# A Research on Patent Strategies for Phosphorus Resource Development and Utilization in Hubei Province of China

Zhang Yuanyuan[1], Wang Xing[1], Xu Yunlu[1], Guo Jia[1,2], Chi Ruan[1,2]
1 "E+" National Dual-degree Talent-training Program, Wuhan Institute of Technology, Wuhan, P.R. China, 430073
2 Key Laboratory for Green Chemical Process of Ministry of Education, Wuhan Institute of Technology, Wuhan, P.R. China, 430073
(E-mail: 402686382@qq.com, 253814165@qq.com, 383769876@qq.com, guojia@mail.wit.edu.cn, rac@mail.wit.edu.cn)

**Abstract** Phosphorus is a basic material for producing phosphate fertilizer. Hubei is a province with abundant phosphate resources and there are lots of phosphorous chemical industries. However, there are some problems in phosphorous resource development and utilization, such as the product line extension and the expansion of the industrial chains, and the production of fine phosphorous chemicals. Patent strategies for phosphorus resource development and utilization in Hubei not only are significant for the development of phosphate resources or the scientific decision-making at the all levels from the nation, the regions, departments, units or enterprises, but also have a positive impetus for innovation and industrialization of Hubei phosphate resources comprehensive utilization technology. Such measures to strengthen the protection of intellectual property rights are proposed in this paper as follows: 1) patent databases are to be established; 2) relevant training activities should be held; 3) the research staff should be well informed of the patent home and abroad; 4) enterprises should take actions to protect intellectual property rights once achieving technical breakthroughs in a particular area.
**Key words** Patent strategy; Phosphorous resources; Development and utilization; Measures

## 1 Introduction

In order to avoid the negative impact on china's economic and social development brought by financial crisis, the Department of State issued successive plans on "Top Ten Industrial Development", including steel industry, automobile industry, equipment & manufacturing industry, electronics, textile, petrochemical engineering, and other fundamental industries concerning people's livelihood. And patent strategies should be focused on implementation of intellectual property strategy and revitalization of these ten industries plans, through analysis and research on related technical fields' patent information, exploring the development direction of the technology, understanding the relevant industries and industry market trends, providing practical policy recommendations to protect the implementation of important measures in key areas and major projects (Jin *et al*., 2008). Due to abundant middle-low-grade phosphorus resources in Hubei province, the patent strategies for phosphorus resource development and utilization were discussed in this paper, which would promote the patent strategy in the development of fine phosphorus chemical products and satisfy the requirements of "State Intellectual Property Office Patent Strategy Promotion Project".

## 2 Current Status

Phosphorus is a basic material for producing phosphate fertilizer, which is of great significance to ensure the sustainable development of China's phosphorus chemical industry, phosphate compound fertilizer industry and food production safety. It has been proved that our country's reserves of phosphate rock resources are 16.78 billion tons, ranking second in the world (Huang *et al*., 2004). It is also known that the middle-low-grade phosphorus makes up 76% of the total amount, and it is difficult to process and produce phosphorus chemical products. Therefore, comprehensive utilization of research and development about phosphate industry and phosphorous chemical phosphorus will solve about 110 million tons of middle-low-grade phosphate rational utilization of resources in our country.

It features that there is a large amount of phosphate reserve in China but it is largely distributed in the numerous low-grade ores and a few high-grade ores. The types of deposit are primarily sedimentary phosphorus rock. Six phosphate production bases with mines of different scales have been built in Yunnan, Guizhou, Wengfu, Jingzhou, Xiangyang, and Sichuan, which promotes simultaneously the phosphate development. Therefore, it is of great importance to strengthen the protection of resources and transformation of the original phosphorous chemical production technology and development of

new phosphorus chemical products, to extend the phosphorous chemical industry chain, and to raise the utilization rate of atoms and added value of phosphorus products, which helps achieve conservation of resources, environmental protection, the harmony between the human being and the nature, and contributes to the needs of achieving sustainable and healthy development of China's economy.

