Experimental Study on the Removal of Nitrobenzene in Groundwater by Ultrafiltration

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Abstract: In order to solve the pollution of groundwater caused by persistent organic contaminants, the removal efficiency and affecting factors of nitrobenzene removal from groundwater by using ultrafiltration technology was investigated. The experimental results indicate that the ultrafiltration system can work continuously for 68 hours when initial concentration is 85 μg/L, and the nitrobenzene concentration of outflow is less than 17 μg/L. Fe and Mn in groundwater have no significant impact on the removal efficiency, but the effect of initial nitrobenzene concentration of inflow is obvious. The continuous operation time decrease sharply from 68 to 14 hours when nitrobenzene concentration is 340 μg/L. 2% CH_3CH_2OH has the best performance for cleaning the fouling caused by nitrobenzene. As an urgent treatment technology, ultrafiltration technology could guarantee the security of drinking water for people living in rural area.

Key words: groundwater; nitrobenzene; persistent organic contaminants; ultrafiltration
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Owing to the unbalanced development of economy and environment of China, more and more groundwater was polluted especially by the persistent organic contaminants[1]. As a typical organic persistent pollutant, nitrobenzene has considerably stable chemical property and high toxicity[2-3]. The effect of nitrobenzene on human health and toxicology has been widely reported in many aspects[4]. There were many studies on the removal of nitrobenzene[5], but there was no report about ultrafiltration. Therefore, the objective of this study was to find whether ultrafiltration was efficient for the removal of nitrobenzene in groundwater.

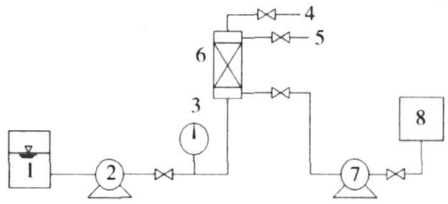
1 Experimental

1.1 Materials

Tests were conducted using the filtration assembly shown in Figure 1. The ultrafiltration system was operated in cross-flow mode and the pressure was controlled less than 0.12MPa. The contaminated water was simulated by adding nitrobenzene to typical groundwater in Changchun, Jilin province.

1.2 Analytical methods

Nitrobenzene concentration was determined according to National Standard Methods (GB13194—91) by gas chromatography with an electrical conductivity detector (GC/ECD) (Shimadzu Co., Japan). Turbidity was determined by 2100N turbidity meter (HACH Company, Loveland, U.S.). Fe, Mn, COD_{Mn} were measured according to standard method[3].



1 water tank 2 peristaltic pump 3 manometer 4outflow 5 concentrated solution 6 ultrafiltration membrane 7 back wash pump 8 clean water tank

Fig. 1 A schematic of ultrafiltration system

2 Results and discussion

2.1 Performance of nitrobenzene removal

As shown as Fig. 2, ultrafiltration has a good performance for the removal of nitrobenzene in distilled water. During the whole process, water yield maintain 17 L/h and the removal efficiency is more than 97%.

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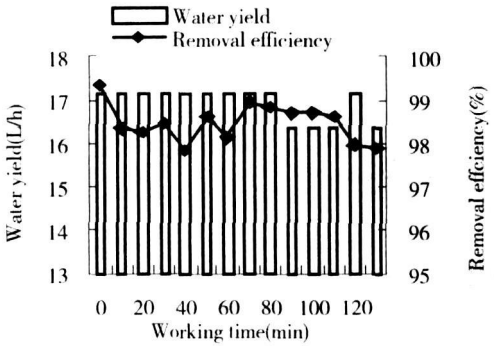


Fig. 2　Nitrobenzene removal in distilled water (Nitrobenzene, 85μg/L)

2.2　Effect of Fe and Mn

Fe and Mn are the common ions in groundwater. The effect of them on nitrobenzene removal would have to be considered. The results are shown in Fig. 3. Comparing the result of groundwater with that of distilled water it can be concluded that Fe and Mn in groundwater affected the removal of nitrobenzene but the influence is not strong.

