Experiment on Al_2O_3 in Removing Fluorin of Groundwater

WU Dao-ji[1], LI Qiu-mei[1], YIN Meng-meng[1], SUN Mei[2], LI Ma-li[1], ZHANG Li[1]
(1. School of Municipal and Environment Engineering, Shandong Jianzhu University, Jinan 250101, China;
2. Jinan Engineering Vocation Technology Institute, Jinan 250200, China)

Abstract: This paper comprehensively compared various impacts on removing fluorin of Al_2O_3 activated by different agents. And $Al_2(SO_4)_3$ was determined as the effective activated agent; moreover, activated and regenerated methods were also studied in this paper, the optimal process parameters of activation and regeneration were determined as follows: Al_2O_3 was activated by 4% $Al_2(SO_4)_3$ at the volume ratio of Al_2O_3 to groundwater 1∶1 during 4 hours; for the regeneration of used Al_2O_3, 4% $Al_2(SO_4)_3$ in 2 h can achieve good result.

Key words: γ—Al_2O_3; removing fluorin process
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1 Experiment Design

The groundwater of a city in Shandong Province has high fluorin content, [F⁻] = 4.66 mg/L. This experiment used Al_2O_3 to reduce its fluorin content[1]. Al_2O_3 used in this experiment is white particle with diameter 1.0 ~ 2.5 mm. Al_2O_3 was added in glass adsorption column, groundwater containing fluorin flowed through the column, and velocity of flow was controlled by valve; the fluorin content of effluent was analyzed. And the content of fluorin ion was performed to use fluorin ion elective electrode[2].

2 Results and Discussions

2.1 Activation

Al_2O_3 needs to be activated before it is used to remove impurity in micropore and to increase specific surface area, to increase effect on removing fluorin.

Such different activated agents as distilled water, $Al_2(SO_4)_3$ and NaOH was first discussed. Al_2O_3 activated by distilled water had the worst efficiency, because Al_2O_3 could not be washed properly and not completely remove impurity or solutable pollutants either in this method. Al_2O_3 activated by NaOH had the worse efficiency, and it presented alkalinity, so it needed large amount of acid to neutralize in practice, which complicated operation and increased the operation cost. Al_2O_3 activated by $Al_2(SO_4)_3$ had the best efficiency, fluorin amount was the lowest in effluent, operation was relatively simpler. So $Al_2(SO_4)_3$ was determined as activated agent.

Then the concentration and volume of activation agent, and activation time were investigated. For the activation agent concentration, 2% $Al_2(SO_4)_3$ had the worse efficiency, and the effluent with the higher residual F⁻, the total treated amount of water was obviously smaller; as concentration increased, treated effect was improved, that was, effects of 4%, 6% and 8% were all superior to that of 2%; but with increasing of concentration, the total amount of treated water and effect were not raised in the same multiple, treated effect was not obviously raised, of that 4% had such best effect as the smallest residual F⁻ and the biggest total amount of treated water. While concentration rised from 4% to 6% even to 8%, the demanded amount of $Al_2(SO_4)_3$ was also raised largely, so the cost will be increased in multiple correspondingly. Hence, the concentration was determined as 4%. For the activation agent volume, no matter how big or small the concentration of $Al_2(SO_4)_3$ was, the volume increased from 20 mL (the volume ratio of Al_2O_3 to activated agent is 1∶1) to 50 mL (the volume ratio of Al_2O_3 to activated agent is 1∶2.5), residual F⁻ concentration in effluent decreased, but the total amount of treated water only increased less than 20%, and the total treating effect was not increased in the same multiple. So considering eco-

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作者简介: 武道吉 (1966年生), 男, 教授; E-mail: wudaoji@163.com

nomically and practically the volume ratio of Al_2O_3 to activated agent was advised as 1 ∶1. For activation time, which not only influences treatment efficiency but also affects the power cost of practical engineering. The longer the time is, the more sufficient the exchange between Al_2O_3 and activation agent is, correspondingly the better the treated effect is. For activation time, 15 h had the best effect and the biggest amount of treated water. While the time decreased to 6.5 h and to 4 h, the treated effect was roughly the same; the time was shorter further, the effect decreased further and was unstable. So the activation time in this experiment was 4 h.

2.2 Regeneration

Al_2O_3 lost the ability of adsorption after it adsorbed to saturation[4], and must be regenerated before used again. Based on datas of activation, this part no longer did research on effect of the volume of regeneration solution, but only on the concentration and time of that.

For the concentration, 2% clearly had the worse effect and Al_2O_3 column easily lost the ability of adsorption, the total amount of treated water was obviously smaller, while 4% and 6% were both superior to 2%; as the concentration of regeneration solution increased, total amount of treated water and treated effect were not raised in the same multiple, but in comparison, 4% had the best effect, not only had the smallest residual fluorin, but also had the biggest amount of treated water. And this corresponds with that of activation. For the regeneration time, the shorter the time was, the worse the effect was. For the reason that the adsorption reaction probably occurs on the outer surface of removing fluorin agent, and the inner part does not adsorb sufficiently[5], proper and short time is demanded for its regeneration. This experiment showed that, 2 h can have the satisfactory result.

3 Conclusions

(1) Al_2O_3 must be activated before it is used, to remove impurity in micropore and to increase specific surface area, to increase effect on removing fluorin. In this experiment, Al_2O_3 was activated by 4% $Al_2(SO_4)_3$ at the volume ratio 1 ∶1 of Al_2O_3 to groundwater in the time of 4 h.

(2) Al_2O_3 lost the ability to remove fluorin after it is adsorbed to saturation, and must be regenerated before used again. This experiment showed that 4% $Al_2(SO_4)_3$ in 2 h can achieve good regeneration result.

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活性氧化铝处理含氟地下水

武道吉[1], 李秋梅[1], 尹萌萌[1], 孙 梅[2], 李 满[1], 张 丽[1]

(1. 山东建筑大学 市政与环境工程学院, 山东 济南 250101;
2. 济南工程职业技术学院, 山东 济南 250200)

摘 要: 综合比较了不同活化剂对 Al_2O_3 除氟能力的影响, 从而选定 $Al_2(SO_4)_3$ 为活化剂; 并对活化和再生方法进行了研究, 提出了最佳的活化和再生工艺参数: 对于 Al_2O_3 使用前的活化, 采用 4% $Al_2(SO_4)_3$ 以滤料/活化剂=1∶1的体积比活化 4 h即可取得良好的效果; 而 Al_2O_3 吸附饱和后, 再次使用前要再生以恢复其除氟能力, 对于本试验使用的 Al_2O_3, 采用 4% $Al_2(SO_4)_3$ 再生 2 h即可取得良好的再生效果。

关键词: γ—Al_2O_3; 除氟工艺

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