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Research Article

Experimental Study on Dust Removal Performance of Electrostatic Water Film Cyclone Dust Collector

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Due to their limitations, conventional electric and water film dust removal methods struggle to handle fine dust. This study presented information on and examined the electrostatic water film cyclone dust collector (EWFCDC). By using the variable control approach, the impacts of inlet flow speed, water film flow rate, and corona pole form on dust removal performance were investigated. At EWFCDC, an orthogonal test was carried out to improve the test design and operating parameters based on the single-factor experiment. The pressure loss in the cyclone cylinder, when there is no water film and no corona pole, is a quadratic function of the inlet flow speed, and it is 2418.10 Pa at a 21.25 m/s inlet flow speed. The effectiveness of dust removal may be increased by increasing the water film flow rate. The effectiveness of dust removal is greatly influenced by the type of corona pole used, and cage needling thread is the optimal type. The electrostatic water film cyclone's multimechanism coupling significantly increases the effectiveness of dust removal.

1. Introduction

The control of fine dust is now challenging owing to the tightening of environmental protection criteria and the limits of conventional electric and water film dust removal methods. The limits of a single mechanism can be successfully offset by an electrostatic water film cyclone dust collector paired with several dust removal mechanisms, resulting in a more thorough and effective treatment of composite contaminants.

The majority of studies on wet electrostatic precipitators have concentrated on electrode discharge and spray performance, while the research on dust particle removal experiments and related influencing factor configuration is not sufficiently in-depth. However, relatively few studies have been conducted at home and abroad on electrostatic water film cyclone dust removal technology. Unreliable figures show that water film precipitators make up 50% of all coal-fired boiler precipitators [1]. Wet-type electric precipitators have the following issues: (1) In most box-type wet dust removal wet-type electric precipitators [2], dust particles are released through the outlet with the airflow before the charge reaches the plate. (2) The dust collection plate corrodes as a result of the water film adhering to it and the box structural plane being split [3]. It is impossible to apply the clean water film to the wall surface evenly. (3) In wet-type electric dedusting, water-laden flue gas is unavoidably produced, particularly when fine water mist is sprayed by nozzles [4]. High flow speeds inside the cylinder can cause the water-laden flue gas to be expelled from the outlet together with the airflow before it reaches the wall, which can lead to exhaust pipe corrosion and wet dust buildup [5]. An effective dedusting tool based on the wet layer purification principle is wet vibrating string grid technology [6]. High-frequency vibration from the vibrating string grid significantly raises the likelihood of dust, liquid droplets, and string collisions, which improves the effectiveness of dust removal from surfaces when high-speed airflow is present. The venturi has the advantages of high dust removal efficiency, compact volume, and minimal investment because it is made up of a shrink tube, throat tube, sprinkler, and expansion tube. The movement and settlement laws of dust

Figure 1: Physical drawing of the experimental model.

particles under the combined effect of various dust removal mechanisms are revealed by an experimental study of the dust removal performance, and the optimized configuration of the electrostatic water film cyclone dust collector is of great significance. This paper proposes a structure-optimized model of the electrostatic water film cyclone dust collector.

The three basic atomization processes—nozzle atomization, droplet impact atomization, and droplet wall atomization—are the foundation of the electrostatic water film cyclone's principle for removing dust. These processes are primarily accomplished through the combined action of inertial collision, gravity, electrostatic force, diffusion, and other dust removal mechanisms. Large dust particles are captured by gravity sedimentation and the interception effect; for tiny dust particles, electrostatic capture and diffusion capture processes are typically used. Inertial collision, the trapping effect, and electrostatic force are the key trapping mechanisms when the water fog charge is charged.

2. Experiment Installation

The experiment made use of a home-built electrostatic water film cyclone collector model. Figure 1 depicts the actual shape, whereas Figure 2 details the precise composition. The primary components of the experimental model are a cyclone (The upper diameter is 50 mm, and the lower diameter is 15 mm. The total height of the cyclone is 140 mm.), corona pole wire and power supply, a system for distributing water films, etc. It also has a fan, a dust generator, a water pump, a dust sampling device, a flow speed pressure drop monitoring device, and other auxiliary equipment.

3. Experimental Measurement

3.1. Particle Size Distribution of Experimental Dust. A microscope was used to determine the talc powder's particle size distribution [7]. The two dust samples utilized in this experiment were 10000 mesh ultrafine talc (i.e., 1.2 μm) and 400 mesh regular talc (i.e., 38 μm). The electrostatic water film cyclone dust collector's ability to remove dust was primarily investigated using ultrafine talc powder as the experimental sample [8].

