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Research on Establishing the Indexes System of Controlling the Coal and Gas Outburst Accident

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Abstract

Coal and gas outburst accident aggravates with the increasing depth of coal mining, which amplifies geostress on coal seam, gas pressure and gas capacity. Studying on coal and gas outburst accident, this paper sets up the indexes system of controlling on the coal and gas outburst accident with consideration on technology factor, including basic technological work, reliability of relative system, prevention technology and concept, technological innovation, technic equipments, and management factor, including investment, management, institution configuration on governing gas, as two main elements.

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Keywords: Coal and gas outburst accident; Technology factors; Management factors; Indexes system.

1. Introduction

Coal, accounting for 70% of primary energy source, is the main energy source in China. The national *Long Term Development Plan Outline of Energy Sources(2004–2020)* has identified the energy sources strategy with insistence on coal centered, electric oriented and integrated development of oil gas and new energy sources. *National Energy Sources Development Strategy(2030–2050)* promulgated by the Chinese Academy of Engineering indicates that every year the requirement for coal reaches 3.8 billions tons. This means that coal still has a proportion by 50% in energy sources structures^[2]. Obviously, coal, serves as the main energy source, is irreplaceable in such a long time in China. Statistical data shows that Chinese output of coal expanded from 1.106 billions tons to 3.25 billions tons between 2001 and 2010. Nevertheless, Chinese coal industry ensures the rapid economic growth, meanwhile it exacerbates mining condition, represented by the increasing depth of coal mining, the amplified gas stress on coal seam and gas capacity, more complicated geological tectonic condition. Gas disaster, especially coal and gas outburst accident is becoming more serious^[1].

By the expanding requirement of coal sources, many mines start deep mining, particularly in Eastern China, where exploitation elevation of deep well in Huaibei Mining Group Taoyuan is -1200 meters, and that in Huainan Mining Group Wangfenggang is -960 meters. The growth of mining depth will cause high geostress on coal seam, big gas capacity, complicated geological structure, soft coal with bad gas permeability, hard pre-draining. These matters can transfer a low or high gas un-outburst mine to a outburst mine. The data in late 2007 indicates, the number of coal and gas outburst mines is 647, including 180 vital coal mines, 64 state-owned endemic ones, 403 town-owned ones. From these information, we can acquire that prevention of coal and gas outburst has been a worldwide challenge. Compared with current foreign coal and gas outburst mine taking closure measure, our coal and gas

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outburst mines quantity is numerous and exploitation of outburst coal seam is important guarantee of national energy source safety and social stability, so this kind exploitation is necessary.

Research on recent great accidents of coal and gas outburst reveals that establishment of a reasonable indexes system of controlling on the coal and gas outburst accident is especially significant with consideration on plentiful factors generating coal and gas outburst accident. This system is meaningful and has a big research area, it also puts forward a new research pattern for prevention of this kind of accident.

2. Effect Factor Analysis of Coal and Gas Outburst Accident

It reveals that, majority of outburst accidents caused by obscure basic factor (as occurrence regularities of coal seams, geological structure) of coal and gas outburst accident and technology and management matters, though the analysis on several outburst accidents. For example, on January 5th 2006, a serious outburst accident happened in the course of continuous construction after revealing C13 coal seam on the working face of main mine shaft in Huainan Mining Group Wangfenggang. Investigation shows a serious hazardous gas outburst with the fact that, original gas pressure is 1.9 MPa (gauge pressure is 1.8 MPa), initial velocity of diffusion of gas is 10, coal's firmness coefficient f value is 0.29, burial depth of coal seam is large, gas pressure is high and coal quality is soft. Furthermore, unreliable effect inspection data, caused by insufficient gas discharging pressure emission of lifted coal seam and short period of gas emission, represent this outburst accident exists problems both on technology and management aspects.

Thus, to set up this controlling indexes system, we can analyze with technology and management factors on the consideration of technology and management factors as two main elements of this system.

