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Study on the Influencing Factors of Efficiency of Biological Aerated Filter

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Abstract

This paper introduces the advantages of aerobic aeration tank in the process of water treatment for the removal of organic matter, suspended matter (SS), ammonia nitrogen and phosphorus, and summarizes several factors influencing the efficiency of aeration aeration tank treatment and the measures that can be used efficiently for aerobic aeration tanks in the process of wastewater treatment.

Keywords

water treatment; aeration tanks; aerobics; influencing factors.

1. Introduction

In recent years, with the construction and development of cities, the discharge of a large number of substandard wastewater not only pollutes the environment, but also increases the shortage of water resources. Therefore, seeking economic and efficient sewage treatment technology is of great significance to promote the recovery of water environment and the development of sewage reuse [1]. Biological aerated filter process (biological aerated filter,BAF) is a new biological treatment technology with rapid development. It is a kind of aerobic wastewater biological treatment process based on the introduction of filtration thought in drinking water treatment based on biological contact oxidation process[2], which is combined with traditional activated sludge Compared with the method, it has the advantages of small occupation area, less investment, less operating cost, good treatment effect, shock resistance load, simple process flow and reasonable flora structure[3]. ensure that the water output and quality can be greatly improved[4]. It is especially suitable for the current situation of insufficient funds and low technical level in water treatment in China. Therefore, an in-depth understanding of its performance, mechanism and its application in water treatment will help to improve people's understanding of the technology and its application level.

2. Principle of Biological Aerated Filter

Biological aerated filter is essentially a biofilm treatment process in which solid, liquid and gas coexist. The top of the device has a water distribution system, which is used to distribute the sewage evenly to the surface of the filter material. The liquid-like sewage can be fully contacted with oxygen. The sewage flows from top to bottom through the filter material, and finally is discharged from the bottom of the device or recycled in the system. in this process,

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microorganisms undergo the process of attachment-desorption-reattachment on the surface of the filter material until a stable biofilm is formed that is no longer desorbed. through appropriate research, we should make full use of appropriate processing media and use commonly used media such as attached biofilms and particle fillers to give full play. metabolism of organisms, it also involves other effects, such as physical filtration and physical adsorption of fillers and biofilms, which can remove contaminants in the same reactor for the above various reactions. pollutants are removed when sewage flows through the biofilm.

3. Advantages of Treating Wastewater by Aerobic Aeration Tank

The aeration tank has many advantages in the process of water treatment, Especially in the sewage pretreatment showed advantages, greatly reduce the difficulty of subsequent treatment process.

3.1. Organics and Suspended Solids (SS)

Different fillers are generally added to the aeration tank, which will filter and remove the suspended organisms accumulated in large quantities in the wastewater and form a set of filtration treatment system. The physical adsorption and filtration interception of the fillers in the biological aerated filter and the biological oxidation of the biofilm are beneficial to the growth of microorganisms with longer generation period, and also determine the efficient removal of SS and organic matter in the tank. Pastorelli G and other scholars have carried out experiments on pilot-scale biofilters for 18 consecutive months, and the results show that the removal rates of BOD5 and SS are above 95%[5]. A British sewage plant treating domestic sewage containing industrial wastewater when, in the biological aerated filter treatment link, the removal rate of CODcr,BOD5 can reach 80%,91.3%, and the removal rate of SS can reach 78%[6]. Li Ruqi and others found that the average removal rates of BOD5,CODcr and SS were 95.3%,92.6% and 96.7%, respectively, when using biological aerated filter for domestic sewage treatment test [7]. At home and abroad, the research and application of this field have fully proved the research point of view, the treatment function of organic matter and SS by biological aerated filter is mature, the removal effect is remarkable, and the removal of organic matter and SS in sewage should be remarkable. has great potential in use.

3.2. NH_3-N

NH_3-N is an important parameter for detecting water quality and one of the most important target removal in water treatment. In order to complete the denitrification process in water treatment, it is necessary to go through the nitrification and denitrification stage first. Inorganic nitrogen in wastewater is changed into ammonia nitrogen by ammoniation, then nitrosation and nitrification into nitrate nitrogen, and then reduced to nitrogen by denitrification. Biological aerated filter has a good effect on the removal of ammonia nitrogen, which can reach the removal rate of 70%~90%. In the process of nitrification, the growth rate of nitrifying bacteria is slow and sensitive to environmental conditions, and the filtration rate, filter material and temperature will affect it. In denitrification studies, it is generally believed that If the inlet TN concentration is high, the combined process of biological aerated filter and post-denitrification filter can be used to reduce the total nitrogen content, or to add a certain carbon source to enhance the denitrification effect. but in the treatment of wastewater with low nitrogen content, additional alkalinity is needed to achieve the effect of treatment [8-9].

