Coagulation Tool Parameters during Emergency Dwasposal of Drinking Water Source

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Abstract. The research and development of the emergency handling device was to deal with sudden pollution incidents of drinking water sources. Kaolin was used to prepare experimental simulated wastewater, and water turbidity was used as an evaluation index. The effect of stirring methods, rotation speed and agitation time on the diffusion rate of kaolin in the water-coagulation pool in water was investigated by single-factor experiments. Then determine the coagulation pool parameters for the emergency treatment of drinking water sources. The results showed: (1) The best stirring parameters for the coagulation pool during mechanical stirring were: stirring speed 80 r/min, stirring time 30 s. (2) The optimal stirring parameters for the coagulation pool during submersion stirring were: the stirring speed was 100 r/min, and the stirring time was 60 s. (3) The optimal flow parameters of the coagulation pool for the gravity-flow of water were: the flow velocity of the water was 2 m/s and the time was 10 minutes. The research showed: the mechanical stirring method was more conducive to the diffusion of the coagulant in the coagulation pool than the submersible stirring and the water body gravity-flow; the parameters of the coagulation pool in the emergency treatment of drinking water sources were determined as the stirring mode: mechanical stirring, stirring speed: 80 r/min, stirring time: 30 s.

1. Introduction
Drinking water source was a very important public infrastructure in rural and urban wereas of China[1]. It ensure the residents' water supply safety and social daily operation, and it was also an important part of the local ecosystem[2]. Sudden pollution incidents of all kinds of drinking water sources have caused severe damage and threats to the society[3]. Thwas makes the emergency treatment of drinking water sources a hot wassue[4]. Li Qingyun[5] analyzed four types of sudden water pollution accidents, and proposed emergency treatment of sudden water pollution should be constructed from three aspects: emergency management, forecasting and early warning, and emergency treatment technologies. Zhang Yong[6] analyzed four stages of the emergency response process of sudden pollution of drinking water sources, and proposed the emergency mechanwasm of “emergency center-affiliated organization”. Based on the exwasting process of the water plant, Wei Zhikuan[7] added potassium permanganate, coagulant PAM and pH-adjusted nickel removal, and obtained the best process conditions. Xiong Wei[8] conducted a field survey of drinking water sources and water plants in Hubei Province and proposed a reasonable proposal for the emergency treatment of drinking water sources from the legwaslative and legal level. However, most of the exwasting researches have remained in theoretical studies of emergency management systems for drinking water
sources or emergency treatment technologies for specific types of pollutants. There was still a gap in the research and development of emergency drinking water source equipment.

Kaolin was used to prepare simulated wastewater\textsuperscript{[9]}, and water turbidity was used as an evaluation index\textsuperscript{[10]}. Through single-factor experiments, the effect of mixing method, rotation speed and stirring time on the diffusion rate of kaolin in the dissolution pool was studied. Further determine the parameters of the coagulation pool in the emergency treatment of drinking water sources, and lay a technical foundation for the research and development of drinking water source emergency treatment devices.

2. Material and methods

2.1. Material

Kaolin was commercially available for analysis. Coagulation pool test water was used to prepare a certain turbidity kaolin simulated wastewater using tap water, and the simulated wastewater concentration was 0.1 g/L. Turbidity meter (WGZ-18 type, Shanghai Xuancheng Instrument Co., Ltd. and conventional experimental instruments); water pump (40ZX10-40 type, Shanghai Shangmin Pump Co., Ltd.); vertical mixer (BLD12-23-2.2KW-380V type, Yongli Motor Co., Ltd.); inverter (8000B, Guangzhou Sanjing Electric Co., Ltd.); submersible mixer (QJB0.37/4-220/3-1440, Yongli Motor Co., Ltd.).

2.2. Methods

Kaolin was used to prepare experimental simulated wastewater, and water turbidity was used as an evaluation index. The effect of stirring methods, rotation speed and agitation time on the diffusion rate of kaolin in the water-coagulation pool in water were investigated by single-factor experiments. The stirring methods were mechanical stirring, submersible stirring, and gravity-flow of water. The mechanical stirring and submersible stirring speeds were set to 60 r/min, 80 r/min, and 100 r/min, respectively. The mechanical stirring time was set to 10s, 30s, 50s, and 70s, respectively. The diving mixing time was set to 30s, 60s, and 90s, respectively. The time of water gravity-flow was set to 5 min, 10 min, 15 min, and 20 min, respectively. The flow velocity of the water body was set to 0.5 m/s, 1 m/s, and 2 m/s, respectively. The sampling point of the coagulation pool experiment was 9. They were 0m from the center of the pool and 0m from the water surface, 0.5m from the center of the pool and 0m from the water surface, 1m from the center of the pool and 0m from the water surface, 0m from the center of the pool and 0.5m from the water surface. The center of the pool was 0.5m and 0.5m away from the water surface, 1m from the center of the pool and 0.5m above the water surface, 0m from the center of the pool and 1m above the water surface, 0.5m from the center of the pool and 1m above the water surface.

