



Research and Application of Foam Dust Removal System in Coal Mine Fully Mechanized Workface

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Abstract The technology of foam dedusting system in coal mine comprehensive excavation face is mainly devoted to the treatment of coal mine dust, especially the control of flour dust in coal mine comprehensive excavation work. The foam dedusting system of coal mine comprehensive excavation face includes the foam dedusting system of the comprehensive excavator, the compounding of foam reagents and the dust-proof auxiliary technology. The foam dedusting system of the comprehensive excavator is the basis and key of the whole system, and its structure is composed of foaming system and elimination. The composition of the bubble system, the compounding of the foaming agent is improved and perfected, the dust-proof auxiliary technology is supplemented and adjusted, and the parts are independent and related to each other, and finally solve the problem that the flour dust exceeds the standard in the mine comprehensive excavation work. The technology of foam dedusting system in coal mine comprehensive face is applied and verified during the excavation of two working faces in a certain province of Henan Province. After field test, the dust removal effect is remarkable.

Keywords coal mine; dust; comprehensive digging face; foam dedusting; application

Introduction

Coal mine dust is one of the most important disasters in mine production. It can not only cause pneumoconiosis, but also cause explosions, causing huge disasters and economic losses to miners, enterprises and society [1-2]. The operating environment is poor, and the dust concentration is seriously exceeded. This is an important reason for China's coal mining enterprises to become a high-risk industry for pneumoconiosis [3]. The dust removal methods commonly used in mines today include coal seam water injection, spray dust reduction, ventilation and dust removal, etc. However, there are many problems in the promotion and use of these methods, and the dust concentration of miners is still relatively large [4-8]. The existing foam dust removal system often has problems such as insufficient foaming ratio, unsatisfactory dust-collecting effect, and pollution of the coal body by the foaming agent used, and the enthusiasm of the coal mine is not high, resulting in environmentally ill environment Slightly, not only affects production efficiency, but also miners are prone to pneumoconiosis, which has a negative impact on mine production efficiency and reputation [9-12].

The dust removal system of the comprehensive excavation face of coal mines in coal mines in various countries is diluted by press-in or extractive ventilation [13]. He is a passive dilution of dust without dusting, but only the symptoms are not cured. This method of diluting dust does not eliminate dust in real time, and people can still inhale the body and cause harm. For the current foaming technology in foam dedusting technology, the foaming agent is often concentrated on the foaming ability, but the trapping effect of the mine hydrophobic dust foam is often not ideal, because the key factor of improving the foam wetting performance is not considered. Moreover, the price is expensive, and the S, P, etc. in the reagents pollute the coal body, resulting in low enthusiasm for coal mine use [14-18]. In the dust-collecting and dust-collecting of the comprehensive excavation face, the dust removal of the coal mining face excavation work is generally carried out by a simple dust collector. The



commonly used general-purpose extraction structure is used to suck the airflow containing dust into the dust collector. The simple pressure type is simply a spray and a dilution function, and the dust cannot be removed, so the pollution range is large. The simple suction type dust remover can remove a part of the dust. It is only because of the short suction, and the suction stroke is short, which affects the dust collection and dust removal effect. On the other hand, it also causes the eddy current to be polluted due to the short suction stroke. A large negative impact [19-21]. In terms of personal protection, many coal mines are doing very badly on the last line of defense. Miners mostly use dust masks because of trouble, causing them to inhale dust in large quantities, which is the cause of pneumoconiosis in China. An important factor in high incidence. And currently known nasal and nasal masks cannot simultaneously have high air tightness, high comfort and high air permeability. In order to maintain the high airtightness around the bridge of the nose and the face, the N95 mask with a high degree of protection must be made of metal beading and elastic band to make the face highly compressed, which may cause discomfort and reduce people's feelings. Willingness to wear. Although the average commercial mask is higher in comfort than the N95 mask, such masks have poor airtightness around the bridge of the nose and the face, and cannot effectively provide a highly airtight environment, and easily cause harmful substances such as bacteria and viruses to pass through the face. The surrounding space easily enters the human body.

