
INDUSTRY OVERVIEW

The information and statistics set forth in this section and elsewhere in this document have been derived from the F&S Report, commissioned by us and independently prepared by F&S, in connection with the [REDACTED]. In addition, certain information is based on, or derived or extracted from, among other sources, publications of government authorities and internal organisations, market data providers, communications with various PRC government agencies or other independent third-party sources unless otherwise indicated. We believe that the sources of such information and statistics are appropriate and have taken reasonable care in extracting and reproducing such information. We have no reason to believe that such information and statistics are false or misleading in any material respect or that any fact has been omitted that would render such information and statistics false or misleading. Our Directors confirm that, after taking reasonable care, they are not aware of any adverse change in market information since the date of the F&S report which may qualify, contradict or adversely impact the quality of the information in this section. None of our Company, or the Sole Sponsor, [REDACTED], [REDACTED], excluding F&S, has independently verified such information and statistics and no representation has been given as to their accuracy. Accordingly, such information should not be unduly relied upon.

SOURCE OF INFORMATION

We commissioned F&S, an independent market research and consulting firm, to conduct an analysis of, and to prepare a report on gold mine hazardous waste and mine solid waste treatment markets in China and other economic data for the period from 2015 to 2025. We have agreed to pay a fee of RMB400,000 for the F&S Report, which we believe reflects market rates for reports of this type. F&S is an independent global market research and consulting firm founded in 1961 and based in the United States. It offers industry research and market strategies and provides growth consulting and corporate training.

The F&S Report includes both historical and forecast information on the gold mine hazardous waste and mine solid waste treatment markets in China and other economic data. To prepare the F&S Report, F&S undertook both primary and secondary independent research through various resources within gold mine hazardous waste and mine solid waste treatment markets in China. Primary research includes interviewing industry insiders, competitors, downstream customers and recognised third-party industry associations. Secondary research includes reviewing corporate annual reports, databases of relevant official authorities, independent research reports and publications, as well as the exclusive database established by F&S over the past decades. F&S has adopted the following primary assumptions while compiling and preparing the F&S Report (i) the social, economic and political conditions in China will remain stable during the forecast period; (ii) government policies on gold mine hazardous waste and solid waste treatment markets in China will remain unchanged during the forecast period; and (iii) relevant key drivers are likely to drive the continued growth of China’s gold mine hazardous waste industry throughout the forecast period. F&S has also obtained the figures for the estimated total market size from historical data analysis plotted against the macroeconomic data as well as the industry key drivers. Our Directors confirm that, after making reasonable enquiries, there have not been

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any material adverse changes to the market information set out in the F&S Report since the date of such report which may qualify, contradict or have an impact on the information contained in this section.





OVERVIEW OF MINE SOLID WASTE TREATMENT MARKET IN CHINA

China is the largest producer and consumer of mineral resources, such as coal, gold and various non-ferrous metals. Mining industry is crucial for the development of China’s economy. The investment in mining industry remains at a relatively high level. More importantly, China is actively promoting the development of green mining. The government keeps introducing relevant policies to encourage and guide social capital to invest in ecological restoration of mining areas and actively promoting the revision and improvement of green exploration standards.

Definition, Classification and Treatment Methods Analysis of Mine Solid Waste

Mine solid waste refers to the waste rock, tailings, waste residue and hazardous waste which are originated from the process of mining and washing ore. A large amount of accumulated mining solid wastes will pollute the land and cause disasters such as landslides and mudslides. Hazardous wastes, containing harmful elements such as arsenic and cadmium, will cause direct harm to human health if being disposed to the environmental system. In order to eliminate the pollution caused by mine solid waste, the government is promoting the comprehensive utilisation of mine solid waste.

Classification of Mine Solid Waste

Tailings		<ul style="list-style-type: none"> • In the process of mining and washing ore, those ores with low content of useful components that cannot be used for production are called tailings. • At present, the primary task of China’s mining recycling economy is to develop and utilise the existing large number of tailings which have been accumulated for a long time.
Waste Rock		<ul style="list-style-type: none"> • Waste rock refers to the surrounding rock and stone that have been mined without ores. • In open-pit mining, the stripped overburden, surrounding rock and gangue without industrial value are generally called waste rocks. These waste rocks must be discharged to a certain place in time which is called waste rock yard.
Waste Residue		<ul style="list-style-type: none"> • Mining waste residue is the high-volume material that originates from the processes of excavation, dressing and further physical and chemical processing of wide range of metalliferous and non-metalliferous minerals by opencast and deep shaft methods.
Hazardous Waste		<ul style="list-style-type: none"> • Hazardous waste is a waste with properties that make it hazardous or capable of having a harmful effect on human health or the environment

Source: China Circular Economy Association, F&S

There are usually three methods of mine solid waste treatment, namely resource utilisation, incineration disposal and landfill disposal.

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Treatment Methods of Mine Solid Waste

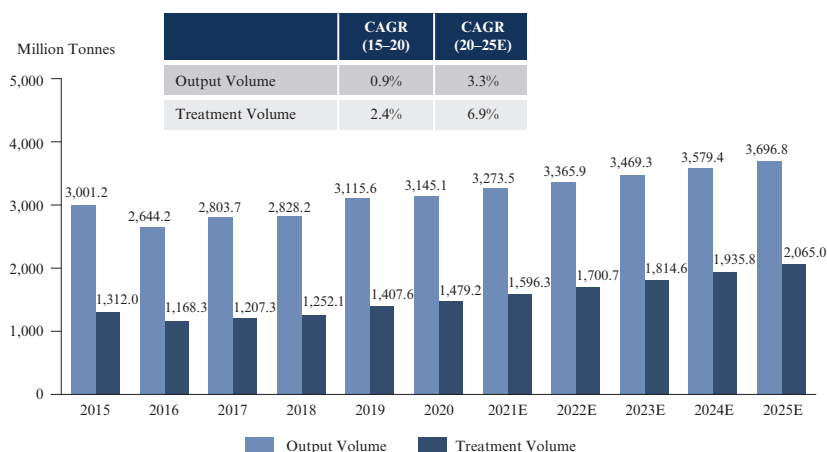
	Resource Utilisation	Incineration Disposal	Landfill Disposal
Application	Mine solid waste which still containing accessible and valuable element	Coal gangue, some hazardous waste and other mine solid waste with high caloric value	Harmless waste rock, tailings and residue, waste without caloric value
Advantages	<ul style="list-style-type: none"> > Raising utilisation value of hazardous waste after harmless treatment > Supply metal, building materials to the market > Maximising the value of waste 	<ul style="list-style-type: none"> > Reduce waste volume largely and efficiently > Eliminate disease agents and pathogens and reduce toxicity efficiently > Save land resources 	<ul style="list-style-type: none"> > Lower cost > Mature technology > Suitable for wide range of waste types
Disadvantages	<ul style="list-style-type: none"> > Need for pretreatment or sorting > Need for further treatment on by-products and residual > High cost for maintenance monitoring > High tech requirement 	<ul style="list-style-type: none"> > Production of undesirable by-products, becoming an environment pollution > Endangering the health of surrounding resident > High initial investment on equipment 	<ul style="list-style-type: none"> > Need for pretreatment on waste before landfilling > Need for large space > Possible risk of pollution > Need for long-time maintenance > Long-lasting effect on land resources

Source: F&S

Output and Treatment Volume of Mine Solid Waste

The total output volume of mine solid waste in China increased from 3,001.2 million tonnes in 2015 to 3,145.1 million tonnes in 2020, representing a CAGR of 0.9% from 2015 to 2020. With the further development and industrial upgrading of mining industry, it is expected to reach 3,696.8 million tonnes in 2025, representing a CAGR of 3.3% from 2020 to 2025. The treatment volume of mine solid waste in China increased from 1,312.0 million tonnes in 2015 to 1,479.2 million tonnes in 2020 with a CAGR of 2.4% from 2015 to 2020. Driven by the strengthening policies, enforcement of environment protection regulations and the efficient utilisation of solid waste resources, the treatment volume of mine solid waste is expected to reach 2,065.0 million tonnes, representing a CAGR of 6.9% from 2020 to 2025, growing faster than the total output volume.