2.1. Technology Factor of Coal and Gas Outburst Accident

2.1.1. Basic Technological Work

1) Gas Occurrence Regularities of Coal Seams. Collection and ordering Works of fundamental gas materials must be strengthened as accurately calculate gas pressure on coal seams and gas capacity to obtain gas occurrence regularities of coal seams. Measurement of gas pressure, gas capacity on coal seams and other basic parameters (like initial velocity of diffusion of gas, coal's firmness coefficient) related to outburst risk is required, when the exploitation of non-outburst coal seam on coal and gas outburst mines and exploitation of large gas mines reach or exceed the depth of 50 meters.

2) Outburst risk identification. Threat of mining activities of each seams are subject to outburst risk identification.

3) Gas geological basic work. Drawing 3 level gas geology map of coal mining area, mine well, mining face level. The group company is responsible for mine gas geology map, production group is responsible for mine well gas geology map and mining face gas geology map. The mine gas geology map should be indicated in progress, under protection mining area, coal occurrence conditions, geological structure, outburst point position, outburst strength, and gas basic parameters ect., as a prove of an outburst dangerous area prediction and making prevention for outburst measures.

4) Outburst risk forecast. Coal and gas outburst need to do risk prediction, classifying outburst hazardous zone and non-outburst danger zone. This evaluation should be entrusted with qualified units on coal and gas outburst hazard identification, and the result must be approved by recognized technology leader of the coal enterprise. Warn on changing non-outburst coal seam to outburst coal in advance. Uncovering non-outburst coal and driving coal seam roadway, you must determine the initial velocity of gas diffusion, consistent coefficient of coal, gas pressure on coal seam, the damage type of coal.

2.1.2. Reliability of the related System

1) Reliability of ventilation system. Mine must establish a complete, separate ventilation system, and continuously optimized to adapt to the change on mine well extension and alternative driving, to keep the system stable, simple and reliable. Mine production levels and mining area must be ventilated by partition of level and area, in and out air must go through the entire mining district. Mining and roadway layout should be reasonable, with a unique exit which impedes returned air from outburst

driving face to go to other driving faces. Other roadway's construction should be implemented by a complete ventilation system consisting of level, mining area, stripe. Down mountain mining is prohibited. On the coal face, contact lane can not be build freely between the upper and lower trough; Ventilation in series is not allowed.

Power supply for part ventilation must implement "three speciality and two lock closure", Positive and negative poles of whirlwind machine should be locked. Power supply to the ventilator, which is used for revealing outburst coal seams from outburst risk areas and cross-hole, should be generated from two transformers. The work, adopting 2 sets of fans blowing simultaneously, must use "three speciality and two lock closure". Mining face must be equipped with the "double fan, double power supply", and can work for automatic switching.

2) Drainage system reliability. Mine gas drainage capacity must meet the needs, outburst mines must establish upper-ground permanent mine gas drainage system. Portable pump, only as ancillary extraction facility, and mobile drainage station must be equipped with alternate drainage pump with the same extraction ability. Drainage piping system should match with the extraction pumps, and pump stations, pipelines, metering devices must meet be installed as required; drainage pumping station should have double-loop power supply.

The mine gas extraction capacity must coordinate with mining layout. Before producing, new work face, new mining area must be provided with any function and conditions of gas disposition, and must be permitted for outburst inspection by the coal mine safety supervision department of local people's government.

In order to get parameters as gas capacity, gas pressure, coal permeability, appropriate drainage system, drainage method and drainage craft is adopted under the gas discharge situation on mining face. For the real requirements of pre-drainage, pressure relief and mining on empty area, Higher and Lower concentration drainage systems should be installed on conditional mine wells.

3) The reliability of the monitoring system. Mine well must establish the safety monitoring system with complete equipments, available operation. Gas shutting down equipment should be settled on the new established high gas, coal and gas outburst well before uncovering. The safety monitoring system must be installed before coal lane construction. Gas extraction, and monitoring on main fan operation state, etc must connect with mine monitoring system in monitor network on operation. Gas sensor must be adjusted on schedule, the monitoring center must timely reflect the true state of gas. Monitoring system interruption and closure are reliable. Center power stations can correctly display interruption alarm, time and place of the feed-back power, which can discover abnormalities in time. The gas accident emergency response procedure should be established, with a rescue teams and underground emergency shelters.

4) Gas treatment planning and engineering. For new building, transformation and integration of resources of the high gas mines, preliminary design of the outburst mines should include gas extraction after collecting samples, and be maintained into the safety special articles. New mining face and new mining area of production, should be edited as a special chapter.

Making long-term plan and the annual plan of gas extraction, we should put the gas extraction plan and production plan, the annual gas extraction plan and annual production plan in the same important position.

Coal seam gas drainage works should be synchronized with the mining engineering design, advanced construction, advanced drainage, advanced drainage time should accord with the coal seam gas drainage requirements.

Optimize production layout, reasonably organize producing, insist on formal mining and regionally governing. Making plan and organizing production according to the coal production license. Strengthening production preparation, keep mining face, mining area replace normally. High gas coal and gas outburst mines must take regional gas control measures, getting the target, developing coal quantity, synchronizing coal quantity with gas disposition and to realize "extraction, dig, mining" balance.

2.1.3. Precaution Technology

1) Regional outburst prevention measures before mining. Regional outburst precaution technique includes mining on protection layer and pre-extraction technology of gas on the coal seam. Prior to mining technology on protective layer, the mining technological scheme should be made for pre-discharge pressure gas extraction of protective layer.

Gas pre-extraction scheme on coal seam should be prepared for outburst coal mines, which do not have protective layer exploitation conditions, in use of pre-pumping coal seam gas with regional outburst controlling measures, and requiring drilling layout uniform. Master seam permeability and drainage radius, using some methods for increasing permeability as hydraulic fracturing, hydraulic punching, pre-Blasting on deep hole.

No outburst risk zone is defined on such parameters: remaining gas pressure is less than 0.74MPa, or remaining gas capacity is less than $8\text{m}^3/\text{t}$, which are acquired from validity check of remaining gas pressure and remaining gas capacity.

2) Gas treatment for roadway tunnelling. Coal seam gas treatment technological scheme of coal roadway Should be prepared for taking regional prevention of outburst on the strip, and coal seam roadway must be tunneled at eliminated in dangerous areas.

3) Gas control on mining. Gas treatment technological solutions should be taken into effective gas drainage, drainage rate need to meet the requirement in accordance with the outburst risk prediction test and validity check of the mining face as required.

4) Outburst prevention measures for uncovering coal. Mastering gas pressure on uncovering coal area of cross-hole (including vertical and inclined well, etc.) and the gas capacity index, making technological scheme for uncovering coal cross-hole (including vertical and inclined well, etc.). Uncovering coal can be performed after eliminating outburst risk according to the rules of validity check on uncovering coal area of cross-hole (including vertical and inclined well, etc.).

5) Outburst prevention measures to close roadway. Shall prepare a special anti-outburst design, continuous coal layer position detection, accurate knowledge of coal layer position, anti-outburst engineering should meet the requirement.

2.1.4. Idea and technical innovation

1) Gas treatment concept Innovation. Establish the concept "only the drilling is not in place, no gas can not be extracted", enhance the beliefs "gas accident is preventable and avoidable", implementation of the "protect as possible, drain as possible" and "more stone heads, more drilling", establish the concept " ventilation is the foundation of the system, drainage is vital, outburst is key, monitoring and management is guarantee", change gas" drainage " to " extraction ", and so on.

2) Gas treatment technology innovation. Establish a innovative technological system for mine gas treatment, based on ore chief engineer. Organize a innovative team for prevention of gas disasters. Establish a collaboration mechanism of research which can make a guarantee for research and development personnel and investment.

3) Change traditional gas treatment idea. From mining stope layout and procedures to adjust, drainage pressure discharging layer, to form up and down the rock movement, coal unloading, coal permeability increasing, gas discharging extraction under the three dimensional gas extraction, coal and gas mining engineering system was established, with implement by " gas pressure relief on the first layer, gas pressure discharging upward, gas pressure on multi-layer discharging downward, gas relief from hole on the ground" theory and technology.

4) Innovative roadway exposing coal technology. Standardize coal exposing design, make time table for every parts of coal exposing and organize construction strictly under planning. To overcome fast manometry, hydraulic punching, fast drilling, deep hole blasting loose technology, to improve the coal seam permeability and drainage effect, reduce outburst elimination time producing from coal exposing, the management at different levels should be implemented.

2.1.5. Technical equipment

1) Ventilation equipment. Mine must implement complete mechanical ventilation of negative pressure, the main mine fan must have the same capacity to achieve double-loop power supply, and have anti-air capability.

2) Drainage equipment. With optimization of gas drainage equipment, extraction system need to achieve maximum capacity, to form "high flow, multi-pump, large diameter, multi-loop" structure of high strength extraction capacity.

3) Monitoring equipment. In accordance with the requirement of "Principle of Management of the Usage of Coal Mine Safety Detection Equipment and Monitoring System" (AQ1029-2007), complete equipped, functioning properly, locking reliably, timely disposal, high and low concentrations of methane sensors should be installed.

4) Gas basic parameters of measurement equipment. Aiming at gas outburst accident indicators, coal seam gas pressure, gas capacity, coal seam gas adsorption parameters, industry analysis, consistent coefficient and initial velocity of diffusion of gas should be measured.

2.2 .Management factors of coal and gas outburst accident

2.2.1.Input of gas treatment

1) Input criteria. Requirements are as follows:

(1) According to the severity of the mine disaster, capacity of gas emission, gas capacity as well as severity of the outburst risk, input on development of standard gas treatment and input on gas treatment of sample mine should be in the same advanced level.

(2) Coal Mine Gas treatment should insist on the implementation of "one mine, one policy, one side, one policy" system, according to forecasts of gas, the annual high gas drainage on all mining faces, must make orientational comprehensive control measures in advance and carefully organize and implement. Highlight of gas treatment input is high gas, outburst mine well, deep mine exploitation, for a large quantity of gas emission, severity of outburst risk, mining face should be given priority to ensure funds invested.

2) System guarantee. Requirements are as follows:

(1) Must increase investment in coal mine gas treatment. Set special funds for gas treatment and clarify the money of tons of coal, with serious regulation and special money used in right position.

(2) Insist on the gas drainage incentive policies and incentive policies for protective layer mining, gas drainage tunnel and the main air duct repair subsidies policies.

(3) Increase research investment. The proposed annual investment in science and technology funds of enterprises accounted for 5% of total sales, including share of science and technology R&D activities, the proportion of the total investment of 20% or more. Establish technological innovation of incentives research and development.

(4) Insist on the path of production and research, strengthen exchanges and cooperation with domestic and foreign technology, the technological research mainly focus on comprehensive management of coal mine gas, coal and gas extraction, safe and efficient mining, coal mine gas utilization.

2.2.2.Gas Control Management

1) Coal mine should establish a comprehensive evaluation system and technical accountability for gas treatment. Should regularly carry out safety technology assessment, consultation activities, promptly solve major issues of gas comprehensive treatment of coal mine, eliminate safety hazards.

2) Acceptance regulation before mining on work face. Returned mining must be accepted, when implement mining protection for coal outburst on outburst risk area, by related department, otherwise can not execute returned mining.

3) Evaluation system of outburst elimination from pre-drainage. On outburst hazardous coal seam without protective layer, when taking anti-outburst measures on gas area from pre-drainage, validity check must be done with indicators by remaining gas pressure and remaining gas quantity.

4) Executive cross-hole(shaft) classification management and treatment policy of exposing coal. Using classification of measures by gas pressure, gas pressure $P \geq 2\text{MPa}$ or dynamic phenomena during drilling process, drilling area should be enlarged by the "anti-outburst standard", while implement continuous hole drilling lane to help intercept extraction, maintain a continuous drainage during uncovering coal, blocking relief pressure gas flock to working face.

5) Establish drilling acceptance policy for anti-outburst. Strictly execute drilling acceptance management on construction site. Borehole should be accepted by the full-time staff for the drilling acceptance of final hole.

6) Execution on regular meetings policy of gas comprehensive treatment with anti-outburst. Coal mining enterprises should organize a monthly video meeting of comprehensive treatment with anti-outburst. Mine site should carry out a symposium for outburst precaution at least once a month, balance needed for conflict prevention human, financial, and material for gas treatment and outburst prevention.

7) Implement the gas comprehensive treatment policy of "one mine, one policy, one side, one policy". "One policy One Mine", "One side One policy" originated by every mines annually should submit to mining enterprises for audit.