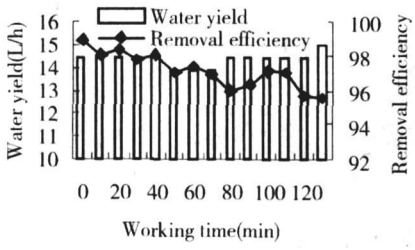
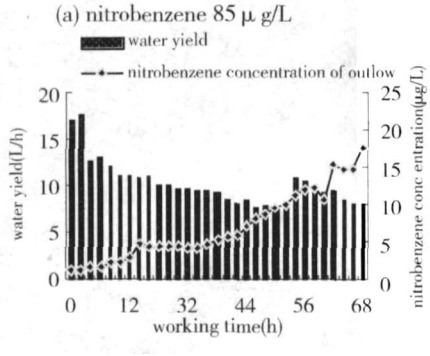


Fig. 3　Nitrobenzene removal in groundwater (Nitrobenzene, 85μg/L, Fe, 1.5mg/L, Mn, 0.5mg/L)

2.3　Effect of initial concentration

The relationship between initial concentration and removal efficiency are shown in Fig. 4. When inlet concentration is 340μg/L, the continuous working time decreas from 68 to 14 h sharply. But it has not much more impact on water yield.



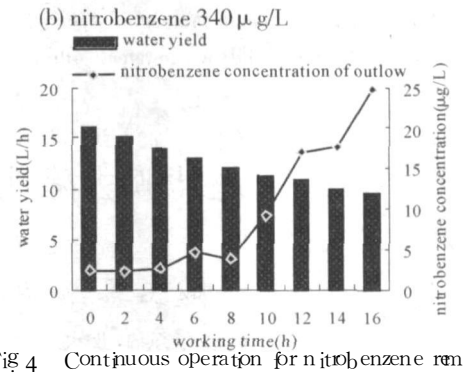


Fig. 4　Continuous operation for nitrobenzene removal

2.4　Membrane flouring and cleaning

Three chemicals were taken to clean the fouling caused by nitrobenzene. They were 2% CH_3CH_2OH, 1% NaOH and 1% HCl. As a result, 2% CH_3CH_2OH has the best performance for cleaning fouling (the date was not shown).

3　Conclusions

From above research, it can be concluded that ultrafiltration has a good performance for the removal of nitrobenzene. Fe and Mn have no significant effect on the removal of nitrobenzene. But initial nitrobenzene concentration has more impact on nitrobenzene concentration of outflow than water yield. For the fouling of membrane caused by nitrobenzene, 2% CH_3CH_2OH is the best choice.

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超滤膜去除地下水中硝基苯的试验研究

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摘 要: 为解决持久性有机污染物对地下水造成的污染, 以硝基苯为研究对象, 考察了超滤膜对硝基苯的去除效果及影响因素。试验结果表明, 当进水硝基苯浓度为 85 μg/L, 超滤膜可以连续工作 68 h, 出水小于 17 μg/L, 地下水中铁、锰离子对去除效果没有显著影响。进水硝基苯浓度对去除效果有显著影响。当进水硝基苯浓度由 85 μg/L上升至 340 μg/L时, 超滤膜连续工作时间急剧下降, 仅为 14 h。对由硝基苯引起的膜污染, 2% CH_3CH_2OH清洗效果最佳。作为一项应急处理技术, 该工艺可以保障小城镇地区饮水安全。

关键词: 地下水; 持久性有机污染物; 超滤; 硝基苯
中图分类号: X523

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常压连续微波辐射法合成聚乳酸—聚乙二醇共聚物

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摘 要: 常压条件下、连续微波辐射功率 90W, 辐射时间 8min, 合成了特性粘度为 0.51 $dL\cdot g^{-1}$的聚乳酸—聚乙二醇共聚物 (PELA)。考察了聚乙二醇 (PEG) 浓度、聚合时间对共聚物特性粘度和收率的影响。此外, 实验研究了连续微波炉与家用微波炉中反应体系的温升曲线。结果显示, 相比于家用微波炉中的间歇微波辐射, 连续微波辐射下反应体系温度上升平稳无突跃。

关键词: 连续微波辐射; 聚乳酸; 聚乙二醇; 共聚物
中图分类号: TQ316.6+1