Output and Treatment Volume of Mine Solid Waste, China, 2015–2025E



Source: China Circular Economy Association, F&S

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ANALYSIS OF GOLD MINE HAZARDOUS WASTE TREATMENT MARKET IN CHINA AND SHANDONG PROVINCE

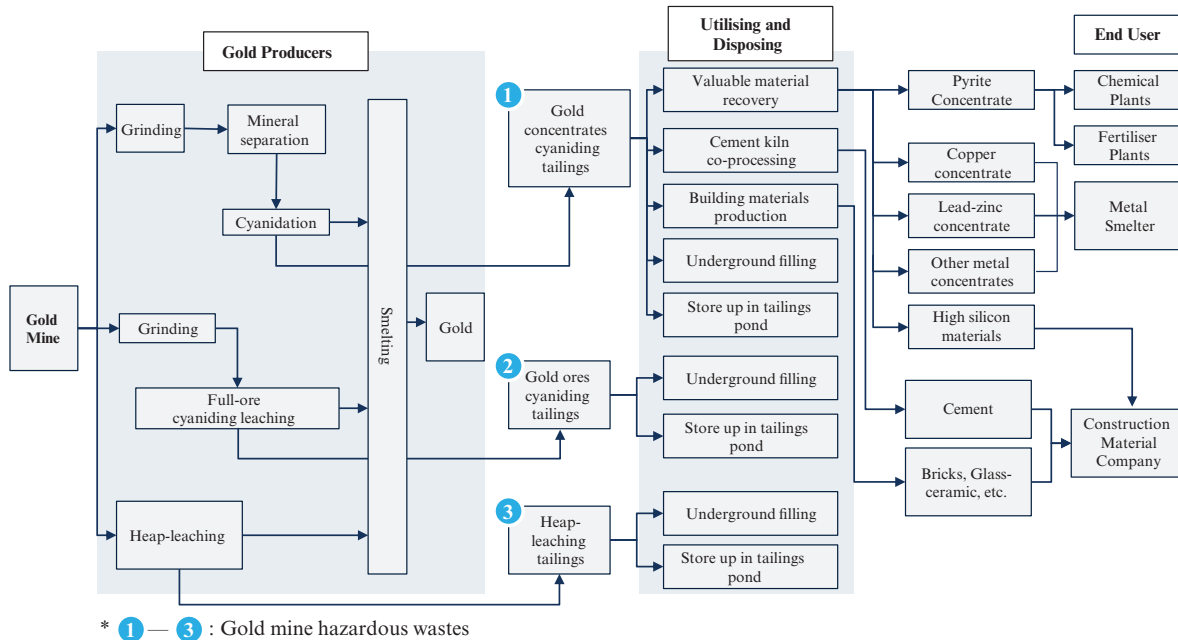
Definition, Value Chain and Business Model Analysis of Gold Mine Hazardous Waste

Gold mine solid waste can be mainly categorised into two types, namely gold mine hazardous waste and gold mine general solid waste. Gold mine hazardous waste includes the wastes that have one or more hazardous characteristics like corrosivity, toxicity, ignitability, reactivity and infectivity and those that are likely to be harmful to the environment or human body and need to be treated as hazardous wastes.

According to Directory of National Hazardous Wastes (國家危廢名錄) issued by the Ministry of Ecology and Environment (“MEE”) on 1 August 2016, cyanide leaching residue, including gold concentrates cyanide tailings, gold ores cyanide tailings and heap-leaching tailings, was listed as hazardous waste. As one of the main hazardous wastes in gold production, the treatment of cyanide leaching residue has been paid attention to and the gold mine hazardous waste treatment market has grown significantly in the past few years. The upstream of the value chain are gold producers, which produce gold mine hazardous waste during gold production through different kinds of methods, either dispose the hazardous waste by themselves or pay a certain amount of disposal fee and outsource the disposal to hazardous waste treatment companies. The midstream of the value chain are hazardous waste treatment companies, after receiving the hazardous waste from gold producers, such companies dispose and utilise the hazardous waste and produce different kinds of recycled products including pyrite concentrate, copper concentrate, lead-zinc concentrate, ceramsite, bricks, high silicon materials and sell products to downstream users. Downstream users purchase recycled products from the hazardous waste treatment companies. The downstream users mainly include chemical plants, metal smelters, construction material companies and fertiliser plants.

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Value Chain of Gold Mine Hazardous Waste Treatment



Source: F&S

There are mainly three types of gold mine hazardous waste, namely gold concentrates cyanide tailings, gold ores cyanide tailings and heap-leaching tailings. According to the Technical Specification for Pollution Control of Cyanide Leaching Residue in Gold Industry (黄金行业氰渣污染控制技术规范) issued by MEE on 1 March 2018, the gold concentrates cyanide tailings, the main gold mine hazardous waste in Shandong province, is suggested to be prioritised for valuable material recovery. The gold producers in Shandong province usually pay treatment fee and outsource the disposal of the hazardous waste to hazardous waste treatment companies with qualification. While outside Shandong province, except the business model demonstrated above, a large proportion of the hazardous waste includes gold ores cyanide tailings and heap-leaching tailings, which were mainly stored up in the tailings pond of gold producers and usually will not be further treated afterwards due to the large production volume and relatively low economic value.

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Before the cyanide leaching residue was listed in Directory of National Hazardous Wastes (國家危廢名錄) issued by MEE in 2016, the gold mine hazardous waste treatment market in China was not highly regulated and adopted a laissez-faire approach. The PRC government gradually regulate the gold mine hazardous waste treatment market in China and further issued other regulations and specifications such as the issue of the Technical Specification for Pollution Control of Cyanide Leaching Residue in Gold Industry in 2018. With a relatively short history of development, the gold mine hazardous waste treatment market in China remains at the development stage and the gold mine hazardous waste treatment fee are not subject to any price control or guidance price for the applicable category of waste set by the PRC government authorities. The treatment fee is mainly determined by negotiation between the upstream customer and the gold mine hazardous waste treatment company based on the grade and volume of gold mine hazardous waste to be treated. The grade of cyanide tailings commonly refers to the sulphur content in the cyanide tailings. Waste treatment fees may also vary across different regions and enterprises according to the grade of gold mine hazardous waste based on the various valuable and recyclable elements contained in the cyanide tailings, which mainly include sulphur concentration and varies according to the gold mine ores in China. There is no clear evaluation standard for the grading. In general, waste treatment company charges a relatively lower treatment fee for relatively higher grade of gold mine hazardous waste as more valuable and recyclable elements could be extracted and hence, more recycled products could be produced and sold, and vice versa.

Apart from the grade of cyanide tailings which is the main contributing factor of gold mine hazardous waste treatment fees, the fees would also be affected by the volume of the cyanide tailings provided by upstream customers for treatment, subject to the level of stability and scale of the demand for gold mine hazardous waste treatment services depending on (i) the scale of operation of upstream customers which would in turn determine how much cyanide tailings are produced from their gold productions; (ii) the annual permitted treatment capacities of gold mine hazardous waste treatment companies, which would determine how much cyanide tailings treatment companies would be able to treat during the year; and (iii) the mutual reliance between the upstream customers and gold mine hazardous waste treatment companies.

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Given that (i) each batch of gold mine hazardous waste has different grade and composition, therefore, waste treatment fee varies; and (ii) the willingness of upstream customers to pay for the waste treatment fee which varies regionally and was affected by their own treatment capabilities and the enforcement of relevant environmental protection policies and plans formulated by the local provincial governments in accordance with the industry layout and situation of hazardous waste in the provincial level. For example, being the largest gold production area in China, Shandong provincial government issued the Plan for Uphill Battle for Treatment of Hazardous Wastes in Shandong Province (2018–2020) (《山東省打好危險廢物治理攻堅戰作戰方案 (2018–2020年)》) in 2018 and the Opinions on Strengthening the Development and Management of Hazardous Wastes Treatment Facilities (《關於加強危險廢物處置設施建設和管理的意見》) in 2019 to further strengthen the treatment of hazardous wastes, including gold mine hazardous wastes in Shandong province. There is a mutual reliance between the upstream customers and waste treatment companies. Due to the limitations of treatment capacities and transportation, treatment of gold mine hazardous waste has certain regional restrictions and is usually supplied by waste treatment companies within the certain area where upstream customers are located. Since there are high entry barriers of waste treatment companies, there is only one or a few qualified waste treatment companies within the region. At the same time, the customer base of waste treatment companies is limited to the gold smelting companies within the region. Upstream customers and waste treatment companies are complementary to each other and depending on the bargaining powers of the parties, they negotiate the treatment fees accordingly. Based on the foregoing, it is a characteristic of the industry to have a wide range of treatment fees.

After the cyanide leaching residue was listed as hazardous waste in 2016, the treatment fee was approximately RMB50 per tonne, which varies regionally. Due to strict environmental regulation and high treatment demand, the gold mine hazardous waste treatment fee increased to approximately RMB40 to RMB180 per tonne in 2020. This price range was based on the price offered by different waste treatment companies to different customers for gold mine hazardous waste with the consideration of various factors. Treatment companies do not have a fixed gold mine hazardous waste treatment fee and the price range did not refer to average treatment fees of specific companies. The major influential factors include the unit value of recyclable elements, i.e. the grade of gold mine hazardous waste and the client’s willingness to pay which mainly represents the upstream of the value chain and is related to the profit margin of the gold production business. In general, cyanide tailings can be categorised into two types by sulphur content; high grade cyanide tailings with sulphur content of or above 30% and low grade cyanide tailings with sulphur content of or below 30%. The treatment fee of high grade cyanide tailings ranged from RMB40 to RMB60 per tonne. The treatment fee of low grade cyanide tailings ranged from RMB95 to RMB180 per tonne. It is expected that the gold hazardous waste treatment fee will increase at a moderate growth rate with a range from 3% to 5% in the foreseeable future, due to the slight increasing gold mine hazardous waste production, decreasing recovery value of the hazardous waste and relatively stable treatment capacity.

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Gold Production in China and Shandong Province

The gold produced from gold mines in Shandong province and China declined from 62.2 tonnes and 379.4 tonnes in 2015 to 57.6 tonnes and 303.7 tonnes in 2020, representing a CAGR of –1.5% and –4.5%, respectively, mainly due to the strict safety and environmental policies and the COVID-19 impact. In 2015, the people’s government of Shandong province issued Notice on the Action of Carrying out Large-Scale Investigation, Rapid Rectification and Strict Law Enforcement on Hidden Production Dangers in the Whole Province 《關於在全省開展安全生產隱患大排查快整治嚴執法集中行動的通知》, calling for the rectification of hidden danger such as hazardous waste pollution and explosion in non-coal mines, which caused the closure of some gold mines. The related environmental regulations including the Directory of National Hazardous Wastes (國家危廢名錄) issued by MEE in 2016 and the Work Plan for the Clean-up of Mining Rights in Natural Reserves 《自然保護區內礦業權清理工作方案》 issued by MNR in 2017 also resulted in the shutdown of some gold mines. The total gold produces from gold mines in Shandong province was in decline until 2019. Impacted by COVID-19 outbreak, gold production in 2020 decreased slightly due to the quarantine policy in the first quarter of 2020. Gold consumption regained increasing momentum in 2020 due to the increasing demand of gold investment as a haven when the worldwide economy was impacted negatively. The increasing demand of gold investment is expected to drive the increase in gold production during the forecast period.

The gold produced from gold mines in Shandong province and China is expected to increase gradually and reach 62.1 tonnes and 339.0 tonnes in 2025, representing a CAGR of 1.5% and 2.4% from 2020 to 2025, respectively. The main growth drivers are increasing gold demand, rising gold price, technology advances and the completion of safety and environmental protection rectification. In general, the increase in gold price may cast certain positive impact on the gold production, which will then cast positive impact on our Company’s business. The decrease in gold price may cast certain negative impact on the gold production, which will then cast negative impact on our Company’s business. It is estimated that gold mine production would not be depleted entirely in the coming 50 years in the PRC and Shandong province, mainly because (i) the proven gold reserves in the PRC and Shandong province amounted to approximately 14.7 thousand tonnes and 4.2 thousand tonnes, respectively, at the end of 2020; and (ii) the current level of gold mine production in the PRC and Shandong province is approximately 300 tonnes and 60 tonnes per year, respectively. By the end of 2020, the number of gold mines in Laizhou city, Yantai city and Shandong province was around 30, 70 and 100, respectively; and the proven gold reserves in Laizhou city and Yantai city were approximately 2.7 thousand tonnes and 3.9 thousand tonnes, respectively. Yantai city accounted for approximately 93% of proven gold reserves of Shandong province in 2020, ranking first in the proven gold reserves among prefecture-level cities in the PRC. Yantai city is, and is expected to continue to be, the prefecture-level city with the largest gold production volume in the PRC with gold production volume of approximately 50 tonnes in 2020, accounting for approximately 17% and 83% of the gold production volume in the PRC and Shandong province, respectively, together with continuous development of new gold mines. Specifically, two major gold mines in Haiyu town and Shaling town in the Yantai prefecture-level city area, with proven mineral reserves of approximately 562 tonnes and 309 tonnes, respectively, had been explored in 2020 by Customer Z, a state-owned gold mining company with its headquarter

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in Shandong province, whose shares are listed on the Main Board, and Shandong Gold Mining Co., Ltd, the parent company of Shandong Gold Smelting, respectively. Both newly explored gold mines in Yantai city are estimated to commence mass production after 2024 and 2027, respectively, which is expected to bring incremental demand for our Group’s gold mine hazardous waste treatment services.

Subject to increasingly stricter environmental policies and initiatives in the PRC, including gold extraction with more environmentally-friendly methods, it is considered that the gold extraction by cyanidation is a mature, low-cost, high-recovery gold extraction process, and it is the most widely used process in gold production in the PRC and worldwide. The environmental-friendly gold extraction method generally does not change the process of gold extraction by cyanidation, but uses low-toxic beneficiation agents to replace traditional sodium cyanate. These beneficiation agents generally still contain sodium cyanate. The penetration rate of these low-toxic beneficiation agents is lower than 5%. The gold production industry is very cautious in the selection and use of beneficiation agents. It needs to go through long-term rigorous tests to determine that the gold can be efficiently and stably extracted before bulk purchases. The application of these products is not mature yet, and they are still at the stage of market introduction and customer cultivation. Being a widely adopted gold extraction method with high efficiency and economy, the gold extraction by cyanidation will not be eliminated in at least 10 years, which is estimated mainly based on the development history and current status of gold extraction by cyanidation and its major alternatives. The treatment method of cyanide tailings is well developed, and the key issue is to strictly enforce the relevant environmental laws and regulations to eliminate the potential hazards to environment brought by cyanide tailings.

The Green Mine Policies, which are for mining industries and introduced by central government and governments of all levels, aim to improve the environmental protection level of mining industries, such as gold mining, and establish a sustainable development model. A large number of mining companies that did not meet safety and environmental protection requirements were shut down. These policies have also regulated the gold production in the PRC and Shandong province, improved the environmental protection level of gold production companies, and accelerated the integration and acquisition of small gold mines by large gold production companies. These policies did not have a materially negative impact on the gold production volume in the PRC and Shandong province, and improved the quality and environmental protection level of the gold production industry.

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The drop of mining corporations in Shandong province was mainly guided by the initiatives by Shandong provincial government such as the Work Plan for the Establishment of Green Mines in Shandong Province (山東省綠色礦山建設工作方案), with an aim to improving the integration and efficiency of mining industry, cultivating competitive mining corporations, and eliminating outdated capacities. The policies cover various segments of mining industry in Shandong province, including coal, gold, iron, gypsum, rock salt, limestone, building stone, underground brine, geothermal and mineral water. After the elimination of mining corporations with outdated capacities and those with insufficient investment for compliance of environmental protection regulations, existing mining companies in Shandong province would be more likely to increase the overall investments in environmental protection of mining industry, bringing increasing demand for environmental protection related services, such as hazardous waste treatment services. The Green Mine Policies would not have a potential material adverse impact on the gold production volume in the PRC and Shandong province.

Production Volume of Gold from Gold Mines, China and Shandong Province, 2015–2025E



Source: China Gold Association, F&S

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Market Size of Gold Mine Hazardous Waste Market in China and Shandong Province

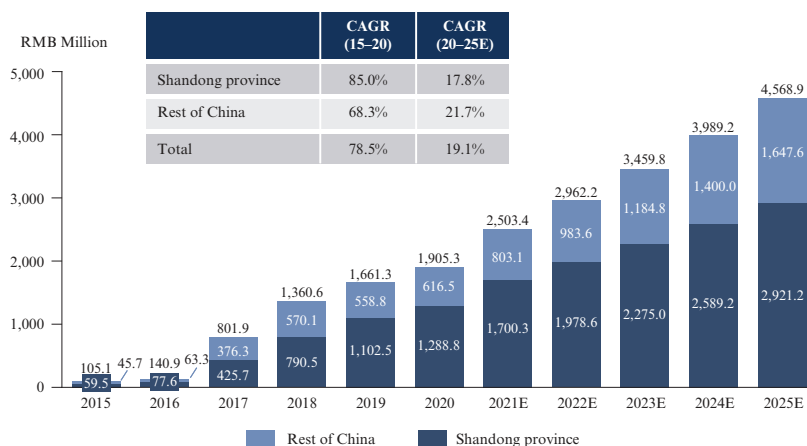
A large number of gold mines in China were cyanided directly, instead of mineral separation, which cause large output of gold ores cyanide tailings and heap-leaching tailings.

Considering that cyanide leaching residue was listed in Directory of National Hazardous Wastes on 1 August 2016, the gold mine hazardous waste treatment market was relatively small due to the lack of attention before 2017. The increasingly strict requirements on environmental protection drove the growth of the market after the implementation of policies, the gold mine hazardous waste treatment market increased from RMB59.5 million and RMB105.1 million in 2015 to RMB1,288.8 million and RMB1,905.4 million in 2020 in Shandong province and China, representing a CAGR of 85.0% and 78.5% from 2015 to 2020, respectively. The gold mine hazardous waste treatment market also increased from RMB50.9 million in 2015 to RMB1,118.2 million in 2020 in Yantai city, representing a CAGR of 85.5% from 2015 to 2020. In 2020, the revenue of gold mine hazardous waste treatment market in Yantai city contributed approximately 87% of total revenue in Shandong province.

While in areas except Shandong province, the majority of gold mine hazardous wastes are gold ores cyanide-tailings and heap-leaching tailings due to different processing techniques. These kinds of hazardous wastes were mainly stored in the tailings pond and the proportion of them being treated is very low due to relative low recycle value, resulting that the total revenue of gold mine hazardous waste treatment in Shandong province accounts for a large proportion of whole market in China. Even though driven by the stricter environmental requirement, a certain amount of such hazardous wastes is expected to be disposed through underground filling by the gold production company themselves. In combination with the high utilisation rate of the hazardous waste in Shandong province, the gold mine hazardous waste treatment market in Shandong province accounts for large proportion of the market in China. The increasing hazardous waste output volume and stricter environmental requirements is expected to drive the gold mine hazardous waste treatment market further increase to RMB2,921.2 million and RMB4,568.9 million in Shandong province and China in 2025, representing a CAGR of 17.8% and 19.1% from 2020 to 2025, respectively. The gold mine hazardous waste treatment market in Yantai city is also expected to increase to RMB2,755.0 million in 2025, representing a CAGR of 19.8% from 2020 to 2025.

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Total Revenue of Gold Mine Hazardous Waste Treatment Market*, China and Shandong Province, 2015–2025E



* Total revenue includes revenue of hazardous waste treatment and sales revenue of recycled products.

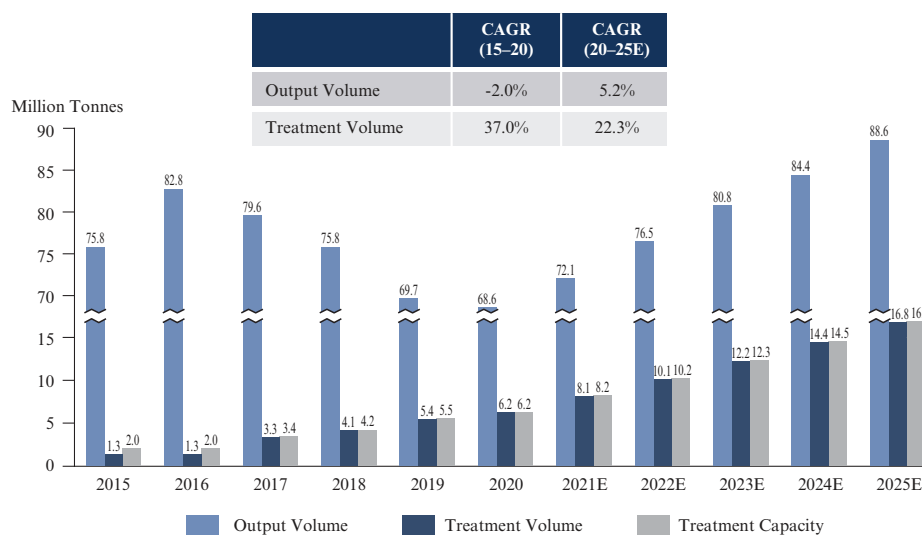
Source: F&S

The overall output of gold mine hazardous waste in China fluctuated in line with gold production, which increased from 75.8 million tonnes in 2015 to 82.8 million tonnes in 2016 and decreased thereafter to 68.6 million tonnes in 2020, representing an overall CAGR of –2.0% from 2015 to 2020. Due to the expected steady gold production caused by strong gold demand and the increasing hazardous waste output rate caused by decreasing grade of gold ores, the output of the gold mine hazardous waste in China is expected to increase to 88.6 million tonnes in 2025, representing a CAGR of 5.2% from 2020 to 2025.

Considering cyanide leaching residue was listed in Directory of National Hazardous Wastes (國家危廢名錄) issued by MEE on 1 August 2016, the treatment volume of gold mine hazardous waste in China increased significantly in 2017. The total treatment volume in overall China increased from 1.3 million tonnes in 2015 to 6.2 million tonnes in 2020, representing a CAGR of 37.0%. Driven by the stricter environmental requirement, increasing percentage of the gold mine hazardous waste are expected to be treated, especially through underground filling, in the forecast period, the treatment volume in China is expected to increase continuously to 16.8 million tonnes in 2025, representing a CAGR of 22.3% from 2020 to 2025.

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Output and Treatment Volume of Gold Mine Hazardous Waste, China, 2015–2025E



Source: Ecology and Environment Bureaus of Municipal Governments, F&S

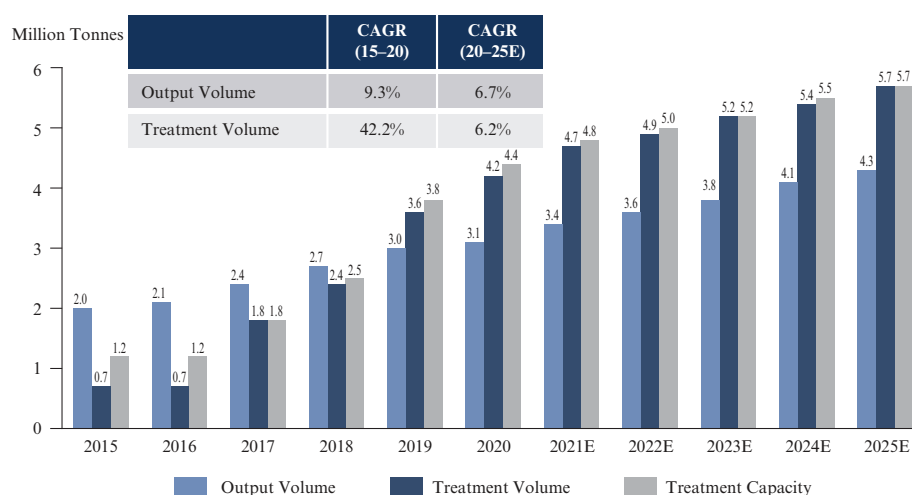
Considering the high grade and the nature of gold ores in Shandong province, majority of gold mines are enriched by mineral separation previously before cyanidation in smelting, which resulted in the output rate of hazardous wastes in Shandong province being lower than that in China. The output volume of gold mine hazardous wastes in Shandong province increased from 2.0 million tonnes in 2015 to 3.1 million tonnes in 2020, representing a CAGR of 9.3% from 2015 to 2020. Due to the naturally declining gold grade in the gold ores being continuously mined, and the expected relatively stable gold production, the hazardous waste output rate is expected to increase continuously, which is expected to drive the hazardous waste output volume in Shandong province to continue to increase to 4.3 million tonnes in 2025, representing a CAGR of 6.7% from 2020 to 2025. The output volume of gold mine hazardous wastes outgrew the gold mine production volume, mainly due to the overall decreasing grading of gold mines, which requires increasing volume of ores to be processed per unit of gold. The treatment volume of gold mine hazardous waste in Shandong province increased significantly in 2017. The total treatment volume in Shandong increased from 0.7 million tonnes in 2015 to 4.2 million tonnes in 2020, representing a CAGR of 42.2%.

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Under the increasingly stricter environmental requirement, the treatment demand from increasing annual hazardous waste output and accumulated hazardous waste which has not been treated from historical period is expected to drive the treatment volume of gold mine hazardous waste in Shandong province to increase continuously to 5.7 million tonnes in 2025, representing a CAGR of 6.2% from 2020 to 2025. The environmental regulations have already been strictly implemented in Shandong province for the past few years, the treatment volume is expected to increase moderately in the forecast period due to the expected relatively stable gold mine and gold mine hazardous waste production in Shandong province. In Yantai city, the CAGR of expected treatment volume of gold mine hazardous waste is 7.0% from 2020 to 2025.

The trend of treatment volume exceeding incremental output volume each year in Shandong province is mainly because of the treatment of accumulated gold mine hazardous wastes, which are estimated to be more than 10 million tonnes and 12 million tonnes in Yantai city and Shandong province, respectively, as at the end of 2020. As the central government and governments at all levels in Shandong province continue to carry out inspection work of environmental protection, of which treatment of stored hazardous wastes is a key area, the treatment of stored gold mine hazardous wastes will continue to be a important driver for the market, along with the treatment of incremental output. The accumulated gold mine hazardous waste in Yantai city and Shandong province is estimated to be exhausted in at least approximately 20 years, based on the current level of treatment volume of historically accumulated gold mine hazardous waste, which is approximately 0.3 million tonnes to 0.5 million tonnes per annum.

Output and Treatment Volume of Gold Mine Hazardous Waste, Shandong Province, 2015–2025E



Source: Ecology and Environment Bureaus of Municipal Governments, F&S

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Drivers of Gold Mine Hazardous Waste Market in China

Stricter Requirements and Enforcement of Environmental Policies. To improve the level of environmental protection in the gold industry, both the requirements and enforcement of environmental policies in the gold industry are being strengthened since 2018. For example, the Law of the PRC on the Prevention and Control of Environment Pollution Caused by Solid Wastes (《中華人民共和國固體廢物污染環境防治法》), the Administrative Measures for Pollutant Discharge Licensing (for Trial Implementation) (《排污許可管理辦法(試行)》) and the Regulations on the Administration of Pollutant Discharge Permits (《排污許可管理條例》) are strengthened with regards to requirements such as establishment of hazardous waste management account, increase in amount of fines and penalties, and legal responsibility of relevant authorities and enterprises. For example, the penalties for unauthorised transfer of hazardous wastes increased from the range of RMB0.02 million to RMB0.2 million to the range of RMB0.1 million to RMB1 million as regulated in the latest versions of Law of the PRC on the Prevention and Control of Environment Pollution Caused by Solid Wastes. On the other hand, environmental protection inspectorates from central government and government at all levels have increased the frequency of environmental inspections in recent years. Under the increasingly stricter environmental protection policies and encouragement of circular economy, an increasing number of companies are expected to improve their hazardous waste utilisation, which enable them to further expand their profitability and maximise the value of the gold mine while meeting the stricter environmental protection requirements. It will increase the overall utilisation rate of hazardous waste in gold industry and drive the growth of hazardous waste treatment market. Meanwhile, the treatment demand from accumulated hazardous waste that has not been treated from historical period is also expected to drive the growth of treatment volume driven by stricter environmental requirements.

Increasing Utilisation Value through Technology Improvement. Encouraged by national circular economy, the utilisation value of hazardous waste has been emphasised. An increasing number of gold companies and hazardous waste treatment companies are expected to enhance their technology research and development ability on hazardous waste resource utilisation. Such effect is expected to further enhanced the utilisation value of unit hazardous waste, driving the development of the industry.

More Utilisation Channels. The encouraging attitude on circular economy has promoted the development of more utilisation channels, including point-to-point hazardous waste utilisation policies, cement kiln co-processing and construction materials. It will reduce restrictions on hazardous waste treatment caused by treatment capacity limitation, which will promote the growth of gold mine hazardous waste treatment industry from supply side.

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Increasing Hazardous Waste Output Rate. With the continuous mining of the gold mines in China, the grade of the gold ore is decreasing year by year, which is expected to increase the hazardous waste output rate and bring more amount of hazardous waste and solid waste with the same gold production volume. In the context of expected stable gold production caused by relatively strong gold demand, the increase in the hazardous waste output rate will lead to an increase in the total hazardous waste output volume, which will drive a huge demand on hazardous waste treatment in gold mines in China.

Entry Barriers of Gold Mine Hazardous Waste Treatment Market in China

Qualification Barrier. According to Measures for Management of Hazardous Waste Business License (《危險廢物經營許可證管理辦法》), companies engaged in hazardous waste collection, storage and treatment in China shall obtain hazardous waste business licenses. In order to get the license, a company must own qualified transportation, packaging, storage, and treatment facilities and equipment, as well as establish qualified rules and regulations, pollution prevention and control measures, and accident emergency rescue measures. For new entrants of the hazardous mine solid waste treatment industry, it takes time and efforts to get familiar with the requirements and eventually meet all the required standards.

Technology Barrier. Mine solid waste industry is a highly specialised industry, which has a high requirement on the technology capability of companies in the industry. More specifically, since hazardous waste is generally corrosive and toxic, hazardous mine solid waste treatment will cause serious secondary pollution to the environment if the risk control technology and experience of the company is insufficient. For new entrants of the market, it requires years of technology accumulation to formulate a whole set of efficient, energy-saving and environmentally-friendly mine solid waste treatment technology system. Before this process is completed, the technology barrier would be one of the major challenges for them.

Expert Barrier. Mine solid waste treatment business requires experts in chemistry, mechanics, environment, engineering design and other industries. More specifically, for hazardous mine solid waste treatment companies, in order to obtain the license, they should have more than three technicians majoring in environmental engineering or relevant fields with professional titles at intermediate levels or above, and with more than three years of solid waste pollution treatment experience. However, high-quality professionals in this field are relatively insufficient in China. Therefore, for new entrants of the market, the lack of professional expertise would be a great challenge in the early stages.

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Capital Barrier. Solid waste treatment industry requires high equipment and land expenditure. Daily maintenance by technical personnel is also required to ensure the production and environmental protection requirements are met, which also requires a large capital investment. Furthermore, as more companies in the industry have been putting focus on technology and equipment upgrade in recent years, it requires more capital investment from new entrants if they want to keep pace with such trends.

Trends in Gold Mine Hazardous Waste Treatment Market in China

Matthew Effect Appears. Except the consolidation of the gold production industry, the smelting process of the gold tends to be centralised as encouraged by the Technical Policy of Pollution Control and In Gold Industry (《黄金工业污染防治技术政策》). The consolidation of the gold mine hazardous waste production is expected to drive the centralisation of the hazardous waste treatment demand correspondingly, which is expected to increase their reliance on hazardous waste treatment companies. Therefore, the leading hazardous waste treatment companies with large treatment capacity are expected to gain more market share.

Preference on Professional Hazardous Waste Treatment Companies. The PRC government’s encouragement of 100% utilisation of the hazardous waste is expected to stimulate the hazardous waste treatment companies to expand their product portfolio to maximise resource utilisation, which is expected to raise the barriers of hazardous waste treatment industry. Under the dual pressures of policy and profitability, the advantages of professional third-party hazardous waste treatment companies that can maximise resource utilisation have gradually become prominent.

Competitive Landscape of Gold Mine Hazardous Waste Market in China and Shandong Province

China’s gold mine hazardous waste treatment companies can be categorised into three types, namely independent hazardous waste treatment company, leading gold producers affiliated hazardous waste treatment company and hazardous waste co-processing companies. At present, the former two types of the companies are dominating the market. Our Company is an independent hazardous waste treatment company. The distribution of hazardous waste treatment company follows the gold producers and has a strong regional characteristic. The gold mine hazardous waste treatment market is concentrated. The leading players obtained large treatment volume from large gold producers, while there are still a large number of small companies in the market. There are approximately 50 gold producer-affiliated hazardous waste treatment companies and independent hazardous waste treatment companies participating in the market, and also hundreds of co-processing companies in China and over 30 co-processing companies in Shandong province with small amount of treatment volume participating in the market. Co-processing companies, such as cement kiln collaborative processing companies, provide treatment service for their clients after the gold hazardous waste is pre-treated to a lower level of hazard.

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As at the end of 2020, there are around five gold producer-affiliated hazardous waste treatment companies with total market share of around 40% in Shandong province, 33 independent hazardous waste treatment companies with total market share of around 35% in Shandong province and over 30 co-processing companies participating in the market with total market share of around 25% in Shandong province. Among these qualified market players which had obtained relevant hazardous waste business licence, around 12 gold producer-affiliated hazardous waste treatment companies and independent hazardous waste treatment companies, and less than five hazardous waste co-processing companies in Shandong province were market players with actual treatment volume for gold mine hazardous waste treatment service during 2020, and ten qualified gold producer-affiliated hazardous waste treatment companies and independent hazardous waste treatment companies, and less than five hazardous waste co-processing companies in Yantai city were market players with actual treatment volume for gold mine hazardous waste treatment service during 2020. Gold producer-affiliated hazardous waste treatment companies mainly provide treatment service for their parent companies. Independent hazardous waste treatment companies provide treatment services for variety of clients. Hazardous waste co-processing companies provide treatment service for their clients after the gold hazardous waste is pre-treated to a lower level of hazard.

In total, there are approximately 100 gold mining companies in Shandong province. There are around five gold producers owning affiliated hazardous waste treatment service providers in Shandong province, among which two hazardous waste treatment service providers affiliated gold mining companies are our Group’s upstream customers during the Track Record Period. Since not all of their production facilities are close to their affiliated hazardous waste treatment facilities, gold mine companies with affiliated treatment service providers will comprehensively evaluate the cost and benefit when selecting treatment service by evaluating various factors, such as the initial investment costs, operating costs, benefits and risks of selecting certain treatment services. These gold mine companies usually do not only engage their affiliated treatment service providers, but engage in third-party treatment service providers such as our Group, since the treatment capacity of their relevant affiliates is usually not sufficient for all of their demand.

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Moreover, given the higher investment costs of establishing a new hazardous waste treatment facility closer to their gold production plants, it is common industry practice for gold mine companies to engage independent treatment companies like our Group, mainly considering the entry barriers of entering into the gold mine hazardous waste treatment market and is not therefore considered as commercially desirable. For example, for new entrants of the hazardous mine solid waste treatment industry, it takes time, investment costs and efforts to (i) familiarise with the requirements and eventually meet all the required standards and to obtain the Hazardous Waste Business Licence; (ii) formulate efficient, energy-saving and environmentally-friendly mine solid waste treatment technology system to meet the technology capability in treating gold mine hazardous waste; and (iii) formulate and implement stringent repair and maintenance measures with high capital expenditure, as well as qualified technological experts to ensure the production and environmental protection requirements are met. By engaging independent treatment companies, these gold mine companies with affiliated treatment service providers can also better control their costs by engaging independent treatment companies which are located closer to their gold production plants and shift their risks of transportation and delivery of gold mine hazardous waste to third-party treatment service providers. In the future, the market concentration is expected to increase.

The top five players accounted for approximately 67% of the total revenue in China in 2020. While there is a great amount of local small companies in the market. Our Company was ranked as the third large hazardous waste treatment company by revenue in China, with revenue of RMB190.5 million, accounting for 10% of the total revenue in China in 2020. Hazardous waste treatment market is relatively concentrated in Shandong province. The top five players accounted for approximately 65% of the total revenue in Shandong province in 2020. Our Company was the second largest hazardous waste treatment company by revenue in Shandong province, with revenue of RMB190.5 million, accounting for 15% of the total revenue in Shandong province in 2020. While Yantai city ranked first among all prefecture-level cities in terms of proven gold reserves in the PRC, our Company accounted for market share of approximately 31% of treatment volume of gold mine hazardous waste in Yantai city in 2020.

INDUSTRY OVERVIEW

Top 5 Gold Mine Hazardous Waste Treatment Companies by Revenue, China, 2020

Rank	Company	Revenue* (RMB Million)	Market Share (approximately)
1	Shandong Guoda (山東國大)	422.6	22%
2	Chenzhou Xiongfeng (郴州雄風)	333.0	18%
3	Our Company	190.5	10%
4	Jiangxi Yiyuan (江西一元)	169.1	9%
5	Zhaojin Jinhe (招金金合)	165.7	9%
	Others	624.4	32%
	Total	1,905.3	100%

* Revenue includes revenue of hazardous waste treatment service and sales of recycled products. Among the top five players in terms of revenue in China in 2020, Shandong Guoda and Chenzhou Xiongfeng, were able to generate higher revenue with a lower treatment volume of gold mine hazardous waste as compared to our Group, as set out in the table below. This is mainly attributable to the fact that Shandong Guoda and Chenzhou Xiongfeng generally treat gold mine hazardous waste containing more recyclable elements from their affiliated gold mine companies, and with their capabilities to extract various elements, more of such elements could be extracted from the hazardous waste, thereby thus generating higher revenue from the sales of recycled products.

Source: F&S

Top 5 Gold Mine Hazardous Waste Treatment Companies by Treatment Volume, China, 2020

Rank	Company	Treatment Volume (k tonne)	Market Share (approximately)
1	Our Company	1,083	18%
2	Shandong Guoda (山東國大)	850	14%
3	Zhaojin Jinhe (招金金合)	600	10%
4	Jiangxi Yiyuan (江西一元)	340	6%
5	Chenzhou Xiongfeng (郴州雄風)	204	3%
	Others	3,078	49%
	Total	6,165	100%

Our Company was ranked the largest hazardous waste treatment company by volume in China, with treatment volume of 1.08 million tonnes, accounting for approximately 18% of the total treatment volume in China in 2020.

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Top 5 Gold Mine Hazardous Waste Treatment Companies by Revenue, Shandong Province, 2020

Rank	Company	Revenue (RMB Million)	Market Share (approximately)
1	Shandong Guoda (山東國大)	422.6	33%
2	The Company	190.5	15%
3	Zhaojin Jinhe (招金金合)	165.7	13%
4	Qingdao Gold Lead-Zinc Development (青島黃金鉛鋅開發)	40.1	3%
5	Zhaoyuan Zhonghuan (招遠中環)	11.6	1%
	Others	458.3	36%
	Total	1,288.8	100%

Source: F&S

Top 5 Gold Mine Hazardous Waste Treatment Companies by Treatment Volume, Shandong Province, 2020

Rank	Company	Treatment Volume (k tonne)	Market Share (approximately)
1	Our Company	1,083	26%
2	Shandong Guoda (山東國大)	850	20%
3	Zhaojin Jinhe (招金金合)	600	14%
4	Zhaoyuan Zhonghuan (招遠中環)	100	2%
5	Qingdao Gold Lead-Zinc Development (青島黃金鉛鋅開發)	50	1%
	Others	1,513	36%
	Total	4,196	100%

Source: F&S

Shandong Guoda (山東國大) is a professional state-owned gold smelting company with hazardous waste treatment business based in Shandong province, which provides a wide range of products including gold, silver and sulphuric acid.

Chenzhou Xiongfeng (郴州雄風) is a subsidiary of the Chifeng Gold, which is a non-state-owned company. The company is committed to recycling, disposal and utilisation of industrial and hazardous solid waste and other renewable resources.

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Jiangxi Yiyuan (江西一元) is a non-state-owned company, which is focusing on the comprehensive recovery of nonferrous metals, rare metals and non-metal, as well as utilisation of industrial solid waste and hazardous waste.

Zhaojin Jinhe (招金金合) is a subsidiary of Shandong Zhaojin Group Co., Ltd. (山東招金集團有限公司), which is a state-owned leading gold producer in China. The company is dedicated in gold mine hazardous waste treatment and utilisation, and sulphuric acid production.

Qingdao Gold Lead-Zinc Development (青島黃金鉛鋅開發) is a subsidiary of Shandong Gold, which is a state-owned leading gold producer in China. The company is committed in recovery of nonferrous metals from industrial waste residue.

Zhaoyuan Zhonghuan (招遠中環) is a non-state-owned company based in Zhaoyuan, Shandong province, mainly engaged in hazardous waste treatment, metal concentrates sales and technology consulting.

Price Analysis of Pyrite Concentrate and Gold-bearing Pyrite Concentrate in China

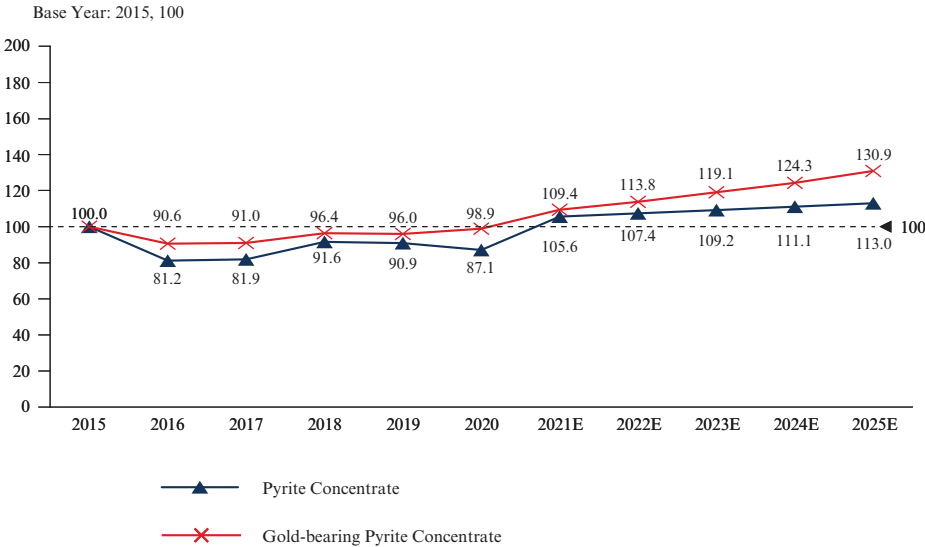
Pyrite concentrate, smelting residue, and sulphur are the three main raw materials for producing sulphuric acid in China. The price of sulphuric acid in China is influenced by various factors, mainly including the price of raw materials, demand from downstream industries and the import from overseas market.

Due to the slowdown in the demand for sulphuric acid in China since 2015, which was mainly caused by decreasing consumption of downstream industries, mainly including chemical fertiliser industry and overcapacity and oversupply in the industry, the price of sulphuric acid dropped from RMB367.7 per tonne in 2015 to RMB265.0 per tonne in 2019. As raw material to produce sulphuric acid, the price of pyrite concentrate has also fallen slightly. Moreover, it was negatively impacted by COVID-19 in 2020. During the period from 2015 to 2020, the price of pyrite concentrate fluctuated with the upward and downward changes of sulfuric acid market in the PRC with the highest reaching RMB510.0 per tonne and lowest reaching RMB105.0 per tonne. As the impact wears off, it is expected that the price of pyrite concentrate will increase by 21% in 2021 year over year and grow at a CAGR of 5.3% during the period from 2020 to 2025.

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Using pyrite concentrate for sulphuric acid production can generate high value by-products, such as iron and niacin, which could have a lot of synergy with steel, chemical and other downstream industries to achieve cleaner production and circular economy of mining resources, which is in line with China’s current policy situation and industry development. Based on the latest market situation in 2021, the price of sulphuric acid is increasing significantly driven by the increase in domestic demand from chemical fertiliser industry and export demand for sulphuric acid, and increase in price of raw material. Therefore, it is expected that the price of pyrite concentrate will restore to pre-COVID-19 price level with stable growth in the coming years, considering the continuous recovery of sulphuric acid industry and the increasing usage of pyrite concentrate for sulphuric acid production as mentioned above.

Price Index of Pyrite Concentrate and Gold-bearing Pyrite Concentrate, China, 2015–2025E



* The price index of pyrite concentrate and gold-bearing pyrite concentrate sets 2015 as a base year to show the trend of pyrite concentrated in the past five years, respectively.

Source: F&S

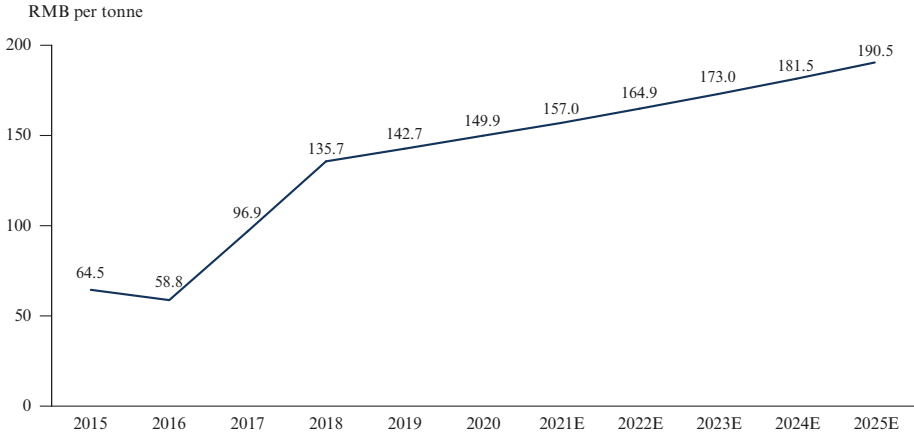
INDUSTRY OVERVIEW

Price Analysis of Construction Aggregates in China

Construction aggregates are inert granular materials, such as sand, gravel, or crushed stone, that are an essential ingredient in concrete. The demand for construction aggregates in China is enormous, which amounts to approximately 20 billion tonnes per year. The demand for construction aggregates in Shandong province is approximately 1.1 billion tonnes per year. The application of lightweight construction aggregates has become increasingly wide in downstream construction industries due to various physical properties and advantages of lightweight construction aggregates, such as low density and relatively high strength. For example, lightweight aggregate concrete is widely applied in the production of pre-cast concrete unit used in prefabricated buildings, which is an emerging market in the value chain of PRC’s construction industry in recent years. In the future, with continuous development of construction industry, the demand for construction aggregates is expected to grow at a CAGR of 6% from 2020 to 2025. The average price of construction aggregates in China increased from RMB64.5 per tonne in 2015 to RMB149.9 per tonne in 2020 with the decrease in supply caused by increasingly stricter environmental policies of construction aggregates production.

With the gradual recovery of production, the price of construction aggregates is expected to continue to increase at a CAGR of approximately 4.9% from 2020 to 2025.

Average Price of Construction Aggregates, China, 2015–2025E



Source: F&S

INDUSTRY OVERVIEW

Major Cost Analysis of Gold Mine Hazardous Waste Market

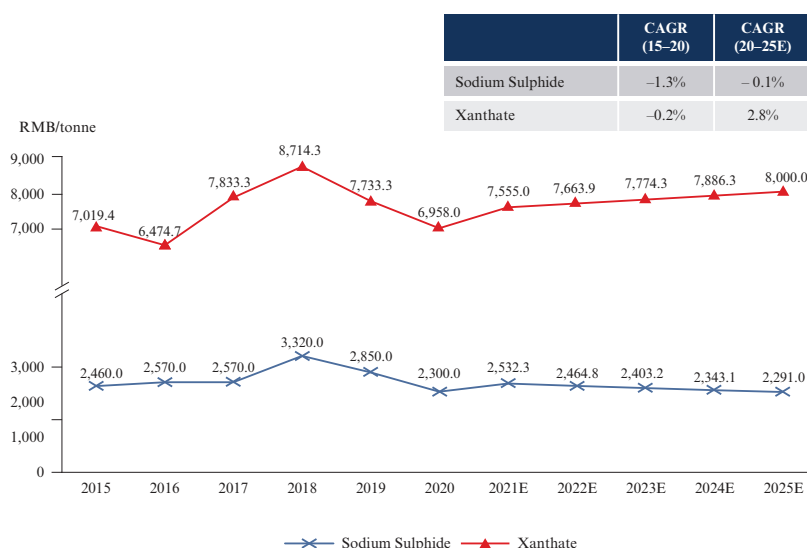
Chemical

Sodium sulphide and xanthate are the two major chemicals used in gold mine hazardous waste treatment business.

The average price of sodium sulphide in China experienced an increase from RMB2,460.0 per tonne in 2015 to RMB3,320.0 per tonne in 2018 and then a decrease to RMB2,300.0 per tonne in 2020. Considering that the downstream demand is expected to gradually recover in 2020, there will be a moderate increase in the price of sodium sulphide. In the long term, the price is expected to be at a stable and slightly declining level, reaching RMB2,291.0 per tonne in 2025.

Affected by the fluctuation of price of butanol, the main raw material of xanthate, the average price of xanthate in China experienced an increase from RMB7,019.4 per tonne in 2015 to RMB7,733.3 per tonne in 2019. However, impacted by the COVID-19 outbreak in 2020, downstream demand for xanthate decreased in early 2020, thus the average price of xanthate in China decreased to RMB6,958.0 per tonne in 2020. While the downstream demand is expected to recover as the influence of the COVID-19 outbreak wears off, which is expected to drive the price recovery in 2021. Moreover, the expected slight increase of gold production is expected to drive the demand of xanthate increase slightly, the average price of xanthate in China is expected to reach RMB8,000 per tonne in 2025.

Price of Sodium Sulphide and Xanthate, China, 2015–2025E



Source: General Administration of Customs, F&S

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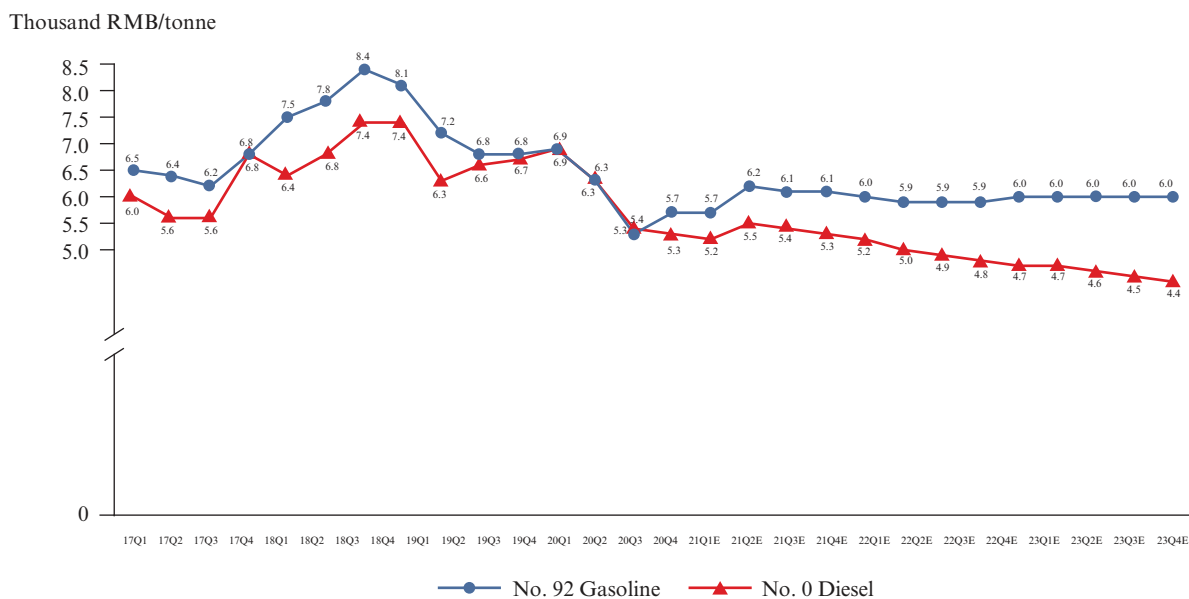
Transportation Cost

The transportation cost is mainly affected by the gasoline and diesel price in China, which is related to the crude oil price in China and affected by global crude oil price. The global crude oil price is further influenced by global oil supply and demand volume, price of alternative energy, international economy and international political relations.

In the past four years, the price of gasoline and diesel in China experienced a process of rise and fall. The price of No. 92 gasoline in China increased from RMB6.5 thousand per tonne in the first quarter of 2017 to RMB8.4 thousand per tonne in the third quarter of 2018, and then decreased to RMB5.7 thousand per tonne in the fourth quarter of 2020. The price of No. 0 diesel in China increased from RMB6.0 thousand per tonne in the first quarter of 2017 to RMB7.4 thousand per tonne in the third quarter of 2018, and then decreased to RMB5.2 thousand per tonne in the fourth quarter of 2020.

The price of gasoline increased in 2020 and is expected to remain at a level of RMB6.0 thousand per tonne in coming years in China. The price of diesel is expected to encounter a decreasing trend in the coming years.

Price of Gasoline and Diesel (Quarterly Average), China, 2017–2023E



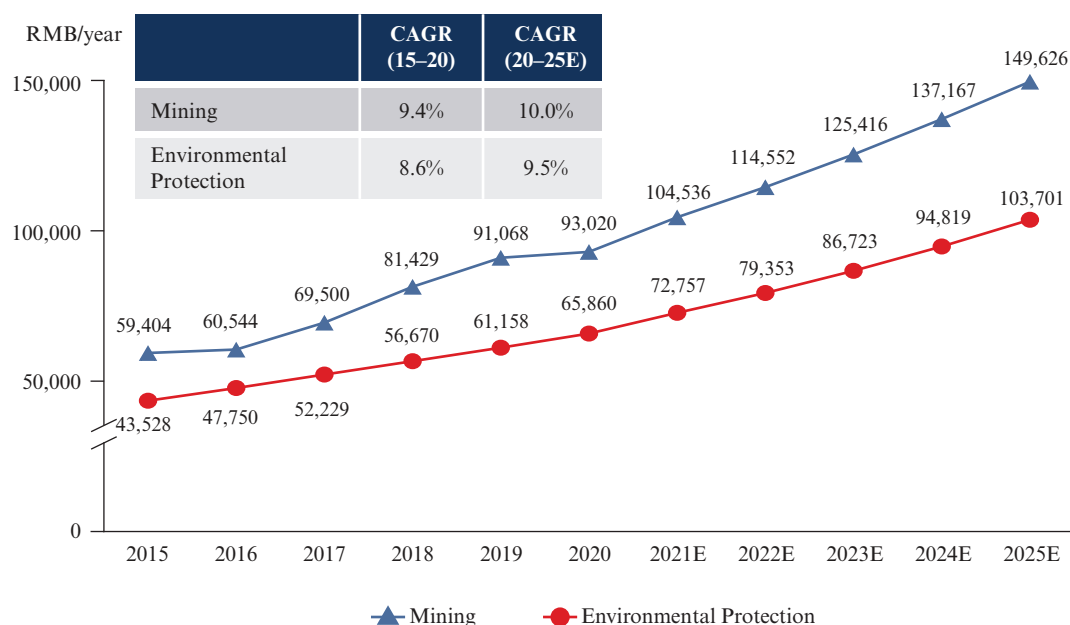
Source: Shanghai Petroleum and Natural Gas Trading Centre, F&S

INDUSTRY OVERVIEW

Wages

With the rapid growth of China’s economy and the mining industry, the average wage of workers in the mining industry has risen continuously in recent years, increasing from RMB59,404 per year in 2015 to RMB93,020 per year in 2020, and is expected to further grow to RMB149,626 per year in 2025, mainly due to the expected economic recovery from COVID-19. Similarly, due to the increasing public awareness of environmental issues, the growing government investment in environmental protection and the protection enhancement for employees and increasing employers’ liability due to implementation of the PRC Labour Contract Law (《中華人民共和國勞動合同法》), the average wage of employees in the environmental protection industry in China has risen from RMB43,528 per year in 2015 to RMB65,860 per year in 2020, and is expected to further increase to RMB103,701 per year in 2025.

Average Wages of Employees in Mining and Environmental Protection Industries, China, 2015–2025E



Source: National Bureau of Statistics, F&S