The application of D filter in wastewater treatment plant' reconstruction for Ⅰ-A criteria

Abstract: With the revision of the National Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant (GB18918-2002), the range of Ⅰ-A criteria of that standard was enlarged. How can reach the new standard and save energy mostly has been one of the focus. The paper introduced one of the new adaptive filter—D filter, by the explanation of D filter's design and its example of wastewater treatment plant, we convicted that D filter was possible and credible in wastewater treatment plant's reconstruction for Ⅰ-A criteria specified, and it has the capacious application perspective.

Key Word: D filter; cometic fiber filtering media; the national discharge standard of pollutants for municipal wastewater treatment plant; water treatment;

1. The resources for discharge water of municipal wastewater treatment plant

The resource of municipal wastewater is a huge market in reuse of environment resources. There are many advantages for discharge water such as massive wastewater, water quality stabilization, reliable resource, low cost, etc., so it was potential water resource. After advanced treatment, it can be used in agriculture, industry, scenic environmental use, municipal green, urban miscellaneous water consumption and so on, so the reuse of urban recycling water was important measure to ease the shortage of water resource, and can promote benign circulation of water, consequently, it could create economic benefits and social effects.

At present, the shortage of water resource and serious water pollution has been restricting urban developments, reuse of recycling water was not only the important part of city infrastructure but also important measure for integrated utilization and saving water. Under such circumstance, most wastewater treatment plants have to improve effluent quality to satisfy the new national standards. For example, in order to achieve the ambition of exit section of river reach Ⅲ criteria before 2008, all wastewater treatment plants of Chengdu city had improve their discharge water quality greatly, and has achieved significant environmental benefits so far. Because of recognition

for wastewater treatment, Chengdu city was the only capitals city of central and western regions which won the title of 'National Environmental Protection Model City'.

2. Application of National Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant

The National Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant (GB18918-2002) was the most restrict standards for urban wastewater plant now. It cleared the standard of discharge water, and it played a major role in enhancing the control and reuse of domestic wastewater, and Ⅰ-A criteria was the minimum standards for reclaimed water. The State Environmental Protection Administration of China has emended this standard at May 2006, and enlarged the scope of implementation of -A criteria. So, many municipal wastewater treatment plants had to reconstruct their original water treatment structure, even added new advanced treatment structures to achieve discharge safely. On the premise of satisfied national standards of present or future, how to decrease the investment, save energy effetely has been the focus of water treatment industry.

Normally, after secondary treatment, most biological indicators has been achieve Ⅰ-A criteria, but SS, fecal coliform etc can not satisfy the standards, so the objective of advanced treatment was the removing of SS, fecal coliform and other biological indicators.

3. The advanced treatment for municipal wastewater treatment plants

According to water quality and water amount of raw water, we design the advanced treatment program by adopting mature technics. It should be technology advanced, requiring low investment and less operating cost, taking small area, operating easily etc., so we should consider the following three aspects:

(1) On the premise of safety water quality, we should adopt mature technics which has simple process, takes small area, requires low investment and owns strong resistance to impact load.

(2) Adopting the techics which needs low-power, lessens sewage and operates easily, compared to the traditional sand filters.

(3) According to local condition, adopting the techics which doses less and needs low operating

cost.

4. D-filter

D-filter is a kind of gravity-filter with high filtration speed which designed by Dean Group and Qinghua university. Its key technology was cometic fiber filtering media which was product of national 863 programs. It adopts low resistance distribution system, back washing with air and water, and it can work whether the water lever is constant or not. It has been used in municipal water project, industrial water supply project and water reclaimed project widely, and has achieved good economic and social benefits.

D-filter has the main advantages of traditional rapid filters, because it adopts new DA863 filtration technology, its capability was prior to the traditional sand filter. It has the following features:

(1)High filtration precision: over 95% of SS in water could be removed. The cometic fiber filter media could remove large molecule organism, virus, bacteria, colloid, iron and other impurities partly.

(2)Rapid filtration speed: usually 18-23m/h in engineers, so it could save plant's room, thus it can save construction investment.

(3)More dust holding capacity: usually 15-35 kg/m^3, is more than 4 times that of traditional sand filter.

(4)Low water consumption of backwashing: water consumption of backwashing is less than 1-2% of filtered water in one filtration period.

(5)Low operating cost: due to the special structure of filter bed and filter media's features, the flocculants dosage is one second to one third of that of traditional technology.

(6)Strong resistance to impact load: can endure strong impact load from water which was high turbidity, and the quality of outlet water is well also.

Compared with the traditional sand filter, D-filter has many advantages such as high filtration speed, low investment, operating cost low and saving energy etc.; compared with the traditional fiber bundle/ball filter, it has the following advantages --- effective backwashing, high performance security and longevity of service, thus, as a key technology of advanced treatment which is high effective and requires less energy, D-filter is an appropriate water treatment

technology for municipal wastewater treatment plant to improve the outlet water quality.

5. Engineering example of D-filter in the reconstruction for Ⅰ-A criteria specified

5.1 Project overview

Chengdu Shahe wastewater treatment plant was key component of environmental governance of Chengdu city. Its raw water was domestic wastewater, and its secondary treatment technology was A^2/O, its advanced treatment adopted DA863 filtration technology ---D-filter.

The size of project: water flow: 100,000 m^3/d, Kz=1.3.