8) Implement the regulation policy of gas comprehensive treatment and outburst prevention. Coal mining enterprises should strengthen the comprehensive treatment of gas, regulation and monitoring on site of outburst prevention, and seriously punish the companies and responsible who are not follow these rules. The mine (mine construction project department) must strengthen comprehensive gas control, and the daily supervision of outburst prevention.

9) Implement monthly traced processing system according to main indicators of comprehensive treatment. Seriously punish and circulate a notice to the companies and responsible who badly complete these indexes. Do periodically inspection for ventilation, drainage, monitoring, and other major system to ensure system stability, and reliable.

10) Implement leader's shift system of outburst prevention. Mining engineer, director of safety lead an outburst prevention at least once a month. For long distance blasting of cross-hole coal exposing, leaders above mine (Mine Construction Project Department) deputy chief engineer must lead or follow the whole process, and account for safety responsibility.

11) Establish and improve the gas comprehensive treatment policy of risks, governance, reporting and classification regulation. Large risk as ventilation, drainage, monitoring, should be registered, ensure improvement of funds, responsibility, protection measures, and implement "hanging out" regulation. Making strict system for risk diagnosis, gas inspection, gas emissions, ventilation system changing, gas extraction, preliminary outburst inspection, clarify responsibility of all sectors, ensure that the system and measure put into place.

12) Comprehensive gas treatment is subject to "two at the same time, one ahead" (gas treatment project and the coal face design are at the same time, construction in advanced and put into use simultaneously), leaving enough time for pre-extraction, so that first pumping follow with the extraction (mining). Gas extraction must be put into successive production to ensure "pumping, extraction, mining", balance. Gas production must implement project plan of comprehensive treatment. Project signed with contract has been completed as requirement of contract book. Gas infrastructure must be completed totally before test running, prior to arrange comprehensive treatment project.

2.2.3. Gas governance institutions

1) Safety management system should be completely established, centered with responsible, implement the responsibility system for coal mine gas control, and strengthen the gas extraction, gas management leadership, and establish gas treatment accountability and management system.

2) It is necessary to establish the technological management system centered by chief engineer, improve the structure and mechanism of responsibilities, rights and interests unity, clarify chief engineer's role in decision-making, give full play to the role of technology management system, improve the chief engineer's technical authority, involve gas roadway layout of mines with comprehensive treatment, mining deployment, production system adjustment and technical specifications, standards, measures. Major technical problems as new technology, new equipment, promotion on new technology application, must be responsibility of the chief engineer's. Adjustment, equipment with "one through three prevention" must seek the views of Chief Engineer. Establish chief engineer office meeting system, to research on solution of problems as technology, team, equipment, management and other issues, and to develop the technology proposal, to put in place on site.

3) High gas, coal and gas outburst mine must install ventilation, outburst prevention, drainage, safety monitoring, and other professional institutions.

4) Mine should be set up comprehensive monitoring system of gas regulation, should establish a comprehensive monitoring systems for ventilation, gas, outburst prevention and other surveillance, clarify responsibility range and management privileges of gas comprehensive treatment of security, design, production, testing, research and other management institution. Safety production technology department is responsible for the comprehensive treatment on gas design, programs, measures and project implementation. Business management department is responsible for the required equipments and investment of comprehensive treatment of gas. Party department is responsible for promote education, training and human resources distribution on comprehensive treatment of gas.

5) Establish safety training center. Safety Supervision Bureau sets up safety training, mine sets up third, fourth level safety class, district security team establishes fifth level class with enough qualified teachers. According to the law, provide special safety training of gas comprehensive treatment and

outburst prevention for management of outburst mines and staff of under mining, and permission on working after examination. The main person in charge of the outburst mine and the coal mining enterprises, coal mining technology responsible should undergo safety training from secondary and higher institutions and organizations on outburst prevention specific training.