The fundamental method for measuring particle size distribution by a microscope is to dissolve a filter membrane containing dust with butyl acetate, stir continuously to fully dissolve the dust particles, take a drop, place it on a slide, paint it into a specimen of dust, and place the slide on the microscope table. An electronic eyepiece is used to project the ScopePhoto image, and the measuring program calibrates the scale to establish the magnification. Following calibration, the program automatically converts the measured dimensions to real values and exports them in batches to Excel for immediate grading. Figure 3 displays the particle size distribution of the two dust samples, whereas Figure 4 displays the microscope and ScopePhoto projections.

The expression for the particle size distribution is

$$n = \left(\frac{a}{N}\right) * 100\%, \tag{1}$$

where n is the particle size distribution of dust particles, a is the number of particles belonging to a particular class of dust particles, and N is the total number of dust particles measured in a single sample.

By conducting single-factor and orthogonal experiments on the inlet flow speed, water film flow rate, and corona morphology, the influencing factors of the electrostatic water film cyclone resistance and dust removal effectiveness were examined, and its ideal configuration was achieved.

3.2. Influence of Inlet Flow Speed on Pressure Loss and Dust Removal Efficiency. A baffle regulates the flow speed in the electrostatic water film cyclone model. Six gears are positioned in the baffle, which is found near the fan's outlet. The three control conditions of a water film flow rate of 0 L/min, the installation of a single rebar corona pole, and a secondary voltage of 0 kV were maintained constant to avoid the impact of water film and voltage on the dust removal effect.

A pitot tube and an inclined differential pressure meter were used to measure the electrostatic water film cyclone's inlet flow speed and resistance loss. The outcomes are displayed in Figure 5.

Figure 5 depicts the fluctuation of the observed pressure under various flow speed circumstances. The findings indicate that, with a flow speed of 12 m/s, the observed pressure varies steadily and increases dramatically; at a flow speed of 17.32 m/s and 21.25 m/s, it reaches 1761.02 Pa and 2418.10 Pa, respectively.

Two dust samples were subjected to a single cyclone experiment for the removal of dust under the conditions of no water film and no voltage, and the results are displayed in Figure 6.

According to the findings in Figure 6, regular talc is removed from the air by the cyclone dust collector at a rate that is substantially higher than that of ultrafine talc. At an inlet flow speed of 12.00 m/s, the efficiency was 84.96%, while ultrafine talc's maximum efficiency was only 20.19%.

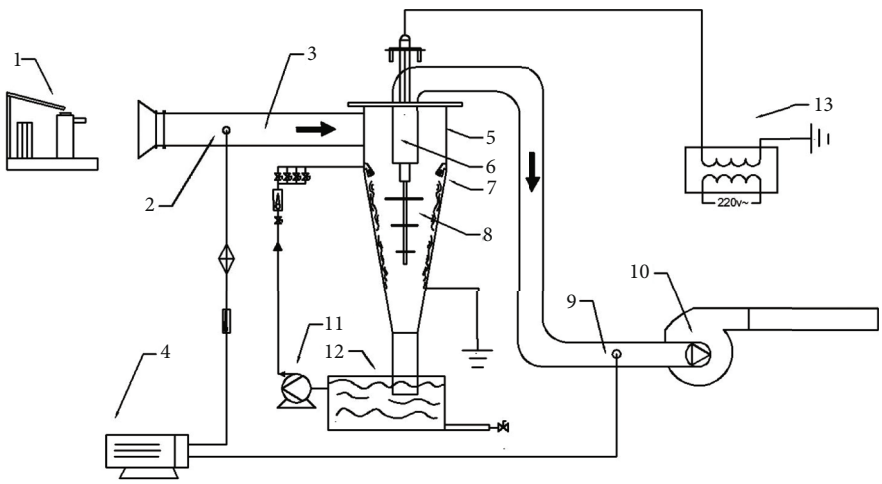

Figure 2: Schematic diagram of experimental device. 1. Dust generator; 2. Sampling hole in front section; 3. Inlet pipe; 4. Filter membrane pump; 5. Cyclone cylinder; 7. Water film nozzle; 8. Corona electrode; 9. Sampling hole in back section; 10. Fan; 11. Water pump; 12. Circulating water tank; 13. High voltage source.