3.3. P

Biological aerated filter has poor impact load resistance and low phosphorus removal rate, which is generally 40%~45%. to meet the first-order A emission standard, the chemical phosphorus removal method can flocculate and precipitate the remaining phosphorus by

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adding medicament, and can use the filtration effect of biology to remove 50% of the remaining phosphorus[10]. The phosphorus removal rate can be increased to 85% by chemical phosphorus removal. Qiu Liping and Ma Jun studied the effect of adding iron salt (FeCl3) and aluminum salt (AlCl3) on phosphorus removal by using model reactor. The results show that adding iron salt and aluminum salt can effectively enhance the phosphorus removal efficiency of biological aerated filter, and at the same time, the removal effect of other water quality indexes has not changed much[11]. after the chemical phosphorus removal, the total phosphorus content in the effluent could be reduced to 0.8 mg/L,BOD5, CODcr and the removal effect was not affected [12].

4. Factors Affecting Water Treatment Efficiency

4.1. Filter Media

Filter material is one of the important factors affecting the efficient operation of biological aerated filter. The roughness, uniformity, pore size and particle size of different filter materials will affect the operation efficiency of the system. In the selection of filter materials will be more wear-resistant, stable structure, rough surface and large porosity of the filler, generally will choose natural materials to drink synthetic high performance filler. Because of its high ion exchange capacity and outstanding adsorption performance, natural zeolite has become the two most widely used fillers. In order to improve the operation efficiency of biological aerated filter, we should select the filler with small particle size to reach to the purpose, but the small particle size of the filler will reduce the amount of pollution interception in the filter, so that the filter is blocked. The packing with large particle size can enhance the ability of the packing layer to absorb pollution, and it is not easy to form blockage in the filter, but if the particle size of the packing is too large to reduce the removal efficiency of solid suspended matter and ammonia nitrogen in the filter, so many factors should be considered comprehensively selecting the packing of the biofilter.

4.2. Backflushing

After stable operation for a period of time, a layer of biofilm will be adsorbed on the filler. With the increase of time operation thickness, the amount of suspended matter in the filter material layer will increase obviously, which will cause turbidity in the effluent, reduce the removal rate of ammonia nitrogen CODcr, affect the effluent quality. It should be noted that the strength of biological aerated filter in the backwashing stage should be paid special attention, generally according to the actual operation of the amount of water, water quality fine-tuning. Flush strength should not be too high or too low, too high will cause should be attached to the filter material fresh microorganisms will also rush out with the flow of water, resulting in poor water quality at the beginning of the end of backwash; too low to reach the role of washing to remove impurities in the pores of the filter material[13]. The combined air-water flushing method is a common backwashing method in biological aerated filter. Qiu Li-equal study on the effect of different backwash methods on the performance in the upflow biological aerated filter found that when the washing strength is 10 L/m2·s, the air-water combined washing 3~5 min, and finally after 9~11 min, the biological aerated filter can quickly recover the treatment capacity [14].

4.3. Temperature

Microorganisms are needed in the process of wastewater treatment, and the temperature will affect the activity and increment rate of microorganisms, so the treatment effect of biological aerated filter is also related to temperature. To ensure the treatment efficiency, it is necessary to control the temperature conditions kept in the biological aerated filter suitable for microbial growth. Taking the denitrification process as an example, the suitable temperature

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of nitrifying bacteria and denitrifying bacteria is 20℃~30℃and 20℃~40℃, respectively. When the two microorganisms are in the suitable temperature range, the denitrification efficiency increases with the increase of temperature. When the temperature was too low, the activity and proliferation rate of nitrifying bacteria and denitrifying bacteria decreased, and the denitrification effect was better poor, the water quality is difficult to meet the requirements. A number of studies have shown that the removal rate of CODcr gradually increases with the increase of temperature in a certain temperature range, but the amplitude of the increase is relatively small, which is basically stable [15]. PCR-DGGE analysis showed that the higher the temperature BAF the better the diversity of total bacterial microbial communities within [16].

4.4. Ph

Biological aerated filter is a process that requires the participation of microorganisms, in which the pH value in wastewater is also one of the important environmental factors, and the pH value is the acid-base condition suitable for the growth of most microorganisms at about 7. Therefore, when treating wastewater with too high or too low pH value, the pH value of wastewater should be pretreated and reconciled first, so that the pH value of wastewater is about 7. At this time because the cell membrane is alkaline, suitable for the growth and reproduction of microorganisms, is conducive to ensure the biological aerated filter treatment of wastewater efficiency.