3. Results and discussion

3.1. Effects of Rotation Speed and Mixing Time on Diffusion Rate of Kaolin in Water Under Mechanically Agitation

In the first group, added 314 g of kaolin into a pool with 3,140 L of tap water under mechanical agitation, stirred at a speed of 60 r/min for a certain period and took water sample at each sampling points. The turbidity of the samples were measured by a turbidimeter. The experiment was repeated with stirring time of 10s, 30s, 50s and 70s, respectively. The effect of mixing time on the diffusion rate of kaolin in water at a stirring speed of 60 r/min was investigated. As can be seen from Figure 1, under the condition of mechanical stirring, 60 r/min stirring speed, when the stirring time was between 10-70s, the turbidity difference at each sampling point of the simulated wastewater decreases with increasing stirring time. When the mixing time was 70 s, the turbidity of the simulated wastewater was basically the same.
In the second group, added 314 g of kaolin into a pool with 3,140 L of tap water under mechanical agitation, stirred at a speed of 80 r/min for a certain period, took sample at each sampling points. The turbidity of the samples were measured by a turbidimeter. The experiment was repeated with stirring time of 10s, 30s and 50s, respectively. The effect of mixing time on the diffusion rate of kaolin in water at a stirring speed of 80 r/min was investigated. As shown in Figure 2, under the condition of mechanical stirring, 80 r/min stirring speed, when the stirring time was between 10-50s, the turbidity difference at each sampling point of the simulated wastewater decreases with increasing stirring time. When the mixing time was 50 s, the turbidity of the simulated wastewater was basically the same.

In the third group, added 314 g of kaolin into a pool with 3,140 L of tap water under mechanical agitation, stirred at a speed of 100 r/min for a certain period, took sample at each sampling points. The turbidity of the samples were measured by a turbidimeter. The experiment was repeated with stirring time of 10s, 30s and 50s, respectively. The effect of mixing time on the diffusion rate of kaolin in water at a stirring speed of 100 r/min was investigated. As shown in Figure 3, under the condition of mechanical stirring, 100 r/min stirring speed, when the stirring time was between 10-50s, the turbidity difference at each sampling point of the simulated wastewater decreases with increasing stirring time. When the mixing time was 50 s, the turbidity of the simulated wastewater was basically the same.

From the above experimental results, under mechanical agitation, 60-100 r/min stirring rate, the diffusion rate of kaolin in simulated wastewater increases gradually with the increase of mixing time, the turbidity difference at each sampling point of the simulated wastewater decreases with increasing stirring time. Therefore, under the mechanical stirring conditions, the best stirring parameters for the coagulation pool were: stirring speed 80 r/min, stirring time 30 s.
3.2. Effects of Rotation Speed and Mixing Time on Diffusion Rate of Kaolin in Water Under Immersion Stirring

In the first group, added 314 g of kaolin into a pool with 3,140 L of tap water under immersion stirring, stirred at a speed of 60 r/min for a certain period, took sample at each sampling points. The turbidity of the samples were measured by a turbidimeter. The experiment was repeated with stirring time of 30s, 60s and 90s, respectively. The effect of mixing time on the diffusion rate of kaolin in water at a stirring speed of 60 r/min was investigated. As can be seen from Figure 4, under the condition of submersion stirring, 60 r/min stirring speed, when the stirring time was between 30-90s, the turbidity difference at each sampling point of the simulated wastewater decreases with increasing stirring time. When the mixing time was 90 s, the turbidity of the simulated wastewater was basically the same.

In the second group, added 314 g of kaolin into a pool with 3,140 L of tap water under immersion stirring, stirred at a speed of 80 r/min for a certain period, took sample at each sampling points. The turbidity of the samples were measured by a turbidimeter. The experiment was repeated with stirring time of 30s, 60s and 90s, respectively. The effect of mixing time on the diffusion rate of kaolin in water at a stirring speed of 80 r/min was investigated. As shown in Figure 5, under the condition of mechanical stirring, 80 r/min stirring speed, when the stirring time was between 30-90s, the turbidity difference at each sampling point of the simulated wastewater decreases with increasing stirring time. When the mixing time was 90 s, the turbidity of the simulated wastewater was basically the same.

