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A Systematic Review of Dust Suppression Methods by Experiment Based on Intelligent Technology in the Coal Mines

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Abstract: - The mining and its transportation processes generate a substantial quantity of dust, which harms miners' health. The extended inhalation of dust particles could result in pneumoconiosis. There are numerous studies on coal mine dust removal, but only a handful of articles critically comment on it. A systematic coal mine dedusting literature review has been conducted to attempt a comprehensive and reproducible analysis. This article reviews dust suppression methods by experiment in coal mines from three aspects: chemical modification of dust removers, structural improvement of dust removers, and other factors. The review showed that independent experimental research suits dust remover's structural improvement and chemical modification. Compared to non-phytochemical modifications, phytochemical modifications are more efficient and environmentally friendly. The development of dust remover structures concentrates primarily on the nozzle structure, nozzle diameter, the number of holes, and the distance, with the nozzle diameter being of particular significance. Sometimes, tweaking the nozzle structure does not yield significant efficiency improvements. However, supersonic nozzles demonstrate high efficiency and are likely to be a key area of future research. Experiments also investigated other factors' effects on coal mines' dust removal efficacy, including ventilation system, metamorphic degree of coal, and particle diameter. This review provides the latest dust removal technology information for coal mines. Intelligent technology provides the basis for experimental research on dust removal in coal mines. The future trends of experimental research in the coal mine dust control field include intelligent and automated dust control systems, comprehensive control of multiple pollutants, application of new materials and technologies, and interdisciplinary collaboration and cross-disciplinary research.

Keywords: Coal mine, Intelligent technology, Experiment, Chemical modification, Structural improvement

I. INTRODUCTION

Coal mine dust is generated during coal mining and processing. According to statistics, coal mine dust is one of the leading causes of coal mine fires and explosions, resulting in many casualties and property losses. Furthermore, miners exposed to coal mine dust for long periods are at high risk of occupational lung diseases such as coal workers' pneumoconiosis. Coal mine dust control is a critical environmental management task. With the continuous improvement in environmental protection and occupational health requirements, coal mining companies and research institutions are dedicated to conducting experimental research to seek efficient and feasible coal mine dust control technologies. For example, the internal and external spray used for coal dust is illustrated in Figure 1 [1].

Experimental coal mine dust removal research is conducted in a laboratory environment that can effectively simulate a natural coal mine dust removal system. It entails constructing an experimental system and setting experimental parameters to study the principle of coal mine dust removal technology, its efficiency, the scope of application, and the impact of various factors. In the experimental research of coal mine dust removal, a system consisting of dust removal equipment, a fan, a particulate generator, a sampler, a laser particle size analyzer, etc., is typically established. Controlling experimental parameters, such as airflow velocity, liquid velocity, airflow flow, and liquid flow, enables experimental operation, data collection, and analysis. During the experiment, relevant parameters, such as atomizing cone angle, particle concentration, and particle size distribution, can be measured to evaluate and optimize the performance and effectiveness of various coal mine dust removal equipment.

The advantages of experimental research in coal mine dust removal include systematic study, precision and controllability, safety, flexibility, and economy. Experimental study can systematically study and evaluate dust

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