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Research on Purification Experiment of Formaldehyde Waste Gas at High Concentration by Biological Method

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Abstract

In this paper, the performance of biological method for the purification of high concentration formaldehyde waste gas was studied. The experimental results show that when the concentration of formaldehyde in the exhaust gas is from 100mg/m^3 to 350mg/m^3, the removal efficiency increases, and the removal efficiency decreases when the concentration of formaldehyde exceeds 350. The relationship between inlet flow and removal efficiency is similar. With the increase of residence time, the removal efficiency is increasing. When the time reaches 50s, the removal efficiency remains stable.

Keywords:gas purification, formaldehyde, high concentration, biological method

1. Introduction

Methanal is commonly known as formaldehyde, with a colourless flammable liquid suffocative irritating smell. It is soluble in water, alcohol, ether, highly volatile at room temperature, the temperature rises more volatile. Comparison of chemical properties of mobile, prone to carbonyl addition, oxidation, reduction, polymerization and other chemical reactions in the list of toxic chemicals on the priority list of formic acid second. The results of the WHO's International Cancer Research Centre for the identification of formic acid carcinogens are identified as carcinogenic and substances, a source of allergy, and potentially a potent mutagen. On the list of priority control of toxic chemicals, formic acid ranks second in China. Formaldehyde emissions are mainly from wood processing, textile, plastics, organic synthesis, synthetic rubber and paint production process.

The most is the formaldehyde pollution of wood processing, plywood and wooden furniture from. Formaldehyde gas has no recycling value but also serious harm to human health and environment, while at home and abroad have photo catalytic oxidation, adsorption, ozone oxidation, cold plasma purification method and other purification method, but these methods are mostly due to the effect of treatment of unstable, high processing cost, two pollution and other factors can promote a wide range of applications. Therefore, the purification treatment of high concentration formaldehyde has become one of the problems of air pollution control technology at home and abroad in the research field in recent years.

2. Experimental device and method

The circulating liquid flows from the circulating pump to the top of the packed tower, from the top of the tower to spray on the filler, in the packing layer in the free flow, and finally flows into the bottom of the column to discharge the water tank. The formaldehyde gas, from the pump to the constant temperature of pure formaldehyde bottle blowing people a little air, blows out the mixed gas containing formaldehyde and air evenly through a flow meter and a buffer bottle from the bottom into the bio-filter. In the process of rising, it is purified by contact with the moist biofilm, and the purified gas is discharged from the top of the tower. The main test device: material bio packing tower for organic glass, the diameter of 12cm and the total height is 1200cm, and the filler is divided into two layers, each layer of packing tower packing layer height is about 20m. The effective volume of the bio packing tower is about four.It uses coke as filler material. In the experiment, the concentration of formaldehyde in the inlet and outlet gas and the circulating liquid were measured periodically. The biofilm strains were selected from the activated sludge of Shenyang northern sewage treatment plant, which was cultured in advance. After a week, the sludge was mixed with the water pump to enter into the biological filter tower. When the biofilm is mature, it enters into the start-up period of the system, and is directly acclimated by low concentration formaldehyde gas. But with the passage of time, the purification efficiency has been significantly improved. During the operation period, when the inlet concentration is lower than 30mg/m3, the purification efficiency can be higher. When the purification efficiency of bio-filter was stable for several days, the system was successfully domesticated. After 10 days of acclimation, the purification efficiency of the bio-filter was observed to be about 90%.

3. Experimental results analysis

3.1Effects of formaldehyde concentration on removal efficiency

The experimental results of the influence of the change of the formaldehyde concentration of the inlet gas on the removal of formaldehyde in the biofilm packed column are shown in Figure 1. As can be seen from Figure 1, with the increase of the concentration of formaldehyde in the inlet gas, the biochemical

removal of formaldehyde is also increased. In the experiment, when the concentration of formaldehyde was increased to 350 mg/m^3, the removal rate of formaldehyde was up to 86%. The result is obviously better than that of the previous study on the purification of low concentration formaldehyde waste gas by biological packing tower. This shows that with the increase of the concentration of formaldehyde gas, the biofilm microorganisms in the moist can absorb formaldehyde gas capture more, which reflects the microbial biofilm packing tower in this study has the strong ability of biochemical degradation of formaldehyde.

