Development Status and Future Development Trend of Integrated Blasting Services in China

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Abstract: Under the guidance of a series of national reform and development policies, China's integrated service model integrating scientific research, explosive production, transportation, loading and blasting technical services has been continuously promoted. The level of specialization and integration of large-scale civilian explosive enterprises has been increasing year by year, but also there are still some issues that need to be addressed urgently. At the same time, China's blasting integration services should develop in the direction of automation, information, and intelligence to adapt to the development of the times and industries.

1. Introduction

The blasting integrated service operation mode refers to the "integrated" integration of purchasing, transportation, storage, blasting operations and clearance for units that require civilian explosives, relying on operational blasting units with blasting qualifications and strong technical force. Paid blasting service, an operation mode that realizes professional blasting operations, closed explosives management, and marketization of blasting services.

In order to achieve the goals of ensuring public safety, reducing links, reducing costs, and improving efficiency, the State Council promulgated and implemented the "Regulations on the Safety Management of Civil Explosives" in 2006, encouraging the development of "purchase, transportation, storage, blasting, and clearance" of civilian explosives. Integrated services. It is the first time to propose and encourage the implementation of integrated blasting services at the official level, providing a direction for the development of blasting technical services.

Therefore, the development of blasting integration services has received more and more attention from the industry. The development of our national blasting enterprise and blasting integration service model has become the focus of discussion. Based on this perspective, this article describes the development of blasting integration mode Status and future directions.

2. Review of the Development of Integrated Blasting Services At Home and Abroad

2.1 Development Status of Foreign Blasting Integration Services

Judging from the development history of foreign blasting integration, its development is closely related to the development and application of on-site mixed explosives vehicles. In the 1960s, with the needs of large-scale mining of mineral resources, explosive field mixing technology has achieved breakthrough development. The first ammonium oil on-site mixing truck was developed by Nitro Nobel in Sweden; the American IRECO company developed a slurry explosive on-site mixing truck, and then developed an emulsion explosive On-site mixing truck and on-site heavy-duty ammonium fried drug mixing vehicle; At the same time, Norway's Dyno Nobel and Australia's Orica have also developed on-site mixing ammonium-fried drug on-site mixing vehicle and emulsification Explosive field mixed loading truck and corresponding ground station supporting equipment. All these indicate that the blasting construction has entered the era of mechanized on-site mixing from manual charging. The development of on-site mixing technology has also promoted the development of integrated blasting services abroad.

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After more than 50 years of development, the integrated blasting service model based on on-site mixing technology has become the main method of explosive production and blasting services in developed countries such as Europe and the United States. At present, the output of field explosives in developed countries in Europe and the United States accounts for more than 85% of the total output of civilian explosives. At the same time, the number of foreign civilian explosion companies has continued to be reduced due to continuous reorganization and mergers. After the reorganization, the large civilian explosion companies have greatly improved their technical level and comprehensive strength. Large civilian explosion enterprises such as Orica, Nobel, and Austin have further extended the industrial chain. From the production of ammonium nitrate, the manufacture of industrial explosives, transportation, loading, blasting technical services, etc., a full industrial chain of blasting integration services and professional development are formed. At the same time, large-scale civil explosive companies further set up their own R & D and design centers, not only engaged in the research of new explosives and mixed equipment, but also combined the development of explosives and equipment with blasting technology to further improve the integrated blasting service level.

2.2 Development Status of Domestic Blasting Integration Services

Prior to 2006, the domestic civilian explosive enterprises were in a “small, scattered, low” situation with insufficient marketization. The number of enterprises is large and the scale is small, and the integrated service level of blasting is relatively low. During the “Eleventh Five-Year Plan” period, major progress was made in the structural adjustment of civil explosive enterprises. Reorganization, integration, and closure of a number of production and sales companies, the production company was adjusted from 421 to 146, the sales company was adjusted from 1,720 to 523, a regional development pattern with leading companies as the leader began to take shape; industry concentration The proportion of the top 20 production companies in the total output value of the industry has increased from 25.1% in 2006 to 42.6% in 2010; the structural adjustment of civil explosive enterprises has provided a good foundation for integrated blasting services.