The technology of foam dedusting system in coal mine comprehensive excavation face is mainly devoted to the treatment of coal mine dust, especially the control of flour dust in coal mine comprehensive excavation work. In response to the defects of mine dust removal, high pressure spray dust reduction, foam dust removal, water curtain dust removal, etc., we have developed a coal mine comprehensive excavation face foam dedusting system, which not only contains foam defoaming foaming system structure, defoaming system Structure, foam reagent formula, also includes auxiliary facilities such as dust-proof system and personal protection.

The main features of the foam dedusting system technology in coal mine comprehensive excavation face are: a system structure is reasonable and easy to implement, not only can effectively reduce the cost of foam dedusting, but also easy to operate and use, easy to popularize; second system can not only overcome the current use of foam in the mine Many defects can more fully protect the miners who work on the working face. The third is that the foam dedusting system is a complete system, not only foam dedusting equipment, but also the formulation of foam reagents, the last of the miners. Dust separation method, etc.

The foam dedusting system of the coal mine comprehensive mining face includes the foam dedusting system of the comprehensive excavator, the compounding of the foam reagent and the dust-proof auxiliary technology. The comprehensive dust collector system is the foundation and key of the whole system. Its structure is composed of foaming system and defoaming system. The foaming system and the defoaming system are coupled with each other to make the foam surround the cutting head of the comprehensive excavator. Without a large amount of accumulation, the foam of the cutting head always surrounds the cutting head. From the plane structure diagram of the foaming and defoaming system of the cutting section of Fig. 1, it is known that the foaming system is composed of a foam nozzle (1), a regulating valve (3), Foam liquid pipe (18), foamer (11), foam mixer (10), adding pump (7), foaming agent (8), flow meter (4), pressure gauge (5), switch (6) It consists of a comprehensive air pressure device (14) and a water supply device (15). Defoaming system consists of defoaming nozzle (2), regulating valve (3), defoaming liquid pipe (19), defoamer (13), adding pump (7), defoaming agent (9), defoamer mixer (12), flow meter (4), pressure gauge (5), switch (6), water pump (15). When dust is generated at the cutting head of the comprehensive excavation face, the foam generated by the nozzle (2) of the foaming system wraps the dust around the cutting head (16) so that the dust cannot fly, and the outer defoaming system The sprinkler (2) sprays the foam to the foaming system nozzle (1) to generate a foam, so that a large amount of foam in the cutting head passes through the dust and reduces the accumulation, so that the sprinkler (1) is ejected through the foaming system. The foam is coupled with the foam from the nozzle of the defoaming system (2) so that the foam of the cutting head cannot be accumulated in a large amount. Under the condition that the two foams are coupled, not only a large amount of water resources are saved, but also the working face is not wet, and the working environment of the workers is comfortable, so the working face is good, the labor efficiency is high, the accident is reduced, and the comprehensive excavation work is also facilitated. The life of the surface mechanical equipment.