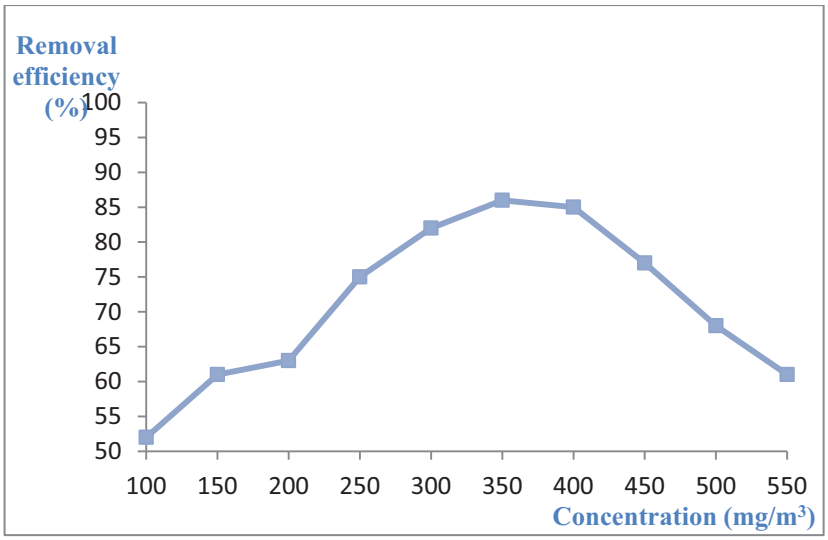

Fig. 1: Effects of formaldehyde concentration on removal efficiency

3.2 Effects of formaldehyde intake flow on removal efficiency

Under the condition that the temperature is 25 DEG C, humidity 40%, the concentration of waste gas in 25mg/m^3, gas flow in 0.2-0.8m^3/h, the relationship between the flow rate and the purification efficiency of formaldehyde is shown in Figure 2. From Figure 2, the formaldehyde concentration is 25mg/m^3 under the condition of entrance, when the air is less than 0.4m^3/h, inlet flow on the purification rate is less affected, can be stabilized at more than 90%, but when the gas flow is greater than 0.4m3/h, purification efficiency is reduced significantly. These results are mainly in the mountain residence time of gas flow directly influence the formaldehyde gas in biological filtration tower in. The gas is decomposed in the tower takes some time. When the residence time is large enough, the pollutants can be degraded. The full flow is too large, then the residence time is too short, which cannot meet the microbial biofilm on pollutants in exhaust gas capture, absorption and biodegradation time requirements, many pollutants yet in contact with the biofilm tower has been discharged to the outside

of the tower. Lead to the purification efficiency decreased. On the one hand the tower gas velocity increases the gas-liquid turbulent mixing degree increase, in favor of formaldehyde from the gas phase into the liquid phase, and promote the tower of biochemical reaction; on the other hand, formaldehyde into the liquid phase difference in concentration under the action of further spread to the biofilm, and micro biological capture, absorption tower, in the experiment the results showed that the increase of the amount of formaldehyde removal.