During the “Twelfth Five-Year Plan” period, civil explosive enterprises will further reorganize and integrate, and the development of integrated services will continue to deepen, and continue to promote corporate reorganization and integration. The proportion of the top 15 manufacturers' GDP in the industry increased from 35.45% in 2010 to 50.72% in 2015. The proportion of field explosives in industrial explosives increased from 14.82% in 2010 to 22.45 in 2015 %. Promote the development of integrated services for production, sales and blasting operations in the civilian explosion industry, and some production and sales companies actively develop and expand blasting service businesses.

The development goals of the “13th Five-Year Plan” of the civilian explosives industry require that the concentration of the civilian explosives industry be further increased. Cultivate 3 to 5 leading enterprises in the civil explosion industry with certain industry driving force and international competitiveness, support 8 to 10 leading enterprises with outstanding technological leadership and strong integrated service capabilities, and rank among the top 15 production enterprises Its share in the industry exceeded 60%. The product structure of civilian explosives was further optimized, and the proportion of on-site mixed explosives accounted for more than 30% of industrial explosives. At the same time, the state encourages civilian explosive enterprises to extend the industrial chain, improve the integrated operation mechanism, and improve the level of integrated operation. These policies have brought great benefits to China's blasting integrated service model.

2.3 Review of Development Status At Home and Abroad

According to the experience of developed blasting integration services and the development of mixed explosives trucks in developed countries in Europe and the United States, China’s mixed explosives market share is low and will continue to increase in the future. It is expected that the output of bulk explosives in China will reach 80% of the total industrial explosives in the future. At the same time, the proportion of mixed ammonium fried explosives in mixed explosives will

increase; the concentration of domestic explosion industry will further increase, and the explosion enterprises will be further integrated to form several specialized, comprehensive, and have a certain industry driving force and international Leading enterprises in the competitive civilian explosion industry.

3. Development Status and Future Development Trend of China's Blasting Integration Model

3.1 Development Status of China's Blasting Integration Mode -- “on-Site Mixed Vehicle Distribution + Loading + Field Operation” Model

“On-site mixed truck distribution + charging + on-site operation” mode is a production operation mode that uses the current mixed-load explosive truck for explosives transportation, on-site mixed production, automatic filling and on-site blasting operations. Judging from the development history of the integration of civilian explosion services abroad, this model is an inevitable choice for the development of integration of civilian explosions at this stage, and an inevitable trend for large-scale mining and blasting technology innovation. At present, most of China's civilian explosion enterprises or mines implementing the integrated blasting model are at this stage, which is also a model supported and vigorously promoted by the state.

At present, this model is widely used. An important reason is that it has safety. On-site mixed loading trucks are semi-finished products of explosives in transportation and storage. The mixed emulsion explosive is a blunt latex matrix without sensitized bubbles before entering the hole. The explosive is sensitive to the detonation bomb only after 5 ~ 10 minutes into the hole. The whole mixing process is safer. The power is a hydraulic system, no static electricity is generated, so it is safe and reliable for the blasting network; the ammonium nitrate granules and light diesel oil are mixed before the mixed ammonium fried powder enters the spiral mixing. Insensitive explosives without detonator sensitivity must be detonated by initiating bombs, so their safety can be guaranteed during transportation and use.

At the same time, the use of mixed explosives has a great advantage in reducing construction costs and loading efficiency compared to the use of bulk explosives. But this model still has some problems that need to be solved urgently.

3.2 Some Problems That Need to Be Solved in This Model

3.2.1 The Problem of Matching Connection of Field Mixed Explosives with Relevant Blasting and Subsequent Processes

With the expansion of the field explosives mixed loading vehicle application object, the research and application of related blasting technology should also be strengthened. For example, the reference of the bucket shovel guided reactor technology requires the support of long section and high step blasting technology, and this technology At the same time, the application of reasonable on-site mixed explosives is needed. On-site mixed explosives and related blasting processes depend on each other, promote each other, and improve together to promote the development of integrated blasting services.

3.2.2 Matching of on-Site Mixed Explosives with Rocks

An obvious advantage of the on-site mixing truck explosive truck is that it can produce explosives with different densities and different performances by adjusting the sensitizer content, and according to demand, it can be randomly produced, filled with different products, different proportions, and different in the same gun hole. The performance is even very different, to meet the requirements of blasting under different geological conditions. Because the problem of on-site mixed explosives and rock matching not only involves the integration of the two majors, but also solves the problems of on-site construction operability, at present, there are only a few domestic explosive enterprises with strong comprehensive capabilities in exploration and implementation. In order to further improve the integrated service level of blasting and improve the quality of blasting, it is necessary to solve the problem of on-site mixing of explosives and rocks.

