The Study of Rock Burst Induced by Underground Mining Excavation

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Keywords: Rock burst, Early warning technology, Underground mining.

Abstract. The underground mining extends to deep, resulting in that underground mining geological environment and mining conditions become increasingly complex, thus induced by various forms of disaster. Among them, rock burst disaster is a serious consequence, and the number has an increasing trend. It has become one of the most important hidden dangers in the excavation of underground engineering. This paper mainly introduces the research status, existing problems and development trend of the monitoring and early warning technology of the rock burst.

Introduction

The utilization of mineral resources plays an important role in our country's economic development, scientific and technological progress and social harmony. Large scale mining enterprises in our country after decades of development, and now almost have been transferred to the underground mining stage, including some of the depth of the mining has more than 1000 meters. Along with the continuously extending to the deep mining, mining conditions become increasingly complex, leading to the number of rock burst induced by excavation of underground engineering disasters continue to increase, the scale is expanding. The harm is not only reflected in the roof displacement of the roadway, but also lead to the production of other safety accidents in the mine, which caused great threat to the personal safety and economic development. Therefore, it is very important to effectively and accurately monitor and early warning of the impact ground pressure during the excavation of underground works. Domestic and foreign scholars have made some achievements in this area, but there is still no substantial breakthrough, monitoring and early warning technology, the practicality and accuracy of the need to be developed.

Research Status of Early Warning Technology for Rock Burst

Overview of Rock Burst Disaster

The deeper the excavation depth of underground works, the more times the mine rock burst disaster occurred. According to the relevant records, the British history blessings worldwide first coal rock burst disaster occurred in 1738, has been in the past nearly 300 years. Almost 300 years of rock burst disaster has been distributed in various parts of the world, including China, including dozens of countries and regions have a record of rock burst disaster. Among them, 67 mines in Poland, 53.7% mines have a strong tendency to impact, since 1949, had 3000 times of rock burst disaster within 30 years, the Federal Republic of Germany in 1949 after nearly 30 years, there were 1000 times of rock burst disaster, rock burst frequent occurrence and serious consequences have attracted great attention all over the world.

According to the relevant records, the first case of rock burst disaster occurred in 1993 in Shengli coal mine of Fushun. With the deepening of the mining depth and the rapid expansion of the mining area, in Beijing, Liaoyuan, Tonghua and other mining areas have occurred in the rock burst disaster. Before 1990s, there are nearly more than and 50 mines had burst, the number of accumulated more than 4900 times, the biggest shock magnitude nearly 3.8 or so, the casualties caused by nearly 100 cases, up to more than and 30 kilometers of roadway damage, economic loss is extremely huge. Only in an accident rock burst in Qianqiu Coal Mine in 2011, caused ten people’s death and as many as sixty-four people were injured, causing economic losses of up to about 2.7 million yuan. Whether it is mine or metal mine, rock burst accidents were recorded in the mine of
different lithology, different types and different depth, the rock burst induced by excavation of underground engineering of metal mine shallow depth is only about 140m. At the beginning of 1970s, some of the metal mines, railway engineering, tunnel engineering et al, also appeared the phenomenon of rock burst, the harm cannot be ignored, for the research of anti-impact monitoring and early warning technology is particularly important.

Research Status

Research on monitoring and early warning technology of rock burst, many countries have some degree of progress, various countries have established monitoring system of mine observation station, mine earthquake monitoring station for real-time observation of rock burst, certain achievements have been made in research on early warning technology. Jiang Yaodong, Lv Jinguo et al. according to the monitoring principle of rock burst, the early warning method is divided into rock mechanics and geophysical methods. Sun Shiguo, Sun Xuehui et al. according to the magnitude of the impact of rock burst monitoring and the early warning methods are divided into local detection and system monitoring method. Wang Enyuan, Wang Wei and others divide early warning technology into theoretical analysis and field measurement analysis. Lv Jinguo, had

(1) Rock mechanics and geophysical methods

Rock mechanics, as this method is according to the relationship between the mechanical properties of rock mass changes in actual projects, with some monitoring instruments as the carrier, direct test of coal and rock, mining, required engineering geological information. On the basis of engineering geological information, research and analysis the related decision indicators for monitoring and early warning of rock burst.

The geophysical method is based on the occurrence of rock mass, the displacement, stress and other physical information that are expressed by the external action, through the comparison between the physical information and the rock burst, the corresponding indicators are established to predict the rock burst in mine, two types of methods are summarized as shown in Figure 1.

![Figure 1. Methods of rock burst monitoring and early warning.](image)

(2) Local detection method and system monitoring method

From the perspective of system theory, the occurrence of rock burst with the whole mine system impact tendency, but cannot be ignored in the local area of effect, it can be divided into the local monitoring system and monitoring method.
Local detection method is mainly based on drilling cuttings, the method is simple, easy, intuitive and reliable, the application range is more extensive, but the drilling chip method in monitoring and forecasting time and space is not continuous, it is more time-consuming.

System monitoring method can realize the forecasting and early warning of mine, the main method is microseismic monitoring system, ground sound system detection and some other geophysical detection method (geothermal, geoelectric and geomagnetic), according to the selected method, through monitoring of the continuously physical information, some advanced physical phenomenon appeared before the impact of the rock burst occurrence could be analyzed and predicted.

Existing Problems and Development Trend

Existing Problems

There are still many problems about the monitoring and early warning of rock burst at home and abroad, research and analysis can be summed up as follows:

1. In the single monitoring and early warning process, the main way is to choose the single factor index of monitoring. The complexity of the occurrence of rock burst is a worldwide problem, the application of a single factor to monitor and early warning, forecasting accuracy is not very accurate

2. As discussed in the previous section, the monitoring methods have their advantages and disadvantages, monitoring and early warning method in China are too inflexible, can't according to different mines, or the same mines with different geological conditions in demand for monitoring and early warning method of choice.

3. For example, in the process of mining which the mining technology is more advanced, mining due to the presence of noise, not necessarily still seek application method is more advanced "seismic method"

4. The real-time situation of underground changed constantly, many methods can't realize the true meaning of the "real time", dynamic prediction.

Development Trend

The development trend of monitoring and early-warning technology can analyze and classify as follows:

1. The real-time dynamic feedback of monitoring information is applied in the process of data analysis and protection measures.

2. For different geological conditions of mine, or the same mine in different regions of the potential impact of rock burst location, occurrence degree, source and so on to determine accurately, so as to carry out the choice of monitoring and early warning methods.

3. Multi factor combined early warning; multi-level and multi factor combined monitoring and early warning model, and overall control of the impact of ground pressure hazard.

4. Deepen the mechanism research: because the occurrence mechanism of the rock burst has not been accurate research, accurate study of the occurrence mechanism of rock burst is the key point to guide the monitoring and early warning technology.

5. Informatization and intellectualization research : the impact of rock burst on the scene of a strong harm, not only to the economic property, more important is the safety of life. Intellectualized development of monitoring and early warning, can be a good solution to the problem.

Acknowledgement

This research was financially supported by the National Natural Science Foundation of China (41172250) /National "12th Five-Year” Plan for Science & Technology Support (2012BAK09B06) /The promotion plan project of Beijing innovative team (IDHT20140501)
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