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Full Length Article

Experimental study of surfactants' performance for suppressing coal dust with respirable size

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ABSTRACT

Long-term exposure to coal dust can lead to severe health problems in coal workers, including Coal Workers' Pneumoconiosis, making effective control of coal dust in underground mines essential. Water spraying is a widely used method for controlling coal dust, and adding surfactants can remarkably enhance its effectiveness. While previous studies have examined the influences of different coal particle sizes on surfactant performance, they have primarily focused on inhalable dust with sizes less than 100 μm. The impact of finer particle sizes, such as respirable dust with sizes less than 10 μm, remains inconclusive. This study aims to investigate the effects of respirable dust ranging from 0.1 μm to 10 μm in diameter, on the performance of surfactants. It was found that the surfactants' performance was weakened significantly with a decrease in the coal dust size. The suppression efficiency for coal dust size between 0.1 μm and 1.0 μm was only half that of size between 4 μm and 10 μm. The primary factors contributing to this result would be the roughness, the specific surface area, the air absorbability, and the number of particles. Furthermore, TX100 surfactant performed slightly better than SDBS in suppressing coal dust. While SDBS performed greater at a concentration of 0.15–0.20%, TX100 had higher suppression efficiency at lower concentrations. This study suggests that future research should focus on improving the suppressing performance of coal dust with finer sizes less than 0.1 μm or 2.5 μm.

1. Introduction

Coal dust is a fine powder that is typically generated during mining and can become suspended in underground air streams [1]. Chronic pulmonary illness, such as Coal Workers' Pneumoconiosis (CWP), commonly known as black lung disease, can result from long-term exposure to coal dust in coal workers and is one of the most severe occupational diseases [2–6]. The inhalation of excessive coal dust can cause CWP to develop into progressive massive fibrosis (PMF), which can be fatal to miners [1]. Fibrosis and the formation of nodular lesions are the most common symptoms of CWP, and currently, there is no effective treatment for these lung diseases [7,8]. Despite significant efforts to control coal dust-related lung diseases in the past few decades, recent medical confirmations of new cases suggest ongoing challenges. For instance, in China, over 350,000 cases of CWP were diagnosed by 2013, accounting for around 50% of total pneumoconiosis cases [9,10]. Additionally, over 480,000 cases were reported from coal industries in 2018, which accounted for 60% of total cases of occupational pneumoconiosis [11–13]. In 2020, over 84% of the total occupational diseases were confirmed as pneumoconiosis, while most of them were from mining industries [14,15]. Similarly, in the U.S., the CWP prevalence has exceeded 10% among coal workers who have worked for over 25 years in underground mines [16,17]. In the central Appalachia area, although the prevalence of CWP decreased in the 1970 s, it has risen again to over 20% by 2015 [16]. In Australia, before 2010, no case of CWP was reported in New South Wales, and only a few dust-related cases were confirmed in Queensland [18]. However, more cases were diagnosed in the following decade. In 2017, over 7% of 248 long-tenured miners were confirmed with CWP in Queensland [19]. In 2019, 20 more cases of CWP were diagnosed among underground coal workers in the same state [20]. Furthermore, 31 diagnoses with CWP were confirmed in 2020 [21]. Globally, more than 25,000 deaths were related to CWP in 2013, indicating the significance of the issue [22]. Although it was believed that coal dust was well-controlled in the past decades, CWP has shown a resurgence in recent years [17]. The increase in coal production and the development of mechanization in coal mines

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could be the main reasons for this phenomenon. Thus, the improvement in coal dust control is of significance.

Generally, hazardous inhalable coal particles suspended in the underground airways typically range in size up to 100 μm in aerodynamic diameter [23–25]. These particles are visible to the naked eye and can affect the upper respiratory system, and can be absorbed in the bloodstream or the lymphatic system leading to systemic toxicity [26–28]. In contrast, the respirable dust is invisible and small than 10 μm in size, making it easier to be breathed deeper into the lungs and causing lung damage [24]. Particles smaller than 5 μm can infiltrate the respiratory system and penetrate the deep parts of the lungs, such as the alveolar region, and bypass the natural defense-mechanisms of the human body, such as the cilia and mucous clearing [29,30]. Furthermore, fine particles less than 2.5 μm and 1 μm in diameter are considered as fine particulate matter and ultrafine particulate matter, respectively, which can travel further into and deposit on the surface of the deeper parts of the lung [24,25]. The fine particle has been linked to 3.2 million deaths globally, making it the sixth risk factor for premature mortality [31]. Previous studies have shown a statistically significant positive correlation between respirable dust and mobility and mortality [32–35]. Therefore, fine coal particles could pose a severe threat to human physical health.