3.2.3 The Technical Level of Underground Emulsion Mixing Explosive Trucks Needs to Be Improved

Although some domestic enterprises have carried out exploration on the development mode of integrated blasting services based on mixed vehicles, such as Gezhouba Yipuli Company, China Railway 19th Bureau, Jiangnan Chemical Company and Hongda Blasting Company, most of them only involve the field of open-air blasting. The underground charging equipment and its blasting services are still in the “vacuum zone”. At present, China’s underground mines account for more than 70% of the total ore reserves. In the underground mine perforation, blasting, shovel loading and transportation operations, blasting charging operations are still mainly manual or simple charging devices, which have low charging efficiency. High labor intensity, many operators, and poor blasting effects. With the domestic demand for resource extraction, the development of technology and economic level, and the requirements for a safe operating environment, domestic underground mines have an urgent need to use on-site mixed vehicles.

In the late 1990s, Orica of Australia, EPG of France, Dyno Nobel of Norway, and AECL of South Africa publicly reported their “underground field mixed emulsion explosives charging vehicles”; Research applications and technological development are relatively backward. Beijing Research Institute of Mining and Metallurgy, Hunan Jinneng Technology Co., Ltd., and Shenzhen Jinaobo Technology Co., Ltd. have successively developed emulsified explosives underground charging vehicles, which has promoted the technical progress of underground on-site mixed explosives vehicles in China.

Although in terms of underground mixing trucks, domestic and foreign research institutes have developed emulsified explosives underground charging trucks with a certain level of technology, in terms of practical applications, the technical level of underground mixing trucks cannot meet the actual production requirements like outdoor mixing trucks. Research and development of more advanced underground on-site mixing emulsified explosives vehicles and filling technology has become one of the technical topics of current underground blasting and blasting integrated services.

3.3 Future Development Direction of China's Blasting Integration Model -- “Intelligent Design + Intelligent Mixed Truck Distribution and Loading + Field Operation” Model

In the future, the integrated blasting service should be developed in the direction of automation, information, and intelligence. The “intelligent design + intelligent mixed truck distribution and loading + field operation” model may become a new model of blasting integrated service. This mode can be achieved by the following steps.

(1) The client of the built-in blasting design software for the mixed-load explosive car, the blasting design of the day is input into the charging car on the ground before the loading operation;

(2) The GPS operation system notifies the number of the gun hole where the on-site mixing truck is located, and the on-site mixing truck can automatically identify the gun hole;

(3) The vehicle-mounted detection system detects the condition of the gun hole and contacts the main control system via the network to correct the charge;

(4) The manipulator feeds the pipe into the blasthole, calls the type and quantity of explosive stored in the blasting design data, and completes the charge;

(5) After the charging is completed, record the charging situation, store it in the computer, and send it to the control center. After the blasting is completed, the automatic imaging system analyzes the photos of the blasting pile, adjusts the blasting parameters and explosive parameters, and provides parameter support for similar lithology in the future.

At present, no domestic explosive enterprises or mines have reached this level. Guangdong Hongda Blasting Co., Ltd. has made a preliminary exploration on this model.

4. Conclusion

With the guidance of national policies and the integration and upgrading of the civilian explosion industry, China's integrated service model that integrates scientific research, explosive production,

transportation, loading and blasting technical services has been continuously promoted, and the level of specialization and integration of large civilian explosion enterprises has been increasing year by year. However, affected by factors such as traditional operation methods, equipment technology level and the characteristics of mineral resource development, China's blasting integration service and technology level still have a certain gap compared with developed countries in Europe and America. We also need to improve the technical level of industrial equipment (especially underground sites). Technical level of mixed explosives vehicles), increase the market share of mixed explosives, match the connection of on-site mixed explosives with related blasting and subsequent processes, match on-site mixed explosives with rocks, etc., and improve the overall technical level of our national explosion integration . At the same time, artificial intelligence has become the industry's development trend, and it is also a national development strategy. China's integrated blasting services should be developed in the direction of automation, information, and intelligence to adapt to the development of the times and the industry.

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