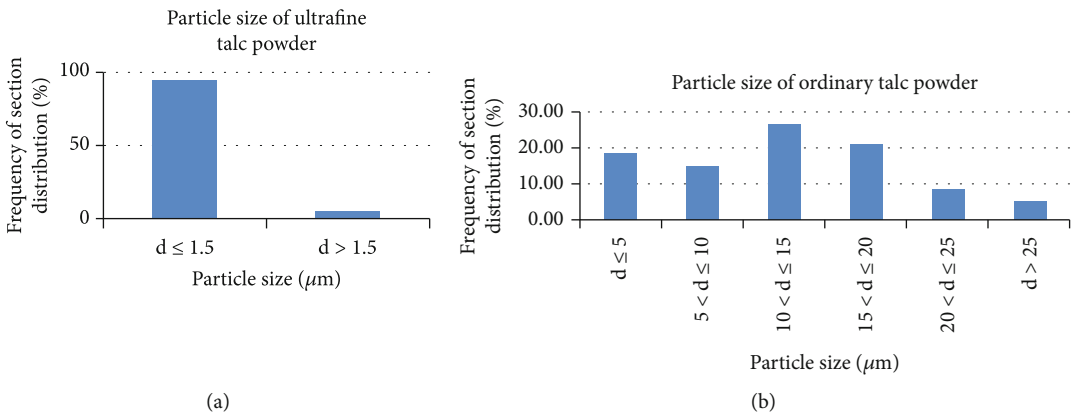

Figure 3: Particle size distribution of two talc dust samples.

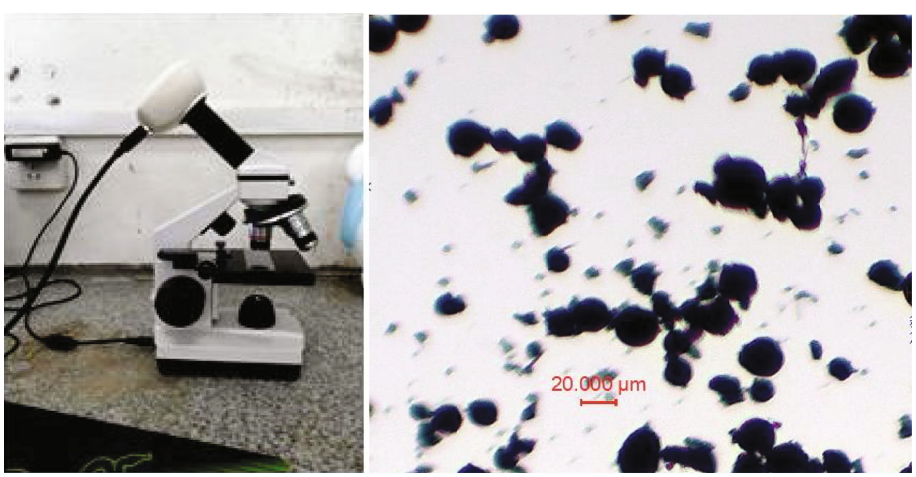

Figure 4: Microscope and microscopic dust image.

A cyclone separator was used to study the law of dust reduction efficiency of the two kinds of dust under the influence of the inlet flow speed, as shown in Figure 6. The normal talc powder was simpler to remove under the action of a single cyclone than the ultrafine talc powder, but the overall efficiency was still not very great. Cyclone removal of ultrafine talc powder has virtually little effect. The best inlet flow speed for both dusts was between 0 and 25 m/s, showing that the cyclone should not be operated at either an excessively high or low flow speed.

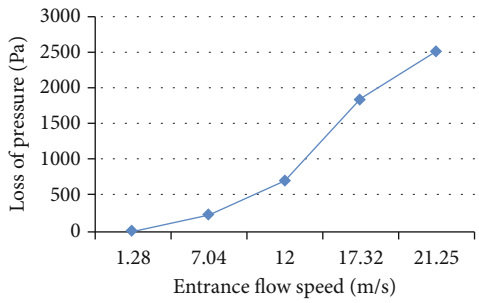

Figure 5: Inlet flow speed and pressure loss curve.

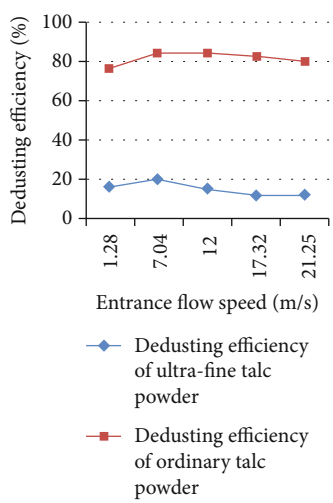

Figure 6: Dust removal efficiency of inlet flow speed under no water film and no voltage conditions.