Hubei is a province rich in phosphate resources, where 20.2 billion tons of proven reserves have been stored, but phosphate with the grade over 30% is only 6.63%. Moreover, mining-rich phosphate rock is not only in a tremendous waste of resources, but also lead to a variety of environmental geological disasters (Yang *et al*., 2004). Hubei is also an agricultural province and the demand for phosphate fertilizer statistically occupies 1/3 of the basic fertilizer; Hubei is a large phosphorous chemical province, and the output of sodium hexametaphosphate ranks the first in the world, sodium tripolyphosphate and sodium hypophosphite ranks the first in China. So the comprehensive utilization of phosphorus resource will promote the phosphorous chemical pillar industry of Hubei province, and strategic objective of the combination of mining, mineral, mineral fertilizer has been put forward by the Hubei government.

Hubei province has lots of phosphorous chemical industries, and the production of the sodium hexametaphosphate ranks the first in the world. Hubei Phosphate resource can be divided into sedimentary metamorphic limestone deposits and sedimentary phosphate rock phosphate deposits in two kinds of genetic type. The total proven reserves of phosphate rock is 2.022 billion tons and maintaining reserves is 1.833 billion tons, of which the phosphate ore $P_2O_5$ graded over 30% only accounts for 6.63%, mostly of middle-low-grade. Based on the geographical location of phosphate rock bed output, it can be divided into seven mines, namely, Yichang, Jingxiang, Baokang, Xingshan, Hefeng, Dawu, and Huangwuxue. However, the extensive mining operations and the overuse of rich mines, abandoning the poor mines in the development and utilization of the phosphate resources, not only result in wastage of resources and environmental destruction, but also seriously affect the rational use of phosphate rock resources.

Now there are 98 phosphorus chemical enterprises above designated size, among which there are 78phosphate fertilizer production enterprises and 28 fine phosphorus chemical enterprises (including 15 yellow phosphorus producers, and some other few enterprises which produce phosphate fertilizer). Of these companies, there are 7 large-scale enterprises (Hubei Yihua Group Co., Ltd, Hubei Xingfa Chemical Industry Group Co., Ltd, Hubei Huangmailing Phosphorous Chemical Industry Group Company, *etc*.), 17 medium-sized enterprises, 3 listed companies. In 2004, the provincial output is 11.36 million tons phosphate rock, among which 5.7 million tons phosphate rock were processed and used in the province, for example, 4.35 million tons ore used for the phosphate fertilizer, phosphorous , and 1.35 million tons mine used for feed-grade DCP etc. In 2004, the output value of phoschemical industry reached 7.851 billion Yuan, accounting for 22% of the province's chemical industry output value, achieving profits and taxes of 842 million Yuan. Among them, the output value of phosphate fertilizer was 4.48 billion Yuan RMB with profits and taxes of 440 million Yuan RMB, and fine phosphorus chemical production value of 3.371 billion Yuan RMB with profits and taxes 402 million Yuan RMB (Kijkowska *et al*., 2002). It's clear that phosphorus chemical industry has an important part in the economic development .The comprehensive utilization technology of developing mid-low-grade phosphate, which provides the high-quality phosphoric acid and phosphate raw materials for fine phosphorous chemical enterprise, provides high concentrations of phosphate agriculture; it has important significance for the economic development in our province.

## 3 Problems in Resource Development and Utilization

The world's phosphorus chemical industry is undergoing dramatic changes in technology and product structure, which can be summarized as follows:

1) Product line extension and the expansion of industrial chain. The phosphorous chemical products are developing to the field of pharmaceutical industry, electronic industry, additives (such as phosphorus-containing water treatment, phosphorus-containing accelerant, and phosphorus-containing antioxidant) phosphate compound new materials, etc, and it's expected to become the mainstream trend of refinement of phosphorus chemical industry.

2) Importance has been gradually attached to fine phosphorous chemical products, and products of high added value will become the industry's new growth point. The chemical industry in the 21st century will be represented in high-performance materials specialty chemicals age. In order to protect resources and save energy, some developed countries in Europe and the Unite States of America have

gradually reduced and abandoned the phosphorous chemical-based products leaving the market of some extensive phosphorus chemical products to the developing countries, and concentrate on developing high-tech, high value-added fine and special phosphorus chemical products.