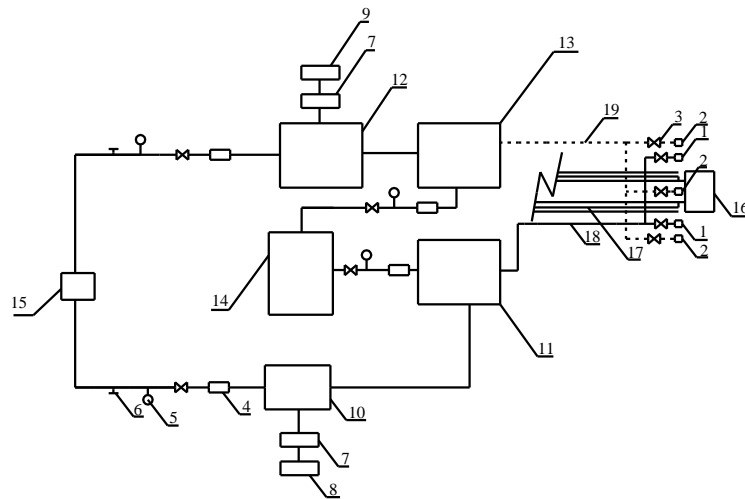


Figure 1: Schematic diagram of the plane structure of the foaming and defoaming system of the cutting section
 In order to improve the dust removal efficiency of the dust removal foam in coal mines, it is preferred that AEC-9Na, AEO-9, APG0814 and CMC-Na, which do not contain N, P and S elements, are widely used as foaming agents, foam stabilizers, wetting agents, The viscosity agent was tested on the basis of the monomer surfactant test to determine the best ratio and concentration: AEC-9Na, AEO-9, APG0814, CMC-Na ratio of 3:1 : 3:5, when the mass concentration is 0.5%, the foaming performance and foam stability of the dust-removing foaming agent are more favorable for the dust removal in the well, and the wettability is better. The effect of testing the foam using the ROSS foam meter is shown in Figure 2 below.

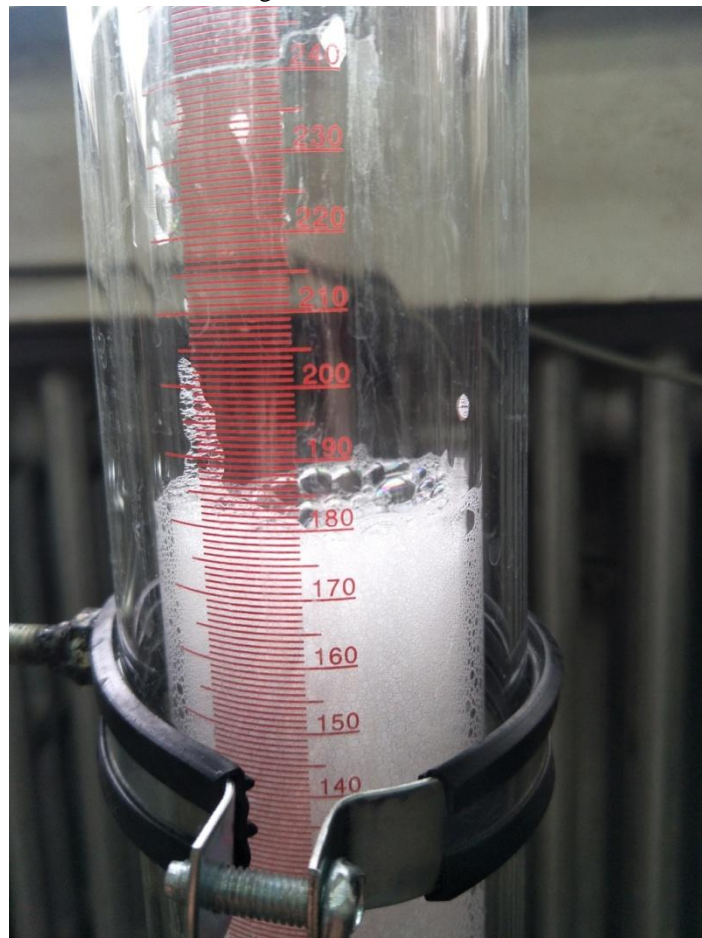


Figure 2: ROSS foam test reagent combination effect real shot diagram

Dust-proof assistive technology includes dust collection and dust collection and personal protection of the working face. The method of dust collection and dust collection in the comprehensive excavation working face adopts the method shown in Fig. 3. The purpose of this method is to use the airflow flow field of the upper and lower chambers to concentrate the dust in a minimum range and collect and concentrate the removal, including the upper cylinder. (2) and the lower tube (3), a lower tube (3) is arranged at a lower portion of the upper tube (2), the upper tube forms an upper chamber bell mouth (4), and the lower tube forms a lower chamber bell mouth (5), in the upper tube (2) There is a suction type dust collector (1), a negative pressure zone in the upper cavity flare (4) form, and a press-in fan (11) and a lower cavity flare (5) in the lower cylinder (3). Forming a positive pressure zone, the airflow blown in the lower chamber bell mouth (5) forms a gas curtain to separate the cutting head (8) of the comprehensive excavator from the swing arm (9), so that the cutting head of the comprehensive excavator (8) is cut. The dust formed at the time is caused by the positive pressure of the lower chamber bell mouth (5) and the negative pressure of the upper chamber bell mouth (4), so that the dust moves upward and is sucked into the upper chamber bell mouth (4). The upper cylinder (2) and the lower cylinder (3) are arranged, and two upper and lower cavities are formed, and a dust remover (1) of the extraction fan is disposed in the upper chamber (2), and a pressure is placed in the lower chamber (3). The air duct of the inlet fan (11). Therefore, the suction of the dust can be greatly increased during use, and at the same time, a partial rectangular air curtain is formed, and the dust generated by the cutting machine bit (8) is separated from the comprehensive excavator and the driver, and the dust can only be moved upwards. The upper suction cap is sucked out and removed. It utilizes the principle of the combined action of the source flow of the jet flow field and the convergence of the suction flow field to control the dust by sucking up and down, so the pollution is only in this range, very small.