Previous studies have focused more on controlling coal dust with inhalable size rather than respirable size. For example, Li et al. evaluated three types of coal samples with three different sizes of coal dust particles (15 μm, 35.42 μm, and 84.65 μm for anthracite coal, 3.61 μm, 10.33 μm, and 44.30 μm for bituminous coal, and 8.60 μm, 37.31 μm and 78.41 μm for lignite coal) by conducting a contact angle test [36]. The results showed that finer coal particles had poor wetting abilities and weak suppressing performance. A similar conclusion was reached in Zhang et al.'s study, which found that coal dust's wettability improves as the particle size increases [37]. Moreover, Chen et al. investigated three ranges of coal dust sizes, including 0–38 μm, 38–53 μm, and 75–90 μm by using the sink test [38]. The study found that larger coal particles had less sink time than finer particles. In addition, larger particles were more sensitive to the changes in surfactant concentrations. In Zhou et al.'s study, a wind tunnel test was conducted to evaluate the coal dust suppression efficiency on the respirable dust less than 7 μm and total dust less than 100 μm [39]. It was found that similar suppression efficiency could be achieved with different surfactants, whereas untreated water was less effective in suppressing respirable dust. Wang et al. conducted a wind tunnel test to assess the surfactant's suppression efficiency on coal dust [40]. The results showed that the surfactant achieved a 63.7% suppression efficiency on inhalable dust, which was slightly higher than the 56.3% efficiency achieved on respirable dust. Overall, these studies suggest that the suppression performance of surfactants may slightly degrade with small-sized inhalable coal particles.

Furthermore, in previous research, the effects of coal dust size had been studied primarily through static tests. For instance, Chang et al. studied the effects of different coal dust ranges using the sink test [41]. The results showed that surfactants had similar performance in the dust size ranges of 38–53 μm and 75–90 μm, while the performance would be significantly weakened if the size is less than 38 μm. A similar finding was reported in Chen et al.'s study, which used the drop penetration test [38]. Nevertheless, only a few studies have investigated the effects of coal dust size in dynamic tests. For example, Tessum et al. investigated the effects of particle size with polystyrene latex spheres instead of coal particles [42]. The experiment involved three particle sizes (0.6 μm, 1.0 μm, and 2.1 μm) and three kinds of surfactants with different ionicities. The study observed that larger particles could present higher suppression efficiency. In addition, high concentrations of non-ionic surfactant had greater respirable dust capture. Generally, static tests can only demonstrate the wettability of surfactants or absorbability of coal, which cannot directly present the effects of dust size [43]. In contrast, dynamic tests could provide a more intuitive result, such as suppression efficiency, and consider more factors, such as particle collision and contact time, which makes them more reliable [44–46]. Therefore, dynamic tests should be prioritized when evaluating the effects of coal dust size to obtain accurate results.

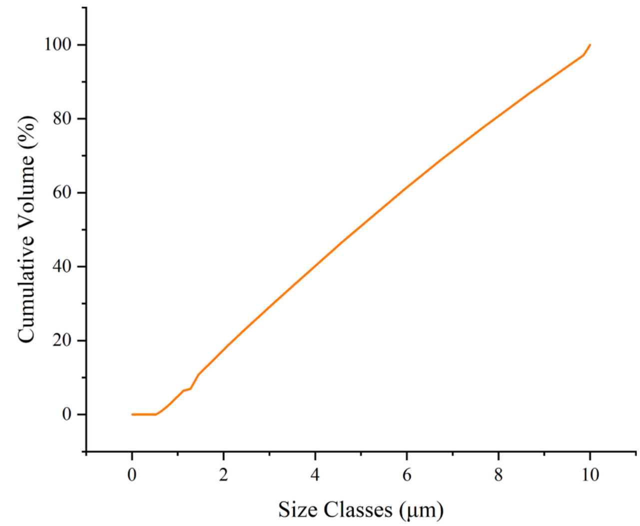


Fig. 1. Cumulative volume of the coal dust sample.

This study aims to evaluate the effectiveness of surfactants in suppressing respirable dust particles ranging from 0.1 μm to 10 μm. The respirable dust size is classified into four size categories: 0.1–1 μm, 1–2.5 μm, 2.5–4 μm, and 4–10 μm. Additionally, the performance of two commonly used surfactants, Triton X-100 (TX100) and sodium dodecyl benzene sulfonate (SDBS), will also be investigated by conducting the wind tunnel test. Seven surfactant concentrations from 0.00% w/v to 0.30% w/v will be studied. The results of this study indicate that coal dust size could significantly impact the performance of surfactants. Finer particles that are less than 2.5 μm in size had a substantial negative effect on the suppression efficiency. Roughness, larger specific surface area, greater air absorbability, and lower quantities of finer coal particles would be the main reasons for this phenomenon. Furthermore, the type and the concentration of surfactants had an essential impact on their performance, and a correlation was revealed between these two factors. TX100 demonstrated a greater performance than SDBS at lower concentrations of around 0.10%. It is suggested that future studies should focus on suppressing coal dust particles that are smaller than the respirable dust size. The findings of this study could be valuable in evaluating surfactants for coal dust suppression and helping industries select appropriate surfactants for underground dust control.

2. Method

2.1. Materials

In this study, a medium volatile sub-bituminous coal sample, which is obtained from the Premier Coal Company in Collie Coal Mine, Western Australia, is used in experiments. The reasons for selecting this particular coal sample are its widespread utilization within industrial applications and its prevalence in research [47–50]. Furthermore, previous studies usually employ a single coal sample in experiments to effectively isolate specific variables of interest [37,39,51,52]. The coal sample is prepared according to the standard preparation procedure [53,54]. The first preparation involves crushing and pulverizing the coal sample into a fine powder using a jaw crusher and a pulverizer. The coal powder subsequently would be sieved using a power sifter, reducing its particle size to less than 10 μm in diameter. Once sieved, the coal powder is dehydrated in an oven maintained at approximately 35 °C. This process continues until the rate of sample weight loss falls below 0.1% per hour. Upon completion of this process, the dehydrated coal sample was

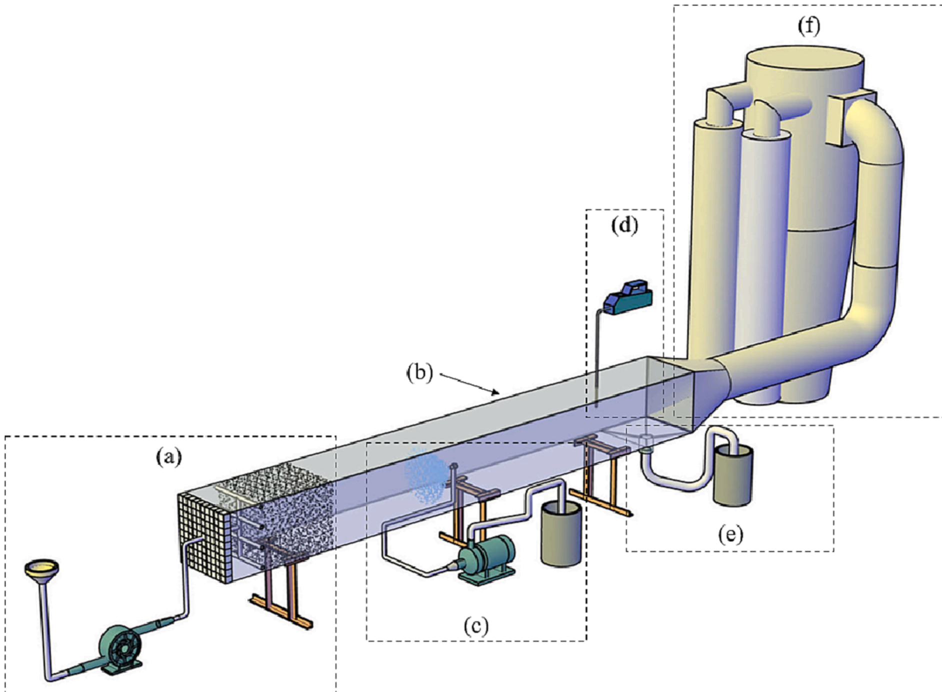


Fig. 2. Laboratory wind tunnel apparatus [55].

deemed ready for the experiment. Fig. 1 shows the cumulative volume of the coal dust size used in this study measured by a laser diffraction particle size analyzer (Model: Malvern Mastersizer). In this experiment, the coal dust size ranges from 0.1 μm to 10 μm.

Two surfactants are evaluated in this experiment, including SDBS and TX100, purchased from Sigma Aldrich Pty. Ltd. SDBS is an anionic surfactant, while TX100 is a non-ionic surfactant. In the experiment, seven concentrations of surfactants are evaluated, including 0.00% (w/v), 0.05% (w/v), 0.10% (w/v), 0.15% (w/v), 0.20% (w/v), 0.25% (w/v), and 0.30% (w/v). The surfactant solutions are made with deionized water.

2.2. Laboratory wind tunnel test and apparatus

Fig. 2 shows the apparatus of the laboratory wind tunnel test used in this study. This apparatus contains six sections, including (a) a dust spraying section, which generates and spreads coal dust into the tunnel; (b) a main wind tunnel section, where the coal dust and surfactants interact; (c) a surfactants spraying section, where surfactant solutions are pumped and spread out from a nozzle; (d) an aerosol concentration measurement point, where the dust concentration is measured and recorded by an aerosol monitor; (e) a disposal section, that collects the liquid waste; and (f) an exhaust fan with dust collector, which generates airflow within the wind tunnel and collects the coal dust waste at the outlet.

