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Original Research Paper

Experimental Study on the Influence of Sediment on COD Degradation

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ABSTRACT

According to the characteristics of river sediment having greater impact on COD values, simulation experiment was used to explore the impact of sediment concentrations on COD, revealing the relationship between COD values and sediment. The level of sediment concentration has a more significant effect on COD degradation; higher the sediment concentration is, the greater is the rate of COD degradation. Sediment particle size also affects the rate of degradation of COD in water. With smaller particle size the rate of COD degradation is increased. This is because with the smaller particle size, the surface area is large, which in aqueous phase contaminants make it easier to achieve COD degradation.

INTRODUCTION

Water flow and sediment in river water environmental system have become the main carrier of pollutants, influencing the migration and transformation of pollutants in water, which ultimately affects the ecological conditions. Sediment movement and sorption characteristics of sediment are the two main aspects affecting the water quality changes. On one hand, the sediment particles can adsorb a variety of pollutants, which are deposited at the bottom of the riverbed under certain dynamic conditions in a certain period of time, reducing pollution, and on the other hand, when the chemical kinetics and other external conditions change, the adsorbed contaminants may be transferred to the dissolved phase. In this way, the deposited pollutants in sediment can re-enter the water, thus significantly altering the chemical composition of the overlying water and even causing secondary pollution of water bodies.

Due to the presence of sediment, transparency of river water is relatively low, sensory effect is poor, but the presence of sediment in river water will increase the capacity of the ecological environment to accommodate more contaminants. When hydrodynamic conditions change to make sediment deposit, their own contaminants can be carried out from water phase, playing a positive role in purifying polluted water. After dam construction, there are many studies on the water environment impact. Numerous studies show that after dam construction, not only the amount of sediment downstream is reduced, but also the tributaries hydrodynamic conditions are changed, to make the water flow slow, a sharp reduction in the aqueous phase sediment concentration, water purification capacity reduction, and intensification of pollution.

Sediment can adsorb nitrogen, phosphorus and other pollutants, as an important component of river water in the process to migrate. Researches have found that sediment has varying degrees of impact on water quality for many indicators such as BOD, COD, phosphorus, nitrogen, etc. in the Yellow River water with large sediment. Hu (2000) studied the influence of the Yellow River sediment on CODMn; Bradley et al. (2001) have studied on widespread potential for microbial MTBE degradation in surface-water sediments; and Guo et al. (2006) studied adsorption properties of sediment for pollutants of contaminated river water. The sediment may have a characteristic adsorption of pollutants. Thus, it is believed that the sediment can be used as collector of aggregation of contaminants into the downstream, and may also be used as the source to release pollutants into water bodies under certain conditions such as low pH, strong oxidizing conditions and high temperature, etc.

For estuarine sediments, clay minerals, organic pollutants, heavy metals, phosphorus, and ammonia adsorption characteristics have been extensively investigated and studied. But for the heavier sediment pollution, polluted river adsorption studies have not been carried out extensively. Exploring the river sediment adsorption of pollutants can reveal contaminated sediment in the river playing an active role in the process of self-purification.

Table 1: Experimental conditions.

No.	Concentration of sediment, g/L	Volume, mL	Initial Concentration, g/L	Temperature, °C	pH
1.	0.3	500	146.71	20	7.5
2.	0.6	500	146.71	20	7.5
3.	1	500	146.71	20	7.5
4.	1.5	500	146.71	20	7.5
5.	2.0	500	146.71	20	7.5

Table 2: COD values with time under different sediment concentration.

Concentration of sediment, g/L	Time/h				
	0	10	32	60	80
0.3	146.71	86.71	56.71	21.00	15.29
0.6	146.71	85.29	52.43	19.57	1386
1.0	146.71	75.29	45.29	16.71	13.86
1.5	146.71	68.14	43.86	15.29	13.86
2.0	146.71	68.14	31.00	15.29	13.86

MATERIALS AND METHODS

Samples and processing of sediment: Sediments were collected from the surface of sediments deposition in Handan sector of Zhanghe river. The sediment samples were placed in deionized water for a period of 7 days and dried. The sediments were sieved from 44μm to 300μm aperture standard sieve.

Experimental methods and procedures: ***Water, sand and COD mixed water sample preparation*:** Five groups of 500mL in beakers were prepared by adding test water (raw water), different amounts of silt and ammonium standard stock solution to prepare a mixed test sample.

Test conditions: Five groups configured test water samples, were placed on a magnetic stirrer with temperature control at 20°C, with stirring speed set so that the sediment can be uniformly suspended. Sediment particle size ranges as 0<d<0.074, 0.074<d<0.1, 0.1<d<0.25.