3.3. Influence of Water Film Flow on Dust Removal Efficiency. Investigated how increasing the water film flow coefficient could increase the effectiveness of cyclone dust removal. Installing a single-threaded electric corona electrode with a secondary voltage of 0 kV at three water film flow rates of no water film, 12.50 L/(min.m^2) water film, and 25.01 L/(min.m^2) water film allowed for the experimental study of the dust removal efficiency of ultrafine talc power at various flow speeds. In Figure 7, the measurement results are displayed.

The efficiency of ultrafine talc powder dust removal in the water film cyclone dust collector was greatly enhanced after the development of the water film. The best efficiency was attained at a flow rate of 12.50 L/(min.m^2), which was 48.13% and 58.78%, respectively, when the optimal flow speed was 7.04 m/s and 12.00 m/s.

Figure 7 depicts the variations in dust removal effectiveness under the three different water film flow conditions. All three curves have declining dust removal efficiencies when the flow speed is too low or too high; the working flow speed range of 5 to 15 m/s has the maximum efficiencies.

The best dust removal performance occurs when the inlet flow speed is 7 m/s, and the dust removal performance when there is no water film is 20.19%. Efficiency dramatically declines when the inlet flow speed reaches 12 m/s.

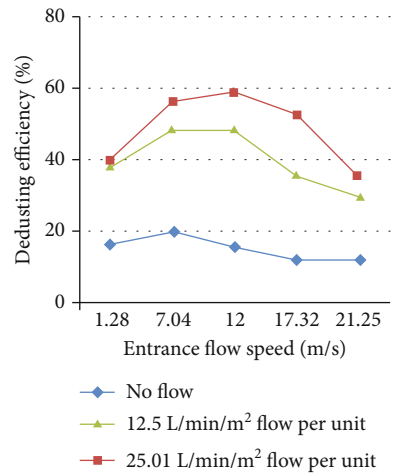

Figure 7: Relationship curve of water film flow rate on dust removal efficiency at different inlet flow speeds.

The lowest dust removal efficiency is only 12.10% when the inlet flow speed is 17.32 m/s. The water film flow rate of 25.01 L/(min.m^2) increased the cyclone effectiveness, and 12.00 m/s produced a maximum dust reduction efficiency of 58.78%. The findings demonstrate that the water film cyclone has enhanced the ability to remove fine particles, but that total removal is challenging.

The effectiveness of a cyclone dust collector's dust removal can be greatly increased by the conditions of the water film. The effectiveness of dust removal can be increased by increasing the water film flow rate; however, the improvement gradually fades. This is because, in comparison to the situation without a water film, adding a tiny amount of water film to complete the wall coverage can reduce interaction with the airflow, reduce frictional resistance, and absorb fine particles. The advantages are minimal, though, as the performance of the wall is not fundamentally altered by raising the water film flow. Therefore, to achieve higher dust removal efficiency and lower water and electricity consumption, the dust collection performance in the experiments with the best parameter configuration should be focused on the water film rates of 12.50 L/(min.m^2) and 25.01 L/(min.m^2).

3.4. Effect of Corona Electrode Morphology on Dust Removal Efficiency. For the purpose of producing dust, regular talc powder was used, and the inlet flow speed was 12.03 m/s. The experimental items were a wider blower nozzle with a unit area flow rate of 68.40/(min.m^2), a combined nozzle with a flow rate of 61.20 L/(min.m^2), and a solid conical nozzle with a 1 mm aperture of 19.80 L/(min.m^2). When the electrostatic voltage varies, the amperage characteristic curve of the electrostatic cyclone water film precipitator is investigated. Figure 8 displays the final result.

According to Figure 8, as the electrode voltage is raised, the discharge current will increase as well. The best discharge effect is achieved with a solid cone nozzle that is 1 mm in diameter; however, the electrode voltage should not be raised too high due to the risk of a breakdown phenomenon. A voltage rise of 25 kV is the highest stable point.