In this study, the air velocity within the wind tunnel is set as 0.68 m/s. The feeding rate of surfactant solutions is 4.97 l/min. The testing procedures of the experiment are shown as follows: (a) prepared coal samples are placed into the dust generator and then spread out into the wind tunnel; (b) once the coal dust stream keeps stable, the coal dust concentration C_{Before} is recorded; (c) after C_{Before} is recorded, the surfactant solution starts to be sprayed for suppressing coal dust; (d) during

Table 1
Overall Suppression efficiency.

	Average efficiency (%)					
	SurfactantConcentration (% w/v)	Coal Size Class (μm)				
		0.1–1	1–2.5	2.5–4	4–10	0.1–10
SDBS	0	41.26	28.41	62.91	79.61	55.37
	0.05	52.81	34.62	71.46	86.55	65.89
	0.1	47.34	32.00	68.81	83.40	60.11
	0.15	51.12	34.81	71.60	85.11	63.59
	0.2	52.12	28.50	67.78	83.18	64.25
	0.25	43.85	28.50	61.97	76.55	57.31
	0.3	47.57	28.50	64.23	78.49	59.72
	SurfactantConcentration (% w/v)	Coal Size Class (μm)				
		0.1–1	1–2.5	2.5–4	4–10	0.1–10
TX100	0	41.26	28.41	62.91	79.61	55.37
	0.05	46.15	29.17	66.10	83.30	60.42
	0.1	56.20	36.00	75.64	88.85	69.38
	0.15	45.97	30.00	68.63	83.05	60.31
	0.2	48.18	35.38	68.80	85.20	62.58
	0.25	52.19	33.23	71.57	86.26	65.79
	0.3	52.95	32.67	72.71	86.42	65.94

Table 2
ANOVA for the wind tunnel test.

Source	Type III Sum of Squares	df	Mean Square	F	P-Value
Corrected Model	4.461	55	0.081	33.969	0.000
Intercept	37.489	1	37.489	15701.794	0.000
Surfactant Type	0.010	1	0.010	4.319	0.042
Surfactant Concentration	0.059	6	0.010	4.100	0.002
Size Class	4.306	3	1.435	601.156	0.000
Surfactant Type * Surfactant Concentration	0.066	6	0.011	4.591	0.001
Surfactant Type * Size Class	0.002	3	0.001	0.233	0.873
Surfactant Concentration * Size Class	0.009	18	0.000	0.202	1.000
Surfactant Type * Concentration * Size Class	0.010	18	0.001	0.225	0.999
Error	0.134	56	0.002		
Total	42.084	112			
Corrected Total	4.594	111			

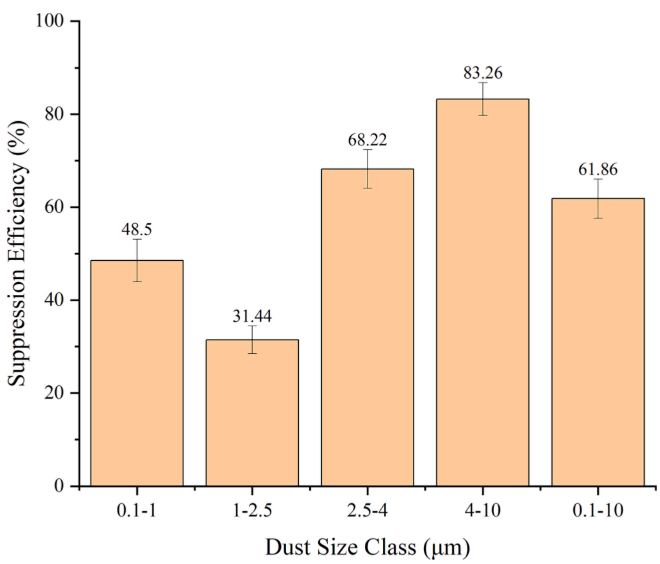


Fig. 3. The effects of coal dust size.

the surfactant spraying, the dust concentration C_{During} is measured. In the conducted experiment, the concentration of coal dust is determined using a light-scattering laser photometer, specifically, the DustTrak II Aerosol Monitor 8534. This instrument has the capability to measure aerosol concentrations corresponding to 1 μm, 2.5 μm, 4 μm, and 10 μm size fractions within a range of 0.001 mg/m^3 to 150 mg/m^3. Each measurement would be continuously recorded at one-second intervals over a period of two minutes. To ensure the reliability and reproducibility of results, the entirety of the experiment would be duplicated. The suppression efficiency of coal dust is calculated by the following formula (1) [39,55]:

$$\grave{E} = (C_{Before} - C_{During})/C_{Before} \quad (1)$$

where η represents the suppression efficiency of coal dust, C_{Before} represents the dust concentration before the spray of surfactant solution, and C_{During} represents the dust concentration during the spray of surfactant solution.