5. Outlook of Biofiltration Technology

Biological aerated filter is a new type of sewage treatment technology, which has the characteristics of low input, less occupied land and convenient operation, and can be used alone or in combination with other sewage treatment technologies. It can remove suspended matter and organic matter in wastewater efficiently, and show high efficiency and stability in denitrification and phosphorus removal, but biological aerated filter also has the problems of harsh drinking and running environment for influent water quality, insufficient carbon source for denitrification, and easy to be affected by organic load. Zhong Hua-wen et al. have achieved good results in treating turpentine wastewater by combining electrolytic adsorption degradation with biological aerated filter[17], Xiang Song et al. human connection of biological aerated filter to hydrolytic acidification and A2O process after the treatment of printing and dyeing wastewater has also been successful[18]. Therefore, it is helpful to improve the understanding of biological aerated filter and optimize the operation of biological aerated filter in wastewater treatment plant, and to promote the implementation of innovative engineering projects. The whole process of the filter is simple and has the advantages of treating waste with waste and saving resources. Reducing the cost of raw material source, reducing the operating cost and occupation cost of the treatment system, so as to reduce or eliminate the pollution of waste water to the environment, so that the wastewater can be discharged up to standard, will be of great significance to the economic and social development and environmental protection of our country.

References

[1] GUAN Hongyan, JIA Quan, DU Yunxia, et al. Deep treatment and reuse of sewage by aeration biofiltration tank method[J].TECHNOLOGY OF WATER TREATMENT,2007,02:74-76.

[2] Lu Hongyu, Ma Wencheng, Zhang Liang, et al. Advanced treatment of mixing dyeing wastewater using biological aerated filter process. Chinese Journal of Environmental Engineering,2013,7 (7) : 2409-2413.

ISSN: 2688-8653

[3] Feng Yan, Yu Yanzhen, Qiu Liping, et al. Performance of water quenched slag particles (WQSP) for municipal wastewater treatment in a biological aerated filter (BAF).Biomass and Bioenergy, 2012, 45: 280-287.

[4] ZHANG Wei, SHI Kaiwu, KONG Hui. Development and status of biological aerated filter (BAF) [J]. Journal of Beijing Institute of Petro-chemical Technology,2005,13(3):24- 30.

[5] Pastorelli G., Andreottola G., Canziani R., et al. Organic carbon and nitrogen removal inmoving2bed biofilm reactor [J].Wat.Sci.Technol.,1997,35(6):91- 99.

[6] J.J. chen, D. Mc Carty, D. Slack. Full scale studies of a simplified aerated filter(BAF)for organic and nitrogen removal [J].Wat.Sci.tech,2000,41(4- 5):1- 4.

[7] Li Rongqi, Kongbo, Qian Yi. Aeration biofiltration tank treatment of domestic sewage test [J]. Environmental Science, 1999, 20(5):69-71.

[8] Chen Yue, Li Yuhua. Application of BAF-coagulation-precipitation-filtration process in medium water reuse [J].Water supply and drainage,2007,33:33- 35.

[9] JING Shuangyi, WANG Xiaoyun, CHEN Qingrui, et al. Removal of Nitrogen and Phosphorus from Domestic Sewage by A2/O-BAF Process [J]. Water and drainage in China, 2016, 032(011):76-80.

[10] He Qiang, Duan Xiuju. Study on the test and efficacy of urban sewage treatment of aeration biofiltration tanks [J]. Resource Environment and Engineering,2006,20(2):178- 181.

[11] Qiu Liping, Ma Jun. A comparative study of iron salt and lu salt chemical reinforcement dephosphate in aeration biofiltration pool [J].Modern workers,2007,27(1):159- 162.

[12] T. Clark,T. Stephenson, P. A. Pearce. Phosphorus removal by chemical precipitation with biological aerated filter[J]. Water Research,1997,31(10):2557- 2563.

[13] Wang Guoping, Zhang Linjun. Experiment slab study on the main parameters of aeration biofiltration tank to treat domestic sewage [J]. Journal of Xuzhou Institute of Architecture and Vocational Technology, 2004,4(3):24- 26.

[14] Qiu Liping, Wang Guangwei, Zhang Shoubin. Study on backflushing of upper-flow aeration biofiltration pool [J]. Journal of Environmental Engineering, 2011(07):85-89.

[15] Zhang Wenyi, Zhai Jianping, Li Qin. Aeration biofiltration tank bio-reinforcement method to deal with heavy pollution of river water [J].Journal of Harbin University of Technology, 2006, 38 (11) :1857- 1860.

[16] Dou Nasha, Wang Lin. Operating efficiency and microbial community structure of aeration biofilter at different temperatures [J]. Journal of Environmental Engineering, 2016(6):2800-2806.

[17] Zhong Huawen, Lin Peixi, Zhou Rujin. lectrolysis-absorbent degradation-aeration biofiltration tanks jointly treat pine-saving production wastewater [J].Water supply and drainage,2013,01:58-60.

[18] Xiang Song, Xu Lezhong, Li Cuimei. Hydrolysis acidification-A2O-aeration biofiltration tank process treatment of integrated printing and dyeing wastewater [J].Industrial water treatment, 2013, 05: 25-28.