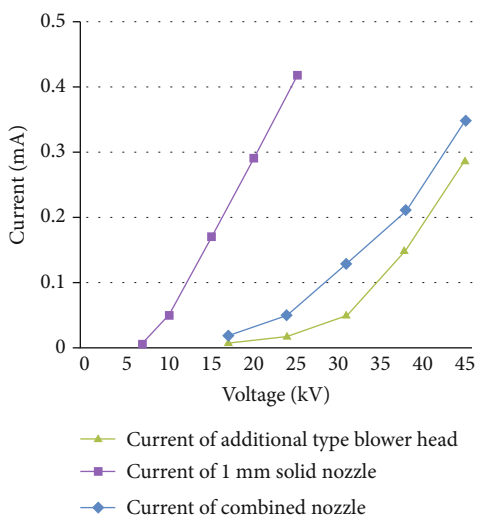

Figure 8: Volt-ampere characteristic.

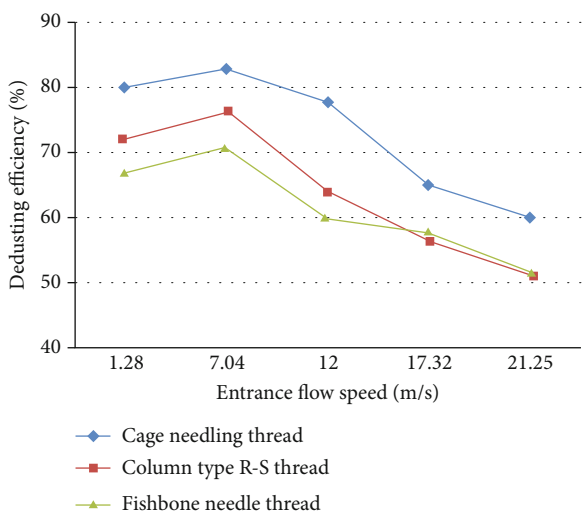

Figure 9: Dust removal efficiency of corona electrode form.

Another crucial element influencing how well dust is removed by electrostatic water film cyclone dust collectors is the morphology of the corona electrode. The probable placement of the conical dust collecting tube and the effect of the water film dust collector on the corona discharge should be taken into account while designing the corona electrode shape. The water film dust collector conical tube's ability to remove dust electrostatically under various corona forms was investigated, and the best corona electrode was optimized. The water film flow rate of 25.01 L/(min.m^2), an operating voltage of 45 kV, and the use of ultrafine talc powder for the experiments were all kept constant. By altering the corona pole form, the effectiveness of dust removal at various flow speeds was assessed; the results are displayed in Figure 9.

As shown in Figure 9, the three types of corona electrodes—cage needling corona electrode, R-S column corona electrode, and fishbone needle corona electrode—have a stronger impact on the effectiveness of dust removal from electrostatic water film cyclone dust collectors. The cage needling thread corona electrode has a higher dust removal efficiency than the other two corona electrodes, at 83.03 percent; in comparison, the R-S column corona electrode and the fishbone needle electrode have dust removal efficiencies of 76.11% and 70.92%, respectively. 7.04 m/s of flow speed is ideal. The dust can be absorbed by the dust collection cyclone, and the electric field force also contributes to dust collection under ideal operating flow speed and water film conditions. The cage needling thread corona electrode outperforms the R-S column corona electrode and the fishbone needle corona electrode in terms of corona discharge capacity and discharge current at 45 kV operating voltage. Under the influence of the electric field force, cyclone centrifugal force, and water film in the electrostatic water film cyclone collector, the cage needling thread corona electrode has a good dust collection effect at optimum inlet flow speed.

The details of the three types of corona electrodes are as follows:

(a) Cage Needling Thread: Using the prickly wire as a base, a cage-type design has been added to make the corona wire's total electric potential fairly consistent before discharge from the tip to the anode plate

(b) Column-Type R-S Thread: Inside the cyclone dust collector, some researchers have placed guide plates, guide rods, etc. Based on the simulation results in the preceding text, friction between the internal and external reverse swirls is one of the primary causes of pressure decreases in the cyclone dust collector. In order to isolate internal and external swirls during discharge and lower the resistance of the dust collector, the column-type R-S line corona electrode is designed with an extended cylindrical electrode that is directly set below the exhaust pipe

(c) Fishbone Needle Thread: Although the fishbone needle is housed in a conical cylinder, the fishbone needle and thread have performed well in the practical application of various medium plate electrostatic precipitators. The aforementioned shapes are set up to uniformly manage the discharge at their needle end

3.5. Orthogonal Experiment of Factors Affecting Dust Removal Efficiency. The relevance and interaction of each factor's influence on dust removal efficiency were examined based on the single-factor dust removal performance study to offer a foundation for the electrostatic water film cyclone dust collector's optimization strategy. Inlet flow speed, water film flow rate, and corona electrode form were the three factors that were the subject of orthogonal studies and ANOVA. With a working voltage of 45 kV and ultrafine talc powder, the corona electrode morphologies include cage needling thread corona, R-S column corona, and fishbone needle corona. Table 1 displays each factor's levels.