3. Result and discussion

Table 1 shows the overall results of average suppression efficiency in the wind tunnel test. This study considered three factors, including the surfactant type, the surfactant concentration, and the coal dust size. The Analysis of Variance (ANOVA) was applied to analyze all the test results in the experiment, which evaluated the significance and summaries relativity of three factors and the suppression efficiency, as shown in Table 2. The results showed that all three factors presented significance in impacting the suppression efficiency. Therefore, the three factors would be analyzed respectively for a better understanding.

3.1. Coal size class

Coal dust size has shown a significance in affecting the effectiveness of coal dust control in previous studies [43,46,51]. As shown in Table 2, the P-value of the dust size class in this study was less than 0.001, ranking the top among three factors, which proves its critical impact on suppression efficiency. Fig. 3 illustrates the effects of different coal size classes, including 0.1–1 μm, 1–2.5 μm, 2.5–4 μm, 4–10 μm, and the overall range 0.1–10 μm. It clearly shows that surfactants achieved an average suppression efficiency of 61.86% on the overall coal dust ranging from 0.1 μm to 10 μm. The highest suppression efficiency was 83.26%, achieved by the coarsest coal dust with 4–10 μm. With the decrease in dust size, suppression efficiency was dropped gradually as expected. The efficiency would be reduced to less than 50% if the coal dust size is less than 2.5 μm. Indeed, surfactants only had 48.5% efficiency for suppressing the finest particles of 0.1–1 μm, which is almost half effective compared to 4–10 μm coal dust.

The relationship between dust particle size and suppression efficiency presents an inverse correlation. With the decrease in particle size, there would be a marked reduction in suppression efficiency. This phenomenon can potentially be attributed to the specific surface area of coal particles. It is known that a finer coal particle has a larger specific surface area [56]. A study revealed that a dust particle size of 5000 μm may have a surface area of around 12 μm^2/cm^3, while it would be increased remarkably to around 12000 μm^2/cm^3 with a particle size of 5 μm [26]. However, a large surface area of coal particles necessitates an increase in attached surfactant molecules for effective suppression because of the complex microstructure and porous structure, resulting in a diminished suppression efficiency. Secondly, a large surface area is usually related to a strong air adsorption ability due to the smaller average pore diameter, the developed pore structure, and the higher

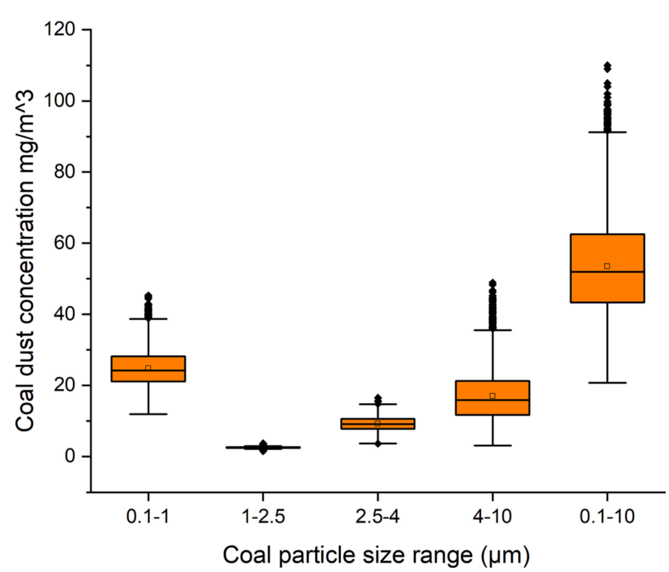


Fig. 4. Coal particle size distribution.

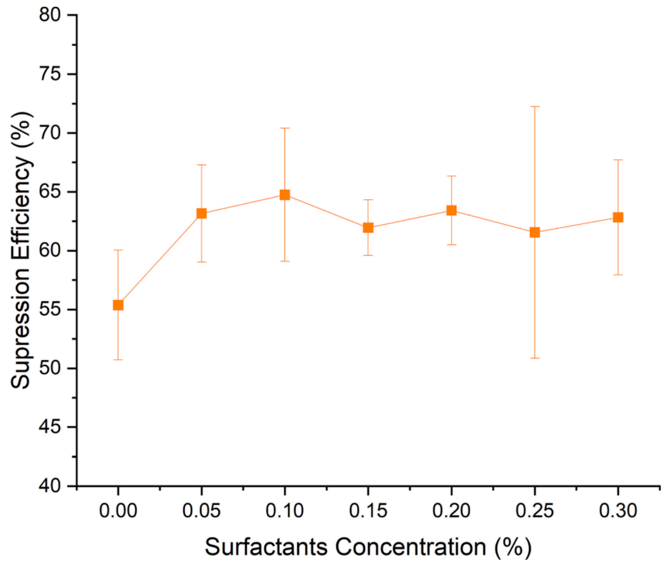


Fig. 5. The effects of surfactant concentration.