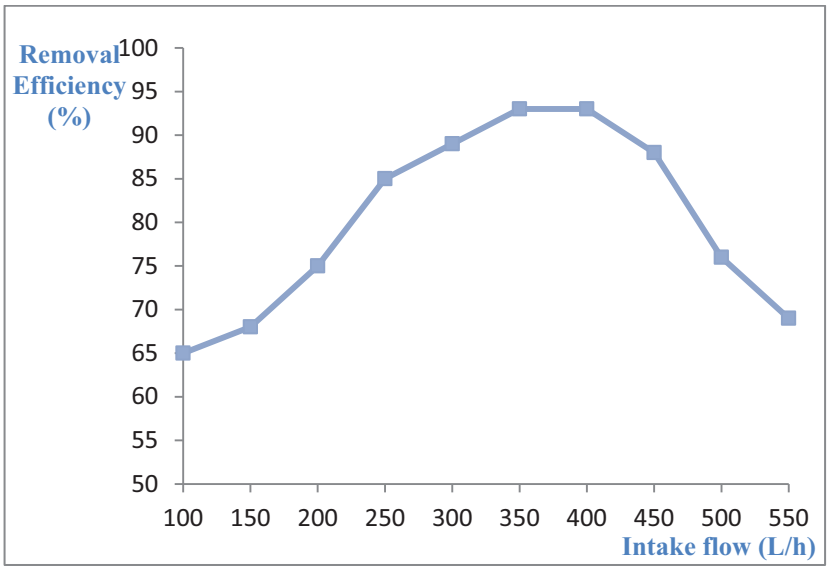

Fig. 2: Effects of formaldehyde intake flow on removal efficiency

3.3 Effects of formaldehyde residence time on removal efficiency

Figure 3 shows the relationship between the residence time of the gas flow rate and the removal efficiency of formaldehyde when the mass concentration of formaldehyde is 30mg/m3 and the liquid spray quantity is 40L/h. You can see from figure 8, with longer residence time, the formaldehyde removal efficiency increased significantly when the residence time from 10 to 45, and the removal efficiency increased from 75% to 91%, reached a maximum value of 91% at 45s, and then tended to be stable. When the gas residence time in the scrubber increases, formaldehyde has enough time to be absorbed into the biofilm surface and degrade quickly at the surface, form a concentration gradient between the liquid phase and the main biological membrane. To formaldehyde dissolved in water rapidly to the biological membrane diffusion, not only to mass transfer between gas and liquid in formaldehyde, and favorable capture, adsorption and biodegradation of formaldehyde on the liquid membrane phase. When the residence time is short, the load is increased, the diffusion time of formaldehyde in water is shortened, and the removal rate is decreased.

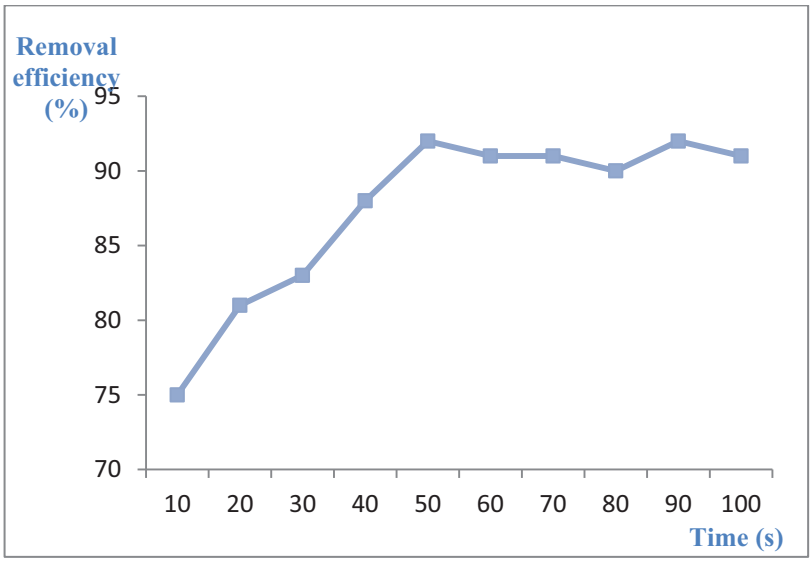

Fig. 3: Effects of formaldehyde residence time on removal efficiency

4. Conclusion

Construction project cost management is the core competitiveness of the construction company. Organization measures, technology measures, economic measures and contract measures are important means of cost management. The cost of construction project must be managed by the comprehensive means of the four above measures. The improvement of construction project cost management is a continuous process, which needs further study.

References

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