The main problem in phosphate fertilizer industry in China is the irrational product structure, which means that the high-grade phosphate and compound fertilizers and phosphorus chemical products can not meet the domestic and international market demand in the final analysis. The main reasons are that our phosphate fertilizer industry's level of technology is not high enough and the backward equipment leads to high product costs. Phosphorous chemical products mainly use yellow phosphorus as a raw, but the productive process of yellow phosphorus involves energy consumption, high production costs, and low resources comprehensive utilization rate. Compared with furnace phosphoric acid, low energy consumption and low production cost of wet-process phosphoric acid production line requires the phosphate $P_2O_5$ of grade over 26%, and the fact that phosphoric acid produced can only be used for fertilizer, which cannot reach the quality requirements of industrial phosphoric acid, restricts the development of food-grade phosphorus-containing products, even with the wet phosphoric acid producing TSP. This traditional craft is still subject to a variety of factors, such as the quality of phosphate and so on. The output of the current wet-process phosphoric acid production has already accounted for more than 80% of the total WAP. The production capacity of domestic wet-process phosphoric acid in 2003 was about 7.4 million tons $P_2O_5$, and the output was about 4.64 million tons $P_2O_5$. In Europe, as early as 1997, more than 80% of STPP was produced by purifying wet-process phosphoric acid. In 1989, after British closing the 6-million- ton/year yellow phosphorus device in Canada, British company AW enlarged the wet-process phosphoric acid purification devices to 25 million tons/year $P_2O_5$ scale. Almost 20 companies in the world have established wet-process phosphoric acid purification equipment, and the scale of production is growing rapidly (Mahoud *et al*., 2009).

## 4 Patent Strategies for Phosphorus Resource Development and Utilization

At present, many related enterprises in Hubei have a certain awareness of IPR protection, but their declarations for patent are ‘loose’ and ‘individual’. By ‘loose’, we mean ‘not of standard, diverge from usual procedure’, while by ‘individual’ we mean ‘not organized’. Due to various reasons, most of them failed to declare patents to protect intellectual property rights. Therefore, we should deeply and accurately understand the patent information about the field of comprehensive utilization of phosphate resources, analyze the comprehensive utilization areas of phosphate resources, as well as the development direction involved in industries, and make contribution to strengthening and enlarging the Hubei Phosphate Cause.

Based on the patent information, enterprises should analyze the comprehensive utilization areas of phosphate resources and the development direction of key technical areas involved in the industries. For example, targeting at such issues as high impurities in the wet-process phosphoric acid, complicated components, difficult separation and purification, we should conduct primary treatment- Solvent Extraction- Solvent precipitation combined treatment of three key technologies. Technical problems in desulfurating off the Fe and Mg should be solved. Moreover, we also should develop effective desulfurizer, defluorination, the removal of iron and magnesium triple combination WPA new technology, achieve the cost of wet industrial phosphoric acid production below 2000 Yuan/ton, complete 10,000t/a WPA installation's industrial research, and implement the national standards of pollutant emissions (Ke *et al*., 2007).

Therefore, as for Hubei phosphorus resources' comprehensive utilization enterprises, we should take the following measures to strengthen the protection of intellectual property rights:

1) Help the enterprises related to establish various databases which are relevant to scientific research, production and management. Try to update these patent databases constantly, enabling enterprises to understand the future trends in technology development.

2) Training programs are to be carried out. During the implementation of the project, we should at least held themed training related to phosphorus chemical industry's intellectual property rights; a group of staff are cultivated enabling to understand both technology and the patent research analysis, then to grasp the status of the international peer-patented technology and developments timely. Moreover, taking the characteristics of the enterprises into consideration, try to find a breakthrough to guide a direction for the research and development on the issue of intellectual property rights related, and to provide legal support for the enterprise's high-level leaders’ decision-making.

3) The research staff should be well informed of the existing patents, aware of where they are and avoid unnecessary repetition of work. They also should provide a platform for exchange, then strengthen the collaboration among enterprise and universities, scientific research units. Joint declaration of the patent are encouraged on the condition that the intellectual property rights are protected legally.

4) Once achieving technical breakthroughs in a particular area, the enterprise should apply for the patent for the core technology first, and the development ideas in the meantime, launch research of the related fields around the core technology timely, promote the patent application at different levels as soon as possible and build patent network around the core technology.

## 5 Conclusions

Patent strategies for phosphorus resource development and utilization in Hubei are not only of great value for the nation, the regions, departments, units and enterprises in the development of phosphate resources and the scientific decision-making, but also have a positive impetus for Hubei phosphate resources comprehensive utilization technology innovation and industrialization, which can further promote the scientific research transformation to technology and techniques with independent intellectual property right, shorten the cycle for technology transformation and application, promote the progress and structural adjustments of traditional industries, and thus accelerate the development of high-tech industries.

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