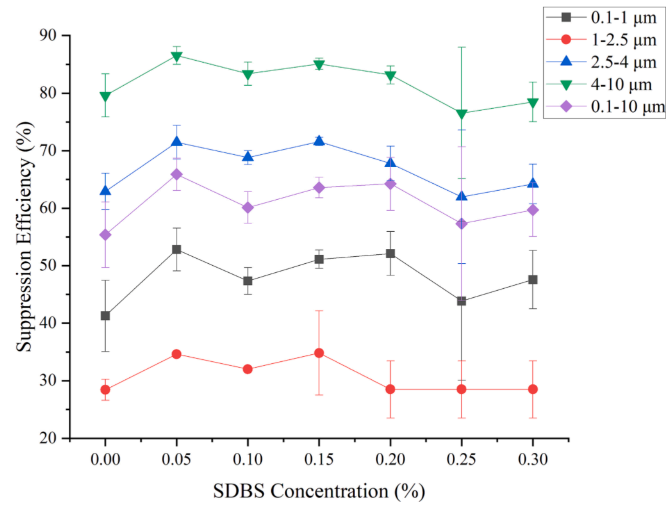


Fig. 6. The wind tunnel test result of SDBS.

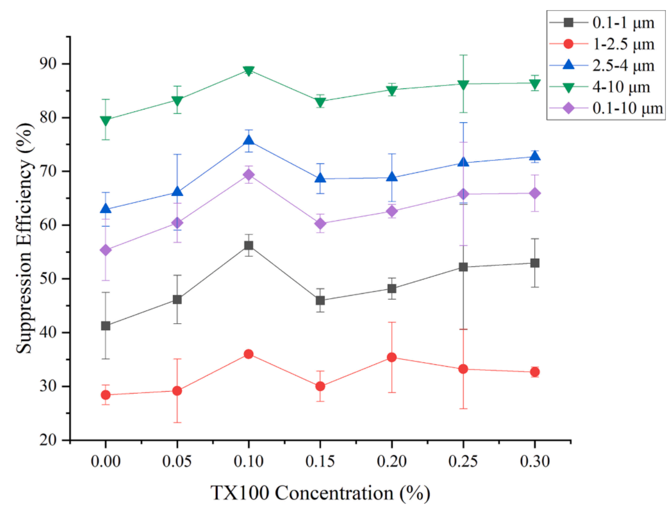


Fig. 7. The wind tunnel test result of TX100.

pore volume [36,41,57–59]. Coal particles with a strong air absorbability usually result in a high hydrophobicity. It was proved that finer particles would extraordinarily increase the period for the wetting process in static tests in previous studies. For instance, a sink test Chen et al.'s study showed that 0.20% SDBS would suppress 0.5 g coal particle sizes less than 38 μm over 100 s, while it would only take around 10 s for coal particles size ranging from 75 μm to 90 μm [38]. Another research of the contact angle test from Li et al.'s study revealed that the contact angle would increase significantly with the decrease of particle size, especially for particles less than 10 μm, resulting in worse wettability and poor suppression effects on underground coal mines [36]. An extended period would be required to eliminate the air from pores on the surface before wetting coal particles. Therefore, particle sizes less than 4 μm would result in low suppression efficiency due to the more complex microstructure and porous structure and smaller average pore diameter in this study.

Additionally, the quantity of coal particles could be another reason for this study. Although the particle distribution usually has been built based on the continuous distributions hypothetically, some researches show that the particle distribution could also present a discrete phenomenon [36,60]. As shown in Fig. 4, the distribution of particle size is presented. The average concentration of coal dust sizes between 0.1 μm and 10 μm was around 50 mg/m^3. The highest volume of coal particles can be found in the size of 0.1–1 μm, which is about 25 mg/m^3, accounting for almost 50% of total dust. The coal dust concentration in size of 1–2.5 μm was 15 mg/m^3, equating to around 29%. Surprisingly, the particle size between 1 μm and 2.5 μm accounts for the lowest amount, making up approximately 8%. Simultaneously, as seen in Fig. 3, the suppression efficiency at this coal dust size accounts for the lowest at 31.44%. Hence, the number of particles could also be a significant factor impacting the performance of surfactants.