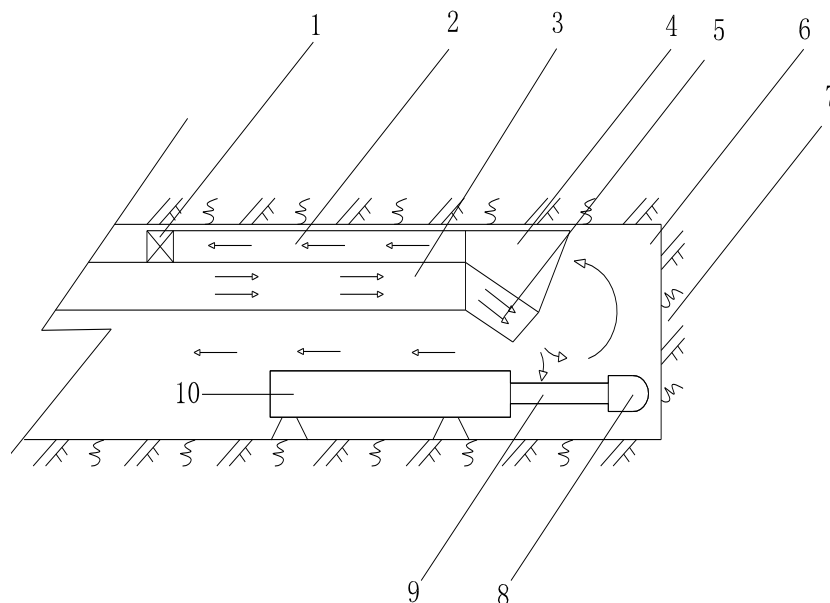


Figure 3: Schematic diagram of dust collection and dust collection method for fully mechanized excavation face

The system's personal protection is the last line of defense to protect miners. As shown in Figure 4, this integrated mine protection device includes a miner's cap (1), a noise-reducing earmuff (7), and a nasal mask (13). (1) It is connected to the nasal mask (13) by a fastening tape (15) through a wearing hole (15), and a length adjusting buckle (9) is provided on the fastening tape (17) at the other end of the wearing hole (15). A locking tongue (8) and a locking buckle (14) are also respectively arranged, and a nose clip (16) is further arranged on the nasal mask (13), and a connecting belt (11) is arranged on the lower part of the nasal mask (13), and the connecting belt (11) A bundle block (12) is provided in the middle portion, and the connecting belt (11) is connected to the fastening tape (17) through the connecting belt (10). A sump (2) is arranged on the miner cap (1), a tension link (3) is arranged in the accommodating groove (2), and a noise reduction ear cover (7) is connected to the tension link (3). A positioning hole (5) is further disposed on the extension link (3), and a



groove (4) corresponding to the noise reduction ear cover (7) is disposed on both sides of the miner cap (1), behind the miner cap (1) A retractable belt (6) with a hook is also provided. This method can effectively help the miners in dust prevention, and also wears dust masks, which has become a necessity.

