Application of Intelligent Means and Advanced Production Technology in Coal Mine Production

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Abstract. This paper mainly analyses the leading production and management technologies of the international coal enterprises aiming to provide technical support for Chinese coal enterprises to enhance their core competitiveness. The results of the study show that modern monitoring system, simulated operation training and intelligent technologies are the key technologies to improve the coal production.

Key words: Coal Mine Production; Technology Means; Coal Mining.

1. Introduction
Strengthening the core competitiveness of enterprises and building world-class enterprises is an effective means of building a modern socialist country. President Xi Jinping mentioned in the 19th Congress Report, that We will deepen the reform of state-owned enterprises, develop a mixed-ownership economy, and foster world-class enterprises with global competitiveness. China is rich of coal, lack of petroleum and natural gas, coal will be very critical energy for China in a long time. Therefore, to improve the comprehensive competitiveness is very important for China to improve the comprehensive national power and international prestige. According to the current situation, the geographical distribution of world's advanced coal enterprises is as follows.
2. The Current Status of World Advanced Coal Enterprises

2.1. Peabody Energy Group
Peabody Energy Group is the world’s largest private coal enterprise, it provides 10% of American and 2% of global coal for electric generation industry. It has subsidiaries and coal mines in major coal producing regions of America and Australia. It has 9 billion tons of proven coal reserves, it is on the list of American 50 biggest companies from Business Week, it has a leadership position in the coal producing industry, it was awarded as “the world’s leading coal company” on the Internal Coal Conference.

2.2. BHP Billiton
The Australian company BHP Billiton is a world leader in petroleum and mining industry, it ranked 296 on the Fortune global 500 list in 2018. It has more than 6200 employees and subcontractors, its client is all over 21 countries and 130 regions, its main business cluster is Australia and America, Singapore and Houston are its major sales and marketing areas. According to its 2018 annual financial statement, its annual net profit was 3.71 billion US dollars.

2.3. CONSOL Energy
CONSOL Energy is the leading diversified energy producer in the United States, its main products are natural gas and coal, it accounts for two-thirds of America's total consumption of natural gas and coal. CONSOL Energy began developing the Coalbed Methane during 1980, this reduced the coal mine gas explosion accident rate, at the same time, coal mine production efficiency was improved through the utilization of natural gas.

3. Leading Practice of World Advanced Coal Enterprise
By researching the leading practice of the above three coal enterprises, combining with the current coal enterprise development trend, it is easy to find out that the advanced coal enterprise production technology and management have following characteristics.
3.1. Modern Monitoring System to Ensure Production Safety
By analyzing the characteristics of coal mine accidents, Peabody Energy Group adopted advanced intelligent monitoring system to monitor each coal mine production index in real time, when the index is abnormal, rectify action will be implemented immediately to ensure the normal production and safety and health of the operators. Learning from the advanced experience of Peabody Energy Group, basing on automation and visualized detection, realizing the intelligent operation and detection step by step, it will monitor each coal mine production indicator and help operators take actions to deal with abnormal situation.

By making further innovation and development, Peabody Energy Group realized intelligent monitoring system, it is able to detect and eliminate accidents in time, it helps automatically monitor each indicator of coal mine production, it is able to take rectify actions at the same time, to ensure safety production and a safety and healthy environment of coal mine.

3.2. Advanced Technology and Management to Ensure High Efficiency Production

3.2.1. Coal Mine Moving Work Front Operation. Peabody Energy Group coal mines have been fully equipped with trackless transport equipment powered by diesel engines. The transportation equipment has the advantages of fast speed, large traction, good slope adaptability, safety and reliability, and can be operated automatically in the process of installation and withdrawal. Because of short move work front time, high efficiency, and Peabody Energy Group adapts single work front coal mining, mobilization would be stopped after one work front is finished, moving work front in three shifts operation, there is no standby work front and standby equipment, it reduces the coal production cost, guarantees the balanced production, improves production intensive degree, also ensures the consecutiveness of coal production.

3.2.2. Information Technology Tunneling Equipment. Taking Peabody Energy Group as an example, it make innovations in tunneling equipment, the tunneling operation is totally automatically operated, there is no need for operators to monitor the operation of the tunneling equipment. The operation data of the tunneling equipment will be gathered to ERP system and other operation systems, it achieved integration of information system and automation system. The Twenty Miles Coal Mine is tunneled in horizontal level, each tunnel is equipped with one Joy12CM12 type continuous coal miner, two Fletcher roof bolt mounting machine, one Joy shuttle car and one Stamler caterpillar feeder crusher. The producing data and status of the tunneling equipment will be automatically gathered into ERP system and other operation systems, which realizes the integration of information system and automation system.

3.2.3. Simulated Operation Training. Peabody Energy Group provides state-of-the-art training programs for thousands of employees. It built employee technology training centers in the mid-west and west of America, which allows the operators to learn how to operate equipment under various working environments during the simulation operation training, in this way the operator does not need to practice operation under the coal mine. Using this training method, new coal mine workers and maintenance workers are able to get training at any time, which improves the training efficiency, it also creates a much safer training environment for the workers, helps them to better understand how the equipment operation and maintenance in the coal mine works.

3.3. Fully Realization of Intelligent Management
The Intelligent Operation Center of the world's advanced mining enterprises is a modern analyzing and control center, by gathering information to help operators or managers make decision, it can monitor different separate coal mines. Meantime, the Intelligent Operation Center combines with other systems, including Distributed Control System, SCADA+PLC system, Historical Data management System, Manufacture Execution System, Advanced Process Control System, Lab Information Control System,
the system analyzes the data gathered from coal mine operation and helps make operating and maintenance decision. The Intelligent Operation Center gathers operators from production plan, equipment maintenance, production implementation together, provides advance observation and prediction means and tools, enables manager early detection and resolution of problems, and improves the trouble-shooting speed. By using this system, the scarce most experienced talents can work together in the central control room and make the most of their experience and skills. The system helps different coal mines bench mark with each other, learn from each other and develop the best practice. The intelligent operation center of the world's advanced coal mine enterprises integrates their independent systems, realizes the information sharing among various systems, ensures the effectiveness and timeliness of information, and improves the accuracy of decision-making.

Fig. 2 The Intelligent Operation Center of Advanced Mining Enterprise.

3.4. Fully Utilization of Coal Mine Resources
The world advanced coal mine enterprises pay more attention to fully utilization of coal mine resources. Taking Peabody Energy Group as an example, they actively carried out restoration work after mining, including land reclamation, afforestation, etc., they established superior wildlife habitat in the gentle mountain and valley area of Montana with 2,200 acres, and transformed it into a tourist scenic spot. Peabody Energy Group takes the lead in the implementation of natural drainage technology, it has developed many important drainage basins in the region, and transformed the remaining high wall of the mining area into the imitation natural sand and rock wall, forming a habitat of great significance and an eye-catching scenic spot. After mining, the mining area is not directly abandoned but further processed and utilized in a planned way to maximize the value of the mining area.

4. Conclusion
By collecting and summarizing the leading practices of international advanced coal enterprises, this essay is expected to provide references for China to build world-class coal enterprises. The modern monitoring system, new employee training system, Intelligent Operation System from world advanced coal enterprises are introduced in this essay for reference. The way how advanced coal enterprise fully utilize the coal mine resource was analyzed for Chinese coal mines to learn, and helps Chinese coal mines build world class advanced energy group.

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