Water inflow quality: SS≤50 mg/L; Water outlet quality: SS≤10 mg/L;

5.2 Process

D-filter's raw water come from the secondary sedimentation tank, and flow into D –filter automatically, then treating water of D-filter disinfected by UV, at last, flowed into Shahe river automatically. We can see the treatment process as following figure:

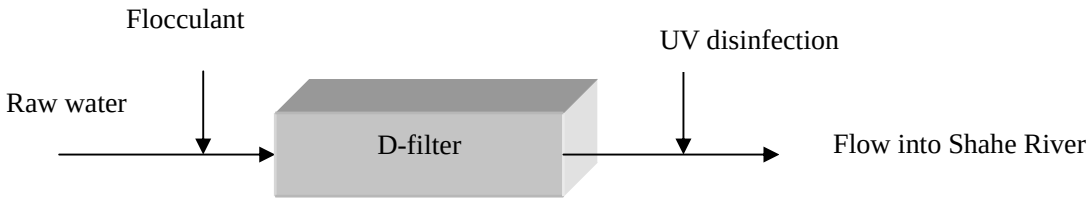

Fig.1 The process of advanced treatment from Chengdu Shahe wastewater treatment plant

5.3 key design parameter

Item	Parameter	Item	Parameter
Influent SS	≤50mg/L	Effluent SS	≤10mg/L
Filtration area	28m^2	number	8 格
Filtration speed	24.2 m/h	Mandatory filtration speed	27.6 m/h
Head lost	0.6～2.0m	Filter cycle	8～24h
Intensity of backwashing(water)	6 L/s·m^2	Intensity of backwashing(air)	20 L/s·m^2
Intensity of surface washing	2.8 L/s·m^2	Thickness of filter bed	0.8m

5.4 Treatment effect

Chengdu Shahe wastewater treatment plant was build at March, 2003, and it was put into operation at September 2004. The following table was the data of SS during one week.

Date	SS (mg/L)		Date	SS (mg/L)	
	Influent	Effluent		Influent	Effluent
2004.10.19	25.2	9.60	2004.10.20	27.2	8.60
2004.10.21	27.4	8.60	2004.10.22	18.2	6.40
2004.10.25	17.4	5.80	2004.10.26	19.4	4.60
2004.10.27	17.2	4.40			

From the table, we could see that with the effluent of the secondary treatment as raw water, when SS of influent is less than 50 mg/L, the SS of effluent is less than 10 mg/L, so it can satisfy the Ⅰ-A criteria.

5.5 Techno-economic indicators

5.5.1 Taking up area of D-filter: 710 m^2; the room of devices: 180 m^2;

5.5.2 The investment of D-filter: Total investment was about 8.5 million (RMB), the construction investment was about 2 million (RMB), the devices, electric and instrument was about 6.5 million (RMB).

5.5.3 Operating cost of D-filter: It was about 0.022 yuan/m^3.

Table 3 The operating cost of D-filter in Chengdu Shahe wastewater treatment plant

Item	Tariff	Labor	Maintenance	Depreciation	Total
cost (yuan/m^3)	0.002	0.004	0.005	0.011	0.022

5.6 Comparison of D-filter with others filters

Comparison of D-filter, V-filter and Aqua Cloth Media Filtration (ACMF), we can get the following preliminary comparisons:

Item	D-filter	V-filter	ACMF
Treatment effect	Excellent	Excellent	Excellent

Technology advanced	Advanced	Normal	Advanced
Maintenance	One for ten years	One for three years	One for five years
Filtration speed	18-25 m/h	6-8 m/h	5 m/h
Equipment manufacturers	Homemade	Homemade	Imports
Area took	Lower	High	Minimum
Infrastructure investment	Lower	High	Minimum
Equipment investment	Minimum	Lower	High
Operating cost	Lower	High	Minimum
Total cost	Minimum	Lower	High

We could get the following comparisons from the data that: ① All filters' treatment effect are able to meet the design requirements, both D-filter and ACMF are advanced technology, and V-filter is very mature; ② On the area took and operating cost, ACMF has more advantageous, and V-filer takes largest area; ③ On the operating cost, ACMF is minimum, and V-filer's backwashing consumed a large number of electric energy, so its energy consumption is most; ④ On the infrastructure investment, because of simple internal structure, ACMF's infrastructure investment is minimum; But there are not domestic alternative equipments, its internal equipments are all imported from the USA, so the total cost is much higher than the other two filters. Therefore, in the premise of same treatment effect, although D-filter's spaces and operating cost was higher, its total cost was far smaller than ACMF's. Compared to the other two filters, D-filer could save more investment and operating cost for customers, and D-filter was possible and credible in wastewater treatment plant's reconstruction for Ⅰ-A criteria.

5.7 Brief examples of D-filter in advanced treatment engineer

5.7.1 Chengdu Tianhui wastewater treatment plant

The size of this project was 100,000 m^3/d, Kz=1.3. The domestic wastewater was treated to Ⅰ-A criteria, then flowed into Jinhua River automatically.

5.7.2 Chengdu Longtan wastewater treatment plant

The size of this project was 100,000 m^3/d, Kz=1.3. The domestic wastewater was treated to Ⅰ-A criteria, then flowed into Ma'anshan River automatically.

5.7.3 Chengdu Wuhou wastewater treatment plant

The size of this project was 100,000 m^3/d, Kz=1.3. The domestic wastewater was treated to Ⅰ-A criