Status and Measures of Preventing and Controlling Environmental Risks in Tailing Impoundment

Li Xinkuan, Kang Jianxiong
Jinduicheng Molybdenum Industry Group Co., Ltd. Weinan, Shaanxi 714102
limin@hzh-vip.com.cn

Abstract: Nowadays, the situation of environmental pollution monitoring and emergency management of tailings impoundment is becoming more and more severe mainly due to the high incidence of environmental emergency in tailing impoundment. Based on which, this paper takes the environmental risk of tailing impoundment as the main research object, focusing on status and corresponding measures of its prevention and control. Hopefully, it will be helpful.

1. Introduction
The tailing impoundment, which is located at the mouth of the valley or the surrounding dams of the gentle terrain, is mainly used to store the tailings or industrial waste residues after ore separation by mining enterprises. The tailings storage system can strengthen the natural purification effect of tailings wastewater, avoid tailings loss, and adjust runoff appropriately. However, the tailing impoundment is a dangerous source of man-made debris flow. If an accident occurs, it will inevitably and directly affect the production and economic benefits of the enterprise, and even make problems of safety and environmental pollution. Therefore, it is very necessary to study and analyze the current situation and measures of environmental risk prevention and control of tailing impoundment.

2. Analysis of the status of environmental risk prevention and control of tailing impoundment
The importance of risk prevention and control should not be underestimated due to the serious environmental pollution of the tailing impoundment. At present, most of tailing impoundment in China have paid more attention to the prevention and control of environmental risks, but there are always has some shortages, especially the poor management, many hidden environmental risks, and serious environmental accidents. Moreover, failure to correctly recognize the importance of environmental emergency management and the poor prevention and management mechanism of emergency have adversely affected the prevention and control of environmental risks in the tailing impoundment. The discussion from multiple perspectives is as follow:

A. Poor management
Many tailing impoundments are located in remote area, have low design standards or poor construction quality at the first period. And some are even without formal design, with inadequate investment in safety and environmental protection. Taking a mining company as an example, the leak of acidic solution in production facilities caused economic losses of more than 30 million yuan. During the inspection, it was discovered that the construction was not following standard procedure and the technology was relatively dated, and the management needs to be improved, and the managers was poor of responsibility. If supervision and management are not in place, similar incidents may still...
occur in companies of tailing impoundment.

B. Many hidden environmental risks

In China, there are many tailing impoundments. According to the statistics of the Ministry of Emergency Management of the People’s Republic of China, there are about 6,261 tailing impoundments in China, and the largest storage capacity has exceeded 800 million cubic meters. Dangerous impoundment, sick impoundment and risky impoundment account for about 20%, and the hidden safety hazards are serious, which can easily cause secondary environmental incidents [1]. Among the total number of tailings impoundment, small ones account for more than 95% of the total, which have obvious environmental risks and do not have a strong ability to prevent environmental emergencies.

C. The severity of environmental emergencies is serious

Currently, the probability of emergent environmental incidents has increased significantly. Since 2006, especially, China’s environmental protection department have directly dispatched more than 40 incidents of tailing impoundment. It should be noted that the drinking water environmental safety of residents has been greatly threatened after an environmental emergency in the tailings impoundment. At present, there are almost 60 environmental emergencies related to drinking water safety, and the number of accidents caused by the production of tailing impoundment has reached 10, which accounts for a large proportion.

D. Incorrect recognition of the importance of environmental emergency management

In the environmental emergency management of tailing impoundment, environmental protection departments in some regions have some deviations in their perceptions, which are mainly reflected in the lack of management willingness or lack of management measures. Taking the “three must” responsibilities as a reference, the safety supervision department is the main body of the safety supervision of the tailing impoundment, but the environmental protection department still needs to assume corresponding responsibilities in the supervision process.

E. The prevention and emergency management mechanism are backward

In China, the environmental emergency management of tailing impoundment has not been developed for a long time, so there is always no sound environmental monitoring and emergency management mechanism. In this case, the prevention effect of the tailing impoundment against environmental risks will be affected to a certain extent, and the lack of an emergency management mechanism as a necessary guarantee is not conducive to the safety of the tailing impoundment or the emergency handling of environmental incidents.

3. Analysis of common forms of environmental pollution in tailing impoundment

Air pollution, water pollution, and tailings weathering pollution are the most common forms of environmental pollution in tailing impoundment. The following analysis is for reference.

A. Air pollution

In the process of building tailing impoundment, foundation excavation, tunnel excavation, dam foundation cleaning, and foundation cutting have to excavate large areas of land resources, so many spoils will be formed. If the particle size of the spoil is not large, it is easy to cause dust in windy weather and cause air pollution. In the case of long-term accumulation of tailings, the surface is weathered by water erosion and wind and sun, showing a dry state [2]. If the wind speed is moderate, it will cause the tailings to fly and form sand dust, which will pollute the surrounding atmospheric environment. After inhaling large amounts of dust, surrounding residents are prone to pneumoconiosis.

B. Water pollution

Tailing wastewater pollution to the environment includes both groundwater and surface water pollution. For the harmful and toxic substances in the tailing wastewater, they will react physically or chemically with other substances during the deposition of the tailings, thereby generating brand new pollutants. There are toxic and harmful elements in the tailings. Once they are discarded, they will inevitably pollute the surrounding environment. In severe cases, they will enter the food chain through plant and cause serious harm to human health.
C. Weathering pollution from tailings

There is a small amount of sulfide in the tailings. The oxygen content in the crevices of the tailings will increase after exposure or deposition, and the sulfide will react with oxygen or bacteria to form acidic water. In this case, the acidic water will dissolve out certain substances and increase the content, which will significantly accelerate the weathering of tailings and the internal chemical reaction, and even the migration of toxic and harmful metal elements and other pollutants will cause serious pollution to the water system.

4. Prevention and control for environmental risks of tailing impoundment

In-depth research and analysis on the prevention and control status of environmental risks in tailing impoundment and common forms of pollution. To comprehensively enhance the environmental safety of tailing impoundment, it is necessary to rationally formulate prevention and control based on reality. The purpose is to effectively reduce the environmental risk coefficient and promote the smooth development of tailings storage.

A. To enhance pollution prevention and control capabilities

As a tailing management department, it should comprehensively consider the actual needs of mine production, continuously innovating technology, and using plot production techniques to fundamentally control tailing wastewater discharge. In addition, the materials used in tailing facilities should be thoroughly studied to improve the performance of facilities and equipment and provide necessary guarantees for the normal operation of tailing impoundment. In practice, technical surveys should be carried out in the early stages of design to make it more scientific and safer. During the construction of the tailings impoundment, a safety assessment agency that is in the same grade as the tailings impoundment and has certain qualifications should be invited to carry out safety and environmental assessment. At the same time, the construction company, design company and supervision company are jointly responsible for the design, supervision and construction, practicing the requirements of the "three simultaneous cooperation" regulations, implementing design review and approval, to achieve final acceptance, and to continuously improving the quality of project construction to avoid many potential safety hazards during construction [3].

B. Strengthening safety supervision and monitoring capabilities

In the process of carrying out daily supervision and management of the tailing impoundment, it should always follow relevant regulations and requirements, actively implement management work, and ensure that there are laws to follow. In addition, as various technological forms such as drones, field surveys, satellite remote sensing and ground sensing networks are developing, the tailings impoundment should also use remote sensing identification technology to determine the actual storage volume and slag composition to make an in-depth understanding of pollutant changes. And corresponding measures should be taken immediately if abnormal situations occur. It is for the purpose of achieving the purpose of safety risk assessment and early warning of the tailing impoundment. That said, the safety of the tailing impoundment can be guaranteed. In addition, it should also refer to existing research results to give assistance to the ecological restoration and treatment of tailing impoundment, and formulate relevant plans scientifically and reasonably.

C. Development of ecological restoration plan

Based on the results of investigation, evaluation and dynamic monitoring, and the corresponding tailings reselection method, storage method and ecological restoration are selected scientifically and reasonably according to the specific location, actual scale, storage category and environmental safety risk of the tailings impoundment and so on. Combined with the various ecological damages in the mining area, such as land degradation, excavation, geological disasters, and occupation on the basis of monitoring the ecological status of the mining area, the ecological restoration plan within the mining area must be formulated specifically to include soil and water management, greening treatment and harmless treatment and others [4].

With modern beneficiation technology, the tailings are sorted again, and then metal and non-metal elements are recycled or harmlessly treated. Under normal circumstances, the tailings should be
transported to the underground area of the mine based on the nature of the tailings as filling material. Through this method, the pollution of the ecological environment caused by the surface discharge of tailings can be effectively avoided, thereby creating considerable economic benefits. In addition, tailings can also be used as building materials, such as ceramics, cement, glass-ceramics and non-fired bricks, which can all be made with tailings. Therefore, it is necessary to make full use of tailings resources to avoid pollution of the ecology by tailing emission and to optimize the economic benefits of mining enterprises to a certain extent.

D. Construction of environmental emergency system

In the daily prevention and early warning of tailing impoundment, it is necessary to actively carry out assessment of environmental impact and environmental risk, and systematically investigate its hidden environmental hazards. For environmental emergency preparation, emergency plans should be prepared in a short time, and necessary emergency materials should be purchased. People should speed up the construction of engineering facilities, and pay attention to the importance of emergency drills. For environmental emergency response and handling, emergency response and contingency plans should be activated in time when the environmental emergency occurs, and responses should be dealt with in a variety of ways, including blocking pollution source and constructing dam. For later processing, it is necessary to systematically analyze and evaluate the entire emergency response process of environmental emergencies, investigate the causes of environmental pollution accidents, clarify the main sources of risks, and improve the emergency plan to strengthen the following management of the tailing impoundment.

E. Emphasizing the importance of design and construction quality

The design company of the tailing impoundment project should have the qualifications of metal and non-metal mining engineering design, while the construction company should have the corresponding construction qualifications to better control the design and construction quality.

5. Conclusion:

In summary, among the wastes of metal and non-metal mines, tailings resources have the largest quantity and the highest value. Especially when the supply of mineral resources is relatively short, the development and utilization of tailings has gradually become the main path for the sustainable development of modern mining in China. For this reason, it is necessary to attach great importance to the environmental risks of tailing impoundment, and formulate preventive measures scientifically and reasonably based on the current situation of prevention to increase the utilization rate of tailings, reduce the risk of tailing impoundment, and improve the safety of tailing impoundment storage.

Reference:
[1] Yang Zhangyu, Tian Shufang, Wei Meng, et al. Research on environmental risk assessment of tailing impoundment based on fuzzy analytic hierarchy process [J]. Surveying and Spatial Geographic Information, 2019, 42(9): 16-21.
[2] Liu Nannan, Lin Xingjie, Miao Yu, et al. Water environmental risk assessment of tailings reservoirs in typical polymetallic associated mining areas[J]. Non-ferrous metals (mining part), 2019, 71(4): 100-105.
[3] Liu Jia, Wang Yabian, Xue Liyang, et al. Research on the standardization model of environmental risk prevention and control in tailing impoundment[J]. Guangdong Chemical Industry, 2019, 46(17): 119-121.
[4] Zhang Hao, Wang Hui, Tang Hongyan, et al. Heavy metal pollution characteristics and health risk assessment of soil and vegetables in lead-zinc tailings pond[J]. Acta Scientiae Circumstantiae, 2020, 40(3):1085-1094.