In the third group, added 314 g of kaolin into a pool with 3,140 L of tap water under immersion stirring, stirred at a speed of 100 r/min for a certain period, took sample at each sampling points. The turbidity of the samples were measured by a turbidimeter. The experiment was repeated with stirring time of 30s, 60s and 90s, respectively. The effect of mixing time on the diffusion rate of kaolin in water at a stirring speed of 100 r/min was investigated. As shown in Figure 6, under the condition of mechanical stirring, 100 r/min stirring speed, when the stirring time was between 30-90s, the turbidity difference at each sampling point of the simulated wastewater decreases with increasing stirring time. When the mixing time was 60 s, the turbidity of the simulated wastewater was basically the same.

From the above experimental results, under submersion stirring, 60-100 r/min stirring rate, the diffusion rate of kaolin in simulated wastewater increases gradually with the increase of mixing time, the turbidity difference at each sampling point of the simulated wastewater decreases with increasing stirring time. Therefore, under the submersion stirring conditions, the best stirring parameters for the coagulation pool were: stirring speed 100 r/min, stirring time 60 s.

3.3. Effects of Rotation Speed and Mixing Time on Diffusion Rate of Kaolin in Water Under Gravity-flow

In the first group, simulated wastewater with a turbidity of 200 NTU in raw ponds was pumped through the pump to the coagulation pool at a flow rate of 0.5 m/s, sample at each of the 9 sampling
points after a certain period of time. The turbidity of the sample was measured with a turbidimeter. Set the time separately to 5min, 10min, 15min, 20min. The effect of mixing time on the diffusion rate of kaolin in water at a gravity-flow of 0.5 m/s was investigated. As can be seen from Figure 7, under the condition of gravity-flow, 0.5 m/s flow speed, when the mixing time was between 5-20min, the turbidity difference at each sampling point of the simulated wastewater decreases with increasing stirring time. When the mixing time was 20 min, the turbidity of the simulated wastewater was basically the same.

In the second group, simulated wastewater with a turbidity of 200 NTU in raw ponds was pumped through the pump to the coagulation pool at a flow rate of 1 m/s, sample at each of the 9 sampling points after a certain period of time. The turbidity of the sample was measured with a turbidimeter. Set the time separately to 5min, 10min, 15min. The effect of mixing time on the diffusion rate of kaolin in water at a gravity-flow of 1 m/s was investigated. As can be seen from Figure 8, under the condition of gravity-flow, 1 m/s flow speed, when the stirring time was between 5-15min, the turbidity difference at each sampling point of the simulated wastewater decreases with increasing stirring time. When the mixing time was 15 min, the turbidity of the simulated wastewater was basically the same.

In the third group, simulated wastewater with a turbidity of 200 NTU in raw ponds was pumped through the pump to the coagulation pool at a flow rate of 2 m/s, sample at each of the 9 sampling points after a certain period of time. The turbidity of the sample was measured with a turbidimeter. Set the time separately to 5min, 10min, 15min. The effect of mixing time on the diffusion rate of kaolin in
water at a gravity-flow of 2 m/s was investigated. As can be seen from Figure 8, under the condition of gravity-flow, 2 m/s flow speed, when the stirring time was between 5-15min, the turbidity difference at each sampling point of the simulated wastewater decreases with increasing stirring time. When the mixing time was 10 min, the turbidity of the simulated wastewater was basically the same.

From the above experimental results, at gravity-flow, 0.5-2 m/s stirring rate, the diffusion rate of kaolin in simulated wastewater increases gradually with the increase of mixing time, the turbidity difference at each sampling point of the simulated wastewater decreases with increasing stirring time. Therefore, at gravity-flow conditions, the best stirring parameters for the coagulation pool were: gravity-flow 2 m/s, stirring time 10 min.

4. Conclusions
Kaolin was used to prepare experimental simulated wastewater, and water turbidity was used as evaluation index. The effect of stirring method, rotation speed and agitation time on the diffusion rate of kaolin in the water-coagulation pool in water was investigated by single-factor experiments. The best stirring parameters for the coagulation pool during mechanical stirring were: stirring speed 80 r/min, stirring time 30 s. The optimal stirring parameters for the coagulation pool during submersion stirring were: the stirring speed was 100 r/min, and the stirring time was 60 s. The optimal flow parameters of the coagulation pool for the gravity-flow of water were: the flow velocity of the water was 2 m/s and the time was 10 minutes. Comparing the mechanical stirring, submersion stirring and gravity-flow, we can see that the mechanical stirring method was more conducive to the diffusion of the coagulant in the coagulation pool than the submersible stirring and the gravity-flow. The parameters of the coagulation pool in the emergency treatment of drinking water sources were determined as the stirring mode: mechanical stirring, stirring speed: 80 r/min, stirring time: 30 s.

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