Experimental results and analysis: ***Effect of sediment concentration on degradation of COD*:** COD in different sediment water samples was measured daily. After 80 hrs the test was stopped, which can be seen in Table 2.

The Fig. 1 is the process of COD values with time under the same initial concentration of COD. In the water with sediment, with the increase of sediment, degradation of COD concentration in the aqueous phase is fast, which has the shorter time.

The results indicate that in the control range of sediment in the laboratory, with the increase of sediment in water, degradation efficiency of COD increases, and the degradation of the time is faster than those without sand water.

Effect of sediment particle size on degradation of COD: As can be seen from Fig. 2, in the case of the same sediment, smaller the sediment particle size is, faster is the degradation degree of the COD in water samples. This is because as the particle size decreases, interface of microorganisms and nitrifying bacteria adhered to the surface in contact with water increases, while the adsorption of the sediment has a role to reduce the level of COD.

CONCLUSIONS

According to the analysis of degradation of COD under different sediment concentration and different particle size criteria, the following conclusions can be made:

1. Sediment had some effect on adsorption of nitrogen, phosphorus and potassium permanganate index in the polluted river water. Migration of sediment with the water can play a more active role in reducing pollutant loads.
2. The adsorption of sediment on pollution in river water is influenced by many factors, such as pollutant concentration, sediment concentration and particle size. The higher the levels of pollutants are, the higher sediment content is and the smaller the particle size is, more obvious the relative adsorption effect is.
3. Sediment particle size also affects the rate of degradation of COD in water, smaller the particle size is, larger is speed speed of COD degradation. Because as the particle size is smaller, the surface area becomes larger and there is wide area in the aqueous phase contaminants to make it easier to achieve degradation.

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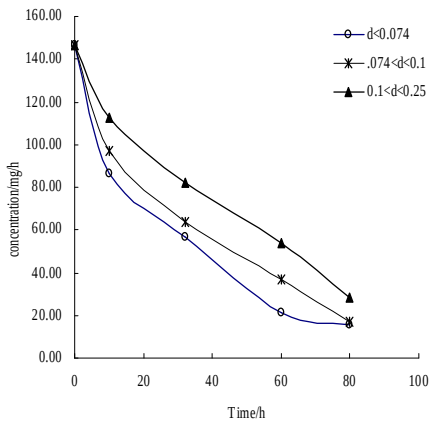

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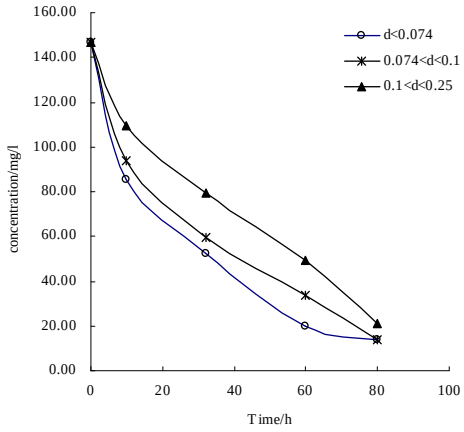

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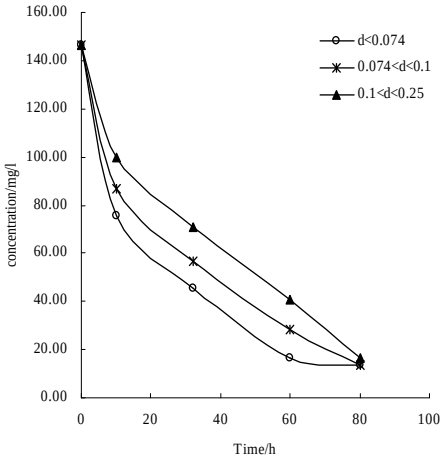

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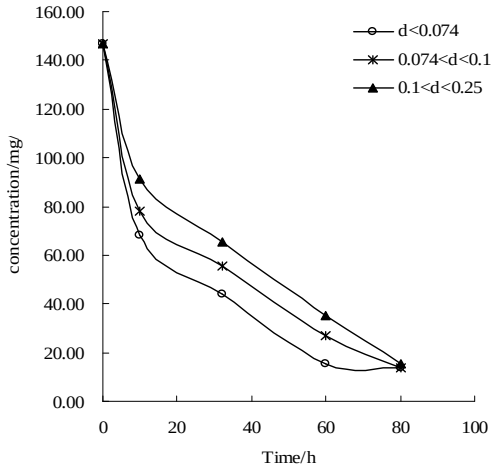