3.2. Surfactant concentration

As shown in Table 2, the P-value of surfactant concentration is 0.002, ranking second among the three factors, which presents the essentiality of impacting the suppression efficiency. Fig. 5 illustrates the interaction between the surfactant concentration and the suppression efficiency. Notably, adding surfactants improved the suppression efficiency for coal dust control because a tremendous increase rate can be found from 0.00% to 0.05%. Indeed, untreated water (0.00% surfactants) suppressed 55% of coal dust ranging from 0.1 μm to 10 μm, while 0.05% of surfactants could raise the efficiency to around 63% on average with 15% improvement. The most incredible efficiency was observed at 0.10% and 0.20% concentrations, which were 65% and 64%, respectively. More details have been plotted accordingly in Fig. 6 and Fig. 7 by the surfactant type. 0.10% TX100 had the highest efficiency among all coal dust size classes. On the contrary, SDBS presented an excellent suppression efficiency for the coarser size at 0.15% and finer size of coal dust at 0.20%.

Other factors may also influence the performance of surfactants in coal dust suppression. As shown in Fig. 5, concentrations over 0.20% presented a decrease marked by fluctuations and demonstrated instability at 0.25%. This variability might be attributed to the generation of foam during experimental procedures, a phenomenon observed upon the application of both SDBS and TX100 surfactants. This observation also aligns with findings from our previous studies [44,55]. The foam generation can potentially interfere with the optimal capture of coal dust, thereby compromising suppression efficiency. While surfactants can significantly suppress coal dust, it is essential to acknowledge that certain surfactants, which include but are not limited to SDBS and TX100, have been identified as primary agents in foam generation within diverse research disciplines [61–66]. Therefore, foam generation is a significant factor influencing the performance of surfactants.

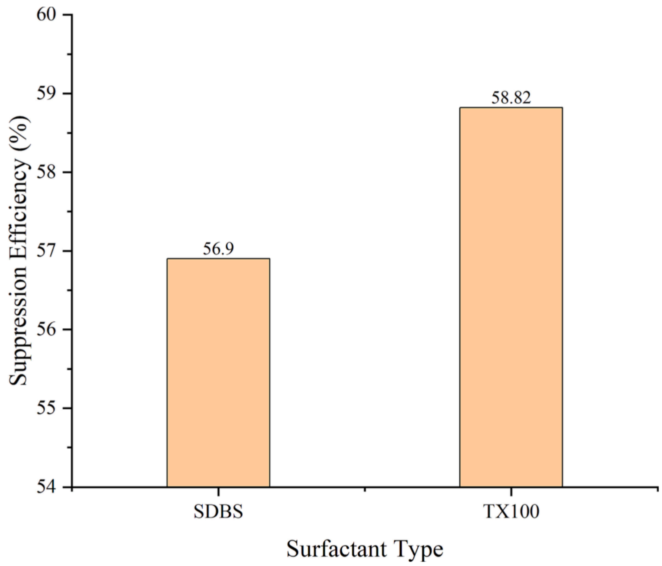


Fig. 8. The effects of surfactant type.

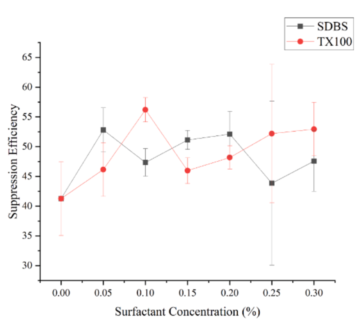
3.3. Surfactant type

The P-value of the surfactant type is 0.042, shown in Table 2, which indicates that the surfactant type is a crucial factor impacting the suppression efficiency. Fig. 8 gives the effects of surfactant type on the suppression efficiency. TX100 had around 59% of average suppression efficiency, which was slightly higher than SDBS. More details can be found in Fig. 9 to compare the effects of two surfactants. It is worth noting that SDBS had more outstanding performance through the whole dust size ranges at higher concentrations, such as 0.15% and 0.20%. Nevertheless, TX100 presented incredible domination at low concentrations. TX100 at 0.1% not only had the most outstanding suppression efficiency among seven concentrations, but also performed greater than SDBS regardless of the dust size range. The outstanding performance of TX100 can also be found in previous studies [48,67–69].

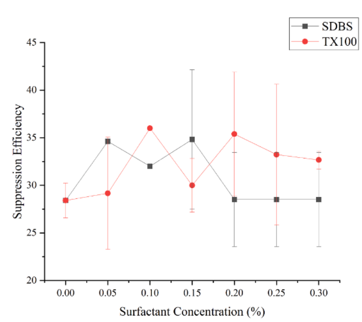
It is noticeable that interactions can be found between the surfactant concentration and the surfactant type. The P-value of the interaction between the two factors is 0.01, shown in Table 2. As analyzed above, TX100 had shown more excellent suppression efficiency than SDBS at lower concentrations around 0.10%. The critical micelle concentration (CMC) would be the main reason for this typical phenomenon. CMC represents the concentration of surfactant solutions when the surface of liquids is saturated with surfactant molecules. These molecules would form a unimolecular layer and interact at the surface. It was considered that surfactants could perform greater than others with a relatively higher aggregation number or a lower CMC [41,70]. If the concentration is lower than CMC, the unimolecular layer cannot be formed adequately, while the concentration is higher than CMC, extra surfactant molecules would form micelles within solutions. However, these micelles cannot interact at the surface as a standby state and thus have no apparent assistance. Additionally, the lower CMC of surfactants generally represents that lower surface tension could be achieved. Theoretically, coal particles are hard to be captured by surfactant droplets with high surface tension, resulting in a low suppression efficiency. A study proved that TX100 could achieve a lower surface tension than SDBS at the same concentration [41]. Therefore, in this study, because TX100 had a relatively lower CMC than SDBS, it would perform greater at lower concentrations.

4. Conclusion

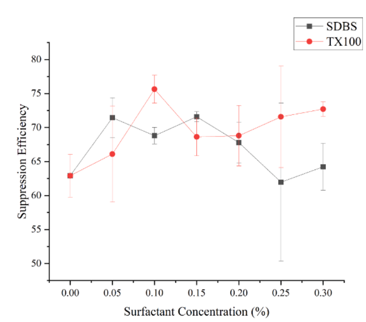
In this study, the suppression performance of surfactants on respirable coal dust particles of 0.1–10 μm was investigated. Our findings



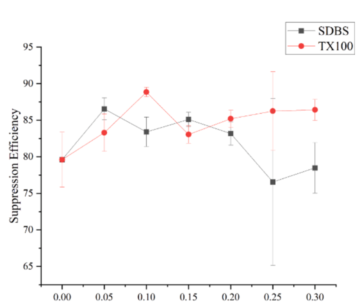
(a) Efficiency with 0.1-1 μm coal dust



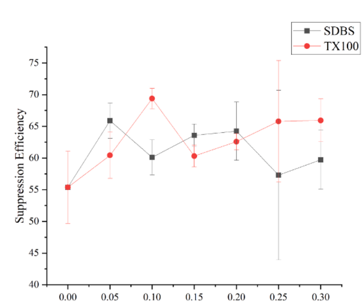
(b) Efficiency with 1-2.5 μm coal dust



(c) Efficiency with 2.5-4 μm coal dust



(d) Efficiency with 4-10 μm coal dust



(e) Efficiency with 0.1-10 μm coal dust

Fig. 9. Suppression efficiency with different coal size classes.

indicate an inverse relationship between particle size and suppression efficiency. Particles of 4–10 μm size demonstrated the highest suppression efficiency, whereas particles of 0.1–1 μm exhibited about half this efficiency. It is worth noting that suppression efficiency for particles smaller than 4 μm did not exceed 50% across all surfactant types and concentrations. Surprisingly, the lowest suppression efficiency was observed with the second finest particle size range at 1–2.5 μm. The reasons for this phenomenon are believed to be related to large surface areas, high air adsorption ability, and small amounts of coal particles. In addition, the surfactants used in this study, SDBS and TX100, showed that the type and concentration significantly influenced suppression efficiency. Non-ionic surfactant TX100 had marginally superior efficiency relative to SDBS, particularly around a concentration of 0.10%, due to its lower CMC and surface tension. SDBS, however, demonstrated comparable efficiency within a concentration range of 0.15% − 0.20%.

Despite these noteworthy observations, the performance of surfactants in suppressing finer coal dust, specifically within the particle size range of less than 2.5 μm, was limited. This diminished efficiency could contribute to the persisting prevalence of CWP and highlights the urgent need for improved strategies to efficiently control finer coal particles. Moreover, another significant future research from this study is the influence of coal rank on suppression efficiency when dealing with fine and ultrafine coal particles. It is conceivable that the coal rank, which impacts its physical and chemical properties, might also affect the interaction with surfactants and thus the suppression efficiency. Thorough investigations into this potential relationship will be critical for the development of more effective coal dust suppressants and dust suppression strategies, aiming to mitigate the health risks associated with coal dust.

CRediT authorship contribution statement

Zidong Zhao: Conceptualization, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Ping Chang:** Investigation, Supervision, Validation. **Guang Xu:** Methodology, Supervision, Validation. **Apurna Ghosh:** Supervision. **Ramakrishna Morla:** Investigation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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