2.2.4. Gas treatment team

1) According to the law, provide special safety training of gas comprehensive treatment and outburst prevention for management of outburst mines and staff of under mining, and permission on working after examination. The main person in charge of the outburst mine and the coal mining enterprises, coal mining technology responsible should undergo safety training from secondary and higher institutions and organizations on outburst prevention specific training. Special training includes the theory, practical experience, occurrence regulation of outburst, outburst prevention measures and policies of outburst prevention. Outburst members (full-time staff working on forecast, validity check, implementation on outburst prevention measures, collection and analysis of relevant parameters) must have education background of coal secondary technical school or high school (including high school) or higher, with refresher training per year. All mine workers can do "should be aware that should be", or not allowed to posts.

2) Establish safety inspection, gas inspection, monitoring and detection, outburst prevention forecasting, extraction drilling, gas geological prediction. High gas must be located full-time deputy chief engineer of ventilation, outburst mines must be set with full-time measuring deputy chief engineer. Suggest outburst mines should be equipped with manager of ventilation, to achieve separation of technical and administrative management responsibilities.

3) Set professional construction team for outburst prevention, construction on uncovering coal of outburst of cross-hole (shaft) should be executed by this team. Construction on extraction and drainage working faces of outburst risk zone must be relatively fixed. Technical personnel must have a bachelor degree or above, managers must have experience and skills in outburst prevention of coal and gas outburst.

3. Establishment of Index System of Coal and Gas Outburst Accident Control

3.1. The principle of establishing index system

Reasonable and scientific evaluation of index system establishment is directly related to the reliability and validity of the results. Indicators used to determine index system for controlling of coal and gas outburst accident, relate to both the coal and gas outburst accident risk assessment and quality and functionality of the control, also involve whether the risk assessment can achieve to promote increasing levels of coal mine safety purposes. This shows that the establishment of index system is very important. General requirements of establishing of index system are the following [16,137]:

1) Systemic principles. The selected indicators can fully reflect the extent of dangers of coal and gas outburst, and can not simply be gathering of single outburst accident effect.

2) Scientific principles. Coal and gas outburst risk is with regulation, which requires its evaluation of the indicators should be scientific and objective. Indicator system must be able to reflect actual situation of disaster of mine coal and gas outburst.

3) Qualitative and quantitative principles. In practice, it often requires combination of qualitative indicators and quantitative indicators.

3.2. Establishment of Index System of Coal and Gas Outburst Accident Control

In summary, in technological factors system of outburst accident, technological basic work includes whether mine gas classification is identified, whether geological map of gas has been drew as requirement. Reliability of the related systems mainly refers to ventilation system reliability, gas drainage system, monitoring system reliability, etc.. Precaution technology includes regional outburst prevention measures before extraction, gas treatment during drainage, gas disposal during mining, Outburst prevention measures of coal uncovering on roadway and outburst prevention measures of close stone head. Concept and technology innovation means whether the gas treatment concept is innovated, concepts are as such ones, "ventilation system is the foundation, drainage is vital, outburst prevention is the key, monitoring and control, management in place is guarantee ", " only the drilling is

not in place, no gas can not be extracted ", establishment of technological innovation of mine gas treatment system, organization of innovation team, establishment of collaborative research mechanism with production, ideas transformation on traditional gas treatment technology, etc.; technological equipment mainly refers to the fan selection, air quantity can meet the requirements, gas extraction equipment refers to surface drainage systems, drilling can meet the requirements, whether the high and low methane sensors is installed etc.

Management factors of outburst accidents mainly contain input of gas control, gas control management, and gas control institution and gas control team and other agencies. Gas treatment input means the input standard of gas treatment, capital input and scientific research input etc.; gas control management refers to establishment of evaluation system of comprehensive gas treatment and technological accountability measures, evaluation system of pre-drainage for outburst prevention, cross-hole (shaft) classified governance of uncovering coal and classification management, etc.; gas treatment agency refers to the establishment of specialized management agencies for gas treatment, foundation on ventilation and fire prevention agencies; gas control team refers to special gas treatment safety training for managers of underground mine staff, safety inspections , gas inspection, monitoring and control, anti-outburst forecasting, drainage drilling and gas geological prediction and other related professional team for gas comprehensive treatment.

Thereby establishment of coal and gas outburst accident index system shown in Figure 1.

