magnesium ingot decreased from 75% (the percentage occupying the total amount of export) in 2002 to 53% in 2003 while the export of magnesium alloy increased from 14% to 22%, and magnesium granular (powder) from 18% to 20%^[2,9]. These data demonstrate that the export of magnesium products in China has changed from single magnesium ingot to multi-magnesium products, especially to magnesium alloys.

The development of Chinese magnesium industry cannot deviate from regarding and supporting of Chinese government. In order to quickly develop and use magnesium products, many kinds of researching pro-

jects have been actualized by Ministry of Science and Technology (MST) and National Nature Science Foundation of China (NSFC). MST started a project named "The Application and Industrialization of Magnesium Alloys" in 2003, in which 4 research institutes, 8 universities and more than 20 enterprises took part^[7]. This project had 7 researching contents, including the melting of magnesium ingot, the industrialized production of magnesium alloy and the key equipments and technologies and so forth. Up to now, several achievements have been obtained. For example, a researching system from scientific research to industrialized development has been established, more than 10 magnesium alloy Ltd. Companies and several bases of industrialization for manufacturing magnesium alloys have been built, the establishment of standard system for magnesium alloy has been started, and 33 patents including 15 patents of invention have been applied until the end of 2002.

Moreover, the High Technique Development Plan (863 plan) has also supported the research and development of magnesium alloys. The purpose of the plan is to obtain the key techniques for the applications of magnesium products in the future 5–10 years.

Anyway, China has built a whole scientific system for magnesium industry from basic study to application and development, so that China is striding forward to the country where magnesium products are widely researched and applied.

3 Developing strategy of Chinese magnesium and its alloys

Chinese magnesium industry is booming in the rate of 37% per year in the recent 10 years. Its output and export has become top in the world, and give a vital force to the Chinese economic development. However, a lot of problems, such as simple techniques, un-advanced equipments, bad environment and wasteful usage of resources and energy, have occurred along with the rapid booming. These problems have become barriers to the development of Chinese magnesium industry, hence the constitution of strategies for developing Chinese magnesium industry is necessary.

These developing strategies include (1) perfecting the macro decision-making system, (2) building the mechanisms of dynamic adjustment and information share in economic and scientific departments, (3) strengthening harmonization among industrial policy, technological policy and investment, (4) actualizing the strategy of knowledge property right, (5) accelerating establishment and generalization of the national standard for magnesium industry, (6) strengthening the cooperation among "government, enterprise, university and institute", (7) training persons with creative ability.

In order to actualize the developing strategy of Chinese magnesium industry, we propose:

(1) To constitute policies to restrict the blind development of magnesium ingot enterprise. The enterprises of which output is less than 10,000 t should be closed as long as they cannot be rebuilt.

(2) To build new-type magnesium industries to develop recycle economics. The waste of the Pidgeon method can be used as the raw materials for some non-metal materials, thus, to solve the pollution problem of the Pidgeon method and to reduce the cost of magnesium ingot.

(3) To strengthen the theoretic study on magnesium alloys and to develop and apply magnesium products with high value, such as magnesium sheets, strips, tubes and rods.

(4) To establish national centers of researching and developing magnesium products. Based on the foreign successful experience, the excellent researchers are centralized to tackle key problems encountered by enterprises and to solve important scientific problems so as to quickly enhance the level of Chinese magnesium industry.

(5) To enlarge applications of magnesium products in the traffic area. Government should make policies to apply magnesium alloys as parts of cars instead of steel, zinc and aluminum alloys to lighten the weight of cars, thus, to reduce air pollution.

4 Conclusions

The development of Chinese magnesium industry should be toward the direction of large scale, specialization and collectivization, because China has rich mineral and energy resource and good environment for investment. The enterprises must become stronger and special to enhance the level of management and to reinforce the international competing ability. In a word, Chinese magnesium industry should develop to be a comprehensive, harmonious and durative industry.

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