Table 1: Factor level table.

Lever	Factor		
	Entrance flow speed (m/s)	Water film flow (L/(min.m^2))	Corona electrode form
I	7.04	0	Column R-S
II	12.00	12.50	Fishbone needle
III	21.25	25.01	Cage needling thread

Table 2: Results of orthogonal test and ANOVA.

Number	Factor				
	Entrance flow speed (m/s)	Water film flow (L/(min.m^2))	Corona electrode form	Interaction	Dust removal efficiency/%
1	7.04 (1)	0 (1)	Column R-S (1)	(1)	60.20
2	7.04 (1)	12.50 (2)	Fishbone needle (2)	(2)	76.11
3	7.04 (1)	25.01 (3)	Cage needling thread (3)	(3)	80.09
4	12..00 2)	0 (1)	Cage needling thread(3)	(2)	70.33
5	12.00 (2)	12.50 (2)	Column R-S (1)	(3)	56.79
6	12.00 (2)	25.01 (3)	Fishbone needle (2)	(1)	63.98
7	21.25 (3)	0 (1)	Fishbone needle (2)	(3)	42.85
8	21.25 (3)	12.50 (2)	Cage needling thread (3)	(1)	55.64
9	21.25 (3)	25.01 (3)	Column R-S (1)	(2)	51.92
K_{1j}	216.40	173.38	168.91	179.82	—
K_{2j}	191.10	188.54	182.94	198.36	—
K_{3j}	150.41	195.69	206.06	179.73	—
${K_{1j}}^2$	46828.96	30060.62	28530.59	32335.23	—
${K_{2j}}^2$	36519.21	35547.33	33467.04	39346.69	—
${K_{3j}}^2$	22623.17	38294.58	42460.72	32302.87	—
Q_j	35323.78	34634.18	34819.45	34661.60	—
SS_j	738.94	49.34	234.61	1138.81	—

These calculations were made for the ANOVA:

$$P = \frac{1}{9}\left(\sum_{i=1}^{9} x_i\right)^2,$$
$$Q_j = \frac{1}{3}\left(K_{j1}^2 + K_{j2}^2 + K_{j3}^2\right), \quad (2)$$
$$SS_j = Q_j - P.$$

where P is the geometric mean of each experimental value; x_i is the experimental value; K_{ji} is the sum of the experimental values of J factors at the I level, i.e., $Kij = \sum_{j=1}^{a} x_{ij}$; J is the experimental influence factor; Q_j is the mean of the sum of the squares of the experimental values under the j factor ($j = A, B, C$); and SS_j is the sum of squares of the variance.

Table 2 displays the analytical results as well as the specific experiment outcomes.

F values were obtained after collapsing the measurements in Table 2 into the sum of squared deviations of the affecting factors. Given the test level α, Table 2's F distribution was used to determine the crucial significant values $F_{0.25}(2, 2) = 3$, $F_{0.10}(2, 2) = 9$, $F_{0.05}(2, 2) = 19$, and $F_{0.01}(2, 2) = 99$. The more relevant the element influencing dust removal effectiveness, the higher the F value.

According to Table 3, the influences of inlet flow speed, corona pole form, water film flow, and interaction on the effectiveness of dust removal by electrostatic water film cyclone dust collectors all attained significant levels. With an F-value of 63.76, the inlet flow speed is the most important element. The corona polar shape, with an F-value of 20.24, is the second most important determinant of the effectiveness of dust removal. With an F-value of 4.26, the water film flow rate has a less significant impact. In other words, inlet flow speed, corona pole form, and water film flow rate are the factors that have the greatest impact on the effectiveness of dust removal.

The interaction group data's F-value is 98.24, which is close to the F-standard for extremely significant variables and suggests that the three influencing factors interact to have a bigger impact on the outcomes. That means there is

Table 3: Significant analysis of influencing factors.