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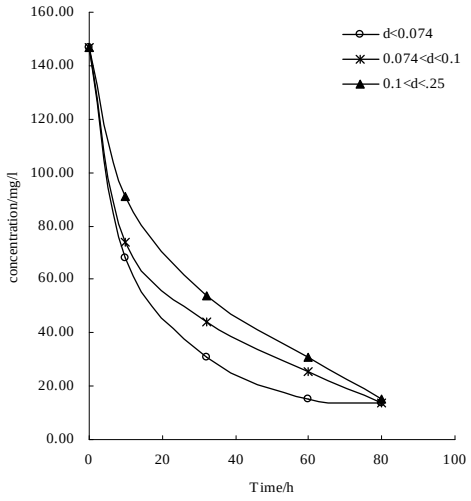

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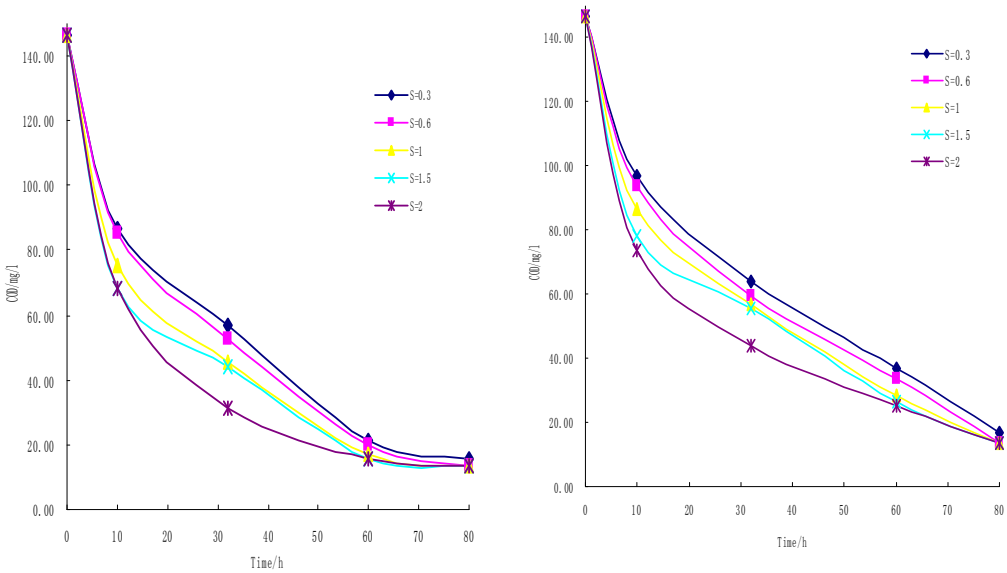
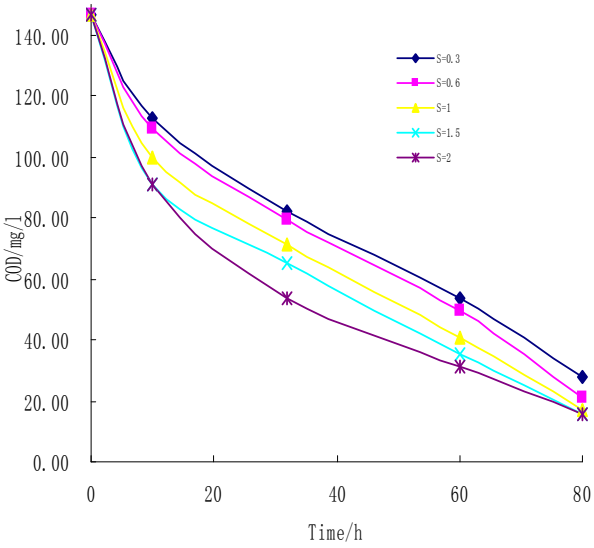
Fig. 1: Degradation of COD under different sediment concentration.



(A) d<0.074

(b) 0.074<d<0.1



(c) 0.1<d<0.25

Fig. 2: Degradation of COD under different sediment particle size.

REFERENCES

Bradley, Paul M., Landmeyer James E. and Chapelle Francis H. 2001. Widespread potential for microbial MTBE degradation in surface-water sediments. Environ. Sci. Technol., 35(4): 658-662.

Guo, Changcheng, Y.U. Guohua and Wang Guoxiang 2006. Adsorption properties of sediment to pollutants of contaminated river water. Ecology and Environment, 15(6): 1151-1155.

Hu, Guohua 2000. Experimental study of influence of the Yellow River sediment on COD_{Mn}. Yellow River, 22(3): 17-19.