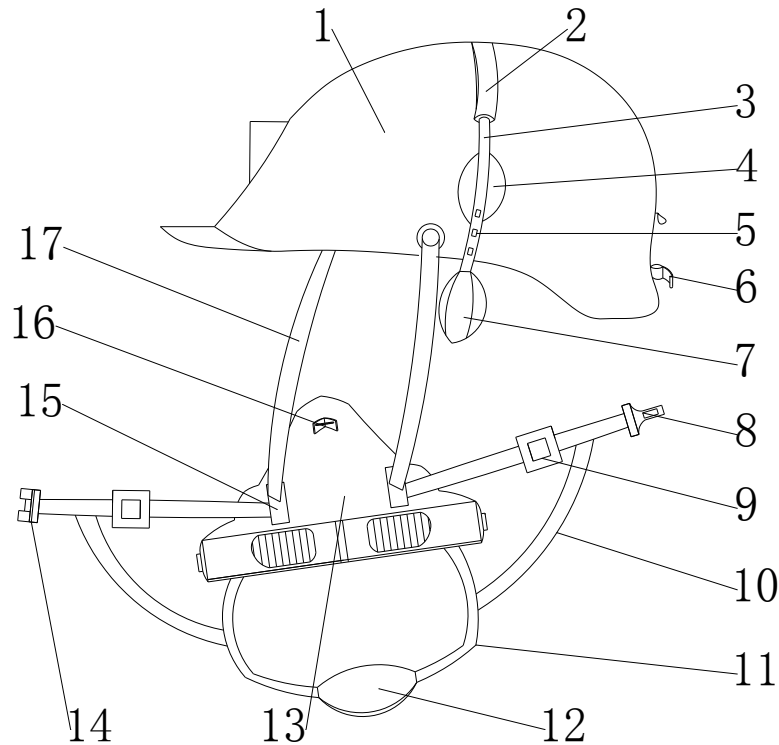


Figure 4: Schematic diagram of the integrated protection device for dustproof and anti-noise of the new mine

The above-mentioned parts are closely related to each other, which constitutes a foam dedusting system for coal mine comprehensive excavation face. The foam dedusting system of the comprehensive excavator is the structure and foundation. The compounding of foam reagents is improved and perfected, and the dust-proof auxiliary technology is supplemented and adjusted. The parts are independent of each other and create a connection that ultimately solves the same problem.

The advanced technology of the foam dedusting system in the coal mining face is: First, the foam generated by the foaming system is wrapped in the cutting head of the comprehensive excavator, and the foam generated by the defoaming system is sprayed to the nozzle of the foaming system. The coupling of the two foams not only prevents the accumulation of foam, but also saves water resources and optimizes the working environment of the miners. Second, the research and development of foam dedusting reagent can not only meet the requirements of coal mine foam dust removal, the dust removal effect is obvious, and it is non-toxic and harmless, will not pollute the coal body, and its cost is low. When the coal mine promotes the system, it can save a large part of the cost. . Third, the invented dust-collecting and dust-collecting method for the working face can capture the dust that has not been removed by the foam dust removal, enhance the effect of the system dust removal, and the integrated protective device used by the miners can better put the last one off. Provide safety protection for miners.

The technology of foam dedusting system in coal mine comprehensive mining face was applied and verified during the excavation of two working faces in a province of Henan Province. The first working face is 1005m toward the machine alley, 1024m in the wind lane, 205m in length and 234m in length. The total length of the roadway is 2234m. The length of the second working face is 922m, the length of the machine way is 856m, the length of the cutting eye is 236m, and the total length of the roadway is 2084m. The above working face coal seam is soft, dry and strong in water repellency. The effect of water injection by coal seam is poor. Although the dust is reduced after sprinkling and conventional water curtain dust reduction, the working environment of workers is damp, which is not conducive to good health and the concentration of dust is still large. At the same



time, the mechanical equipment is seriously damaged and the maintenance is frequent. From August 2013 to October 2015, the foam dust removal system technology of the coal mine comprehensive working face was used in the above-mentioned working face alleys and wind lanes, which solved the problem of excessive dust in the mine production process, improved the working environment of workers and improved The equipment utilization rate has also improved the production efficiency. The tunneling speed is increased by 60m before the use of this technology, and the working surface is penetrated three months ahead of schedule. According to the on-site measurement, the dust removal efficiency of the foam dust removal system is 80.62% for the whole dust, and the dust removal efficiency for the respiratory dust is 75.43%, which is 2.38 times and 2.12 times of the spray dust reduction efficiency, respectively, and the dust removal effect is remarkable.

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