Source of variance	Sum of squares of deviations	Free degree	Mean deviation sum of square	F-value	Conspicuousness
Entrance flow speed	738.94	2	369.47	63.76	***
Water film flow	49.34	2	24.67	4.26	*
Corona electrode form	234.61	2	117.31	20.24	***
Interaction	1138.81	2	569.41	98.24	***
Error	115.92	2	57.96		

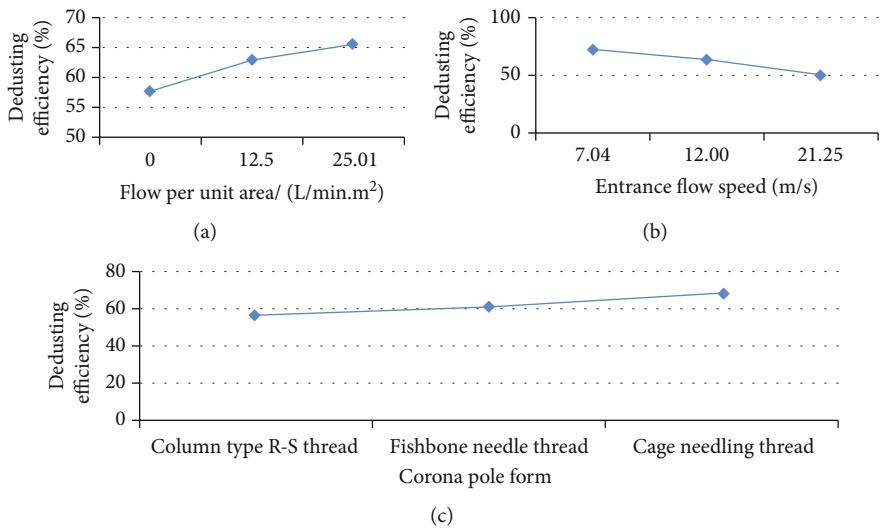

Figure 10: Analysis chart of factors influencing dust removal efficiency.

a strong linkage between the impacts of inlet flow speed, water film flow rate, and corona pole form on the dust removal process.

The dust removal efficiency is generally low and flat when the inlet flow speed is between 7 and 12 m/s.

The cause is that charged particles can travel entirely from the airflow to the dust collection wall within the residence time since their driving speed is almost constant. The residency duration of the dust particles decreases as the flow speed in the electric field rises, and they are swept out of the cyclone without being suitably charged. The efficiency of dust removal significantly declines at a 12 m/s flow speed. Corona electrodes vary greatly across various forms of corona electrodes in performance studies, which is a crucial factor in improving the removal rate of tiny particles. A strong air exhaust system can increase dust removal effectiveness by 5% to 12%. Studies show the importance of water film in the process of removing dust, which can increase that efficiency by 5% to 10%. The effect is more pronounced when the water film flow is combined with a corona electrode.

According to Figure 10(b), the ideal flow speed is 7.04 m/s. As the input flow speed increases, the electrostatic water film cyclone's effectiveness falls quickly. The electrostatic water film cyclone dust collector achieves wall-driven motion primarily by the coupling of centrifugal force and electric field force, with the electric field force factor playing a significant role for fine particles. The electric field force remains constant as the flow speed rises, but the efficiency and particle residence time both drastically decrease. The effectiveness of dust removal is greatly influenced by the type of corona pole used, and the best type is a cage needling thread, as shown in Figure 10(c). The reason for this is that the discharge performance controls how many free electrons are present in the electric field, which influences the likelihood that dust will charge and enhances the performance of dust removal. The water film flow rate has a similar and less significant impact on the effectiveness of removing dust. The optimal flow rate is 12.50 L/(min.m^2), and the efficiency curve flattens out over time. The water film may cover the metal wall more thoroughly at a flow rate of 12.50 L/(min.m^2); hence, increasing the water film flow rate lowers the efficiency improvement, as illustrated in Figure 10(a). Therefore, cyclone dust removal, electric dust removal, and water film dust removal are the three primary dust removal mechanisms of the electrostatic water film cyclone. These three mechanisms have good complementary effects, and the absence of one or both of them may result in a 10%–30% reduction in overall dust removal efficiency. Appropriate configurations of cyclone air tubes, corona lines, and dust water films enable effective dust removal.

3.6. Optimum Operational Parameters Configuration. Table 4 displays the electrostatic water film cyclone's ideal

Table 4: Optimal configuration parameters of the device.

System	Item	Parameter
Cyclone cylinder	(1) Cylinder type	Turn-back conical cylinder
	(2) Inlet flow speed	7.04 m/s
Water film	(1) Nature of the water film	Fiber evenly uniform water film
	(2) Water film flow	25.01 L/(min./m^2)
Corona electrode	(1) Electrode form	Cage needling thread
	(2) Secondary voltage	55 kV

Table 5: Optimal parameter configuration for removal efficiency of two kinds of dust.