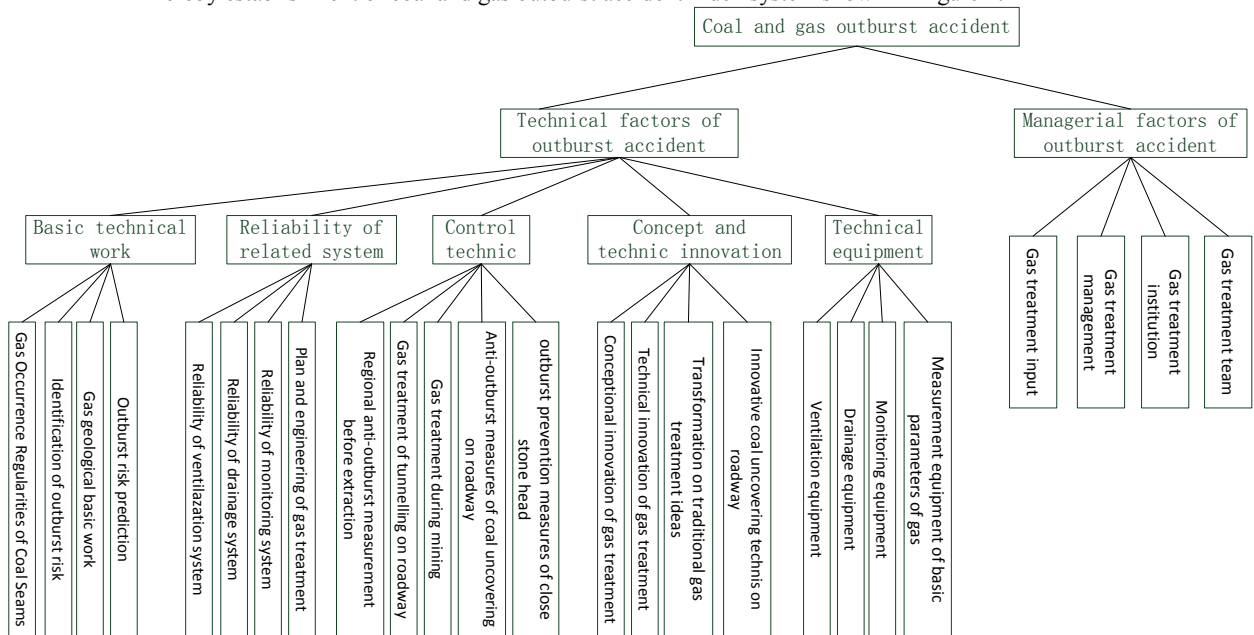


Figure 1, Index system of coal and gas outburst accident

4. Conclusions and Outlook

4.1. Conclusions

In this paper, coal and gas outburst accident control index system was studied, combining with related theory on coal and gas outburst prevention technology. Work undertaken in this paper and results can be summarized as follows:

1) Identify technology factors of outburst accident prevention from technical basic work, reliability of related systems, prevention techniques, concept and technical innovation and technology equipment, and other aspects. Technical basic work includes gas occurrence regularities of coal seams, evaluation on outburst risk, the basic work and geological gas outburst division. Reliability of related systems include reliability of ventilation systems, drainage systems, monitoring system and gas management and engineering. Control techniques contain regional anti-outburst measures before extraction, gas control on coal roadway drifting, gas treatment during mining, outburst prevention measures of coal

uncovering on roadway and outburst prevention measures of close stone head. Concept and technical innovation includes conceptional innovation for gas treatment, technological innovation for gas treatment, transformation on traditional gas treatment ideas and innovation of coal uncovering technology on roadway. Technical equipments include ventilation equipment, drainage equipment, monitoring equipment and measurement equipment of basic parameters of gas.

2) Establish index system of management factors of outburst accident prevention from the gas control input, gas control management, and gas control and gas management team and other agencies.

3) Establish index system of coal and gas outburst accident control, according to technical and managerial factors of coal and gas outburst accident.

4.2. Outlook

1) This paper's establishment on index system of coal and gas outburst accident needs supplement and improvement, which is an important research in the future, with changing on technology development and governance concepts of coal and gas outburst prevention.

2) This article aims to leading with deeper research on coal and gas outburst accident, not to create a realistic and precise theoretical system of coal and gas outburst accident control. Because of the complexity, this paper just makes a preliminary discussion on this topic, pending further study.

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