Dust sample type	Dust removal efficiency/%
Ordinary talc powder (namely, 38 μm)	99.50
Ultrafine talc powder (namely, 1.2 μm)	93.14

setup and operating conditions. The water film and cage needling thread were both set to flow at their maximum rate of 25.01 L/(min.m^2). The voltage was adjusted to 55 kV to enhance the number of positive and negative ions and the average electric field strength to improve the effectiveness of dust removal in light of the cage needling thread's good discharge performance.

Both regular and ultrafine talc dust samples were tested for dust removal using the electrostatic water film cyclone dust collector under the parameter setup parameters described in Table 4. According to the testing findings, the electrostatic water film cyclone dust collector has a dust removal effectiveness of 99.50% for regular talc and 93.14% for fine powder (particle size less than 1.2 μm), as shown in Table 5.

4. Conclusion

Using a variable control method, the effects of inlet flow speed, water film flow rate, and corona pole form on the dust removal efficiency of an electrostatic water film cyclone dust collector were examined. The following results were reached after conducting orthogonal experiments in the electrostatic water film cyclone dust collector with optimal configuration and operating parameters based on single-factor studies:

(1) Without the water film and corona pole, the cyclone pressure loss is inversely proportional to the inlet flow speed, and at an inlet flow speed of 21.25 m/s, the pressure loss is 2418.10 Pa. The efficiency of removing dust increases initially and then falls as the incoming flow speed increases. The highest dust removal effectiveness of a common cyclone for common talc powder is 84.96% when the single cyclone dust removal mechanism is in operation, and the input flow speed is 12.00 m/s. The typical cyclone's maximum dust removal efficiency for ultrafine talc powder is 20.19% when the input flow speed is 7.04 m/s. These tests confirmed the cyclone's limitations in the removal of fine particles and offered a benchmark for later component installation

(2) Under the same maximum flow speed situation, adding wall water film can minimize pressure loss by roughly 20% and lower the pressure drop of the water film cyclone from 2418.10 Pa to 1932.45 Pa. At the ideal flow speeds of 7.0 m/s and 12.00 m/s, respectively, the dust reduction efficiency was 48.13% and 58.78% for two water films of 12.50 L/(min.m^2) and 25.01 L/(min.m^2), respectively. According to the experimental findings, raising the water film's flow rate can enhance its ability to remove dust; however, as the flow rate rises, this enhancement of dust removal effectiveness becomes less rapid

(3) The best corona pole is the cage needling thread, and the type of corona pole has a significant impact on the effectiveness of dust removal. The reason is that the discharge efficiency impacts the number of free electrons in the electric field, which influences the likelihood of dust charge and enhances the efficiency of dust removal

(4) According to the orthogonal experiment ANOVA significance analysis, the intake flow speed has the most significant impact on the effectiveness of dust removal in the electrostatic water film cyclone, followed by the corona pole form and the water film flow rate. The electrostatic water film cyclone's multimechanism coupling significantly increases the effectiveness of dust removal

(5) The orthogonal experiment served as the foundation for the optimal configuration experiment. The inlet flow speed of 7.04 m/s, the unit area of 25.01 L/(min.m^2), the fiber optic network with a uniform water film and cage needling thread, and the operating voltage of 55 kV were found to have the best dust removal efficiency. The typical talc sample had a 99.5% dust clearance rate. In the electrostatic water film cyclone dust collector, the rate of dust reduction for the ultrafine talc sample was 93.14%

To completely wet the dust, surfactant solution droplets can stick to and spread throughout a surface that is free of dust particles. Compared to water, the surfactant solution will break and divide into smaller and more droplets when it is sprayed from the nozzle at a fast rate of speed. This will increase the likelihood of a collision and the surface area where dust and fog droplets will come into contact. Additionally, the mixture of dust and fog droplets is more steady, which can to some extent increase the effectiveness of dust removal. This experiment, which is constrained by the experimental site and conditions, simply employs water as a solution, but appropriate surfactants should

be added to optimize the dust removal effectiveness based on the chemical characteristics of dust. The effectiveness of an electrostatic water film cyclone dust collector at removing dust will be examined under various surfactant solution conditions in the ensuing experimental research. Existing experimental equipment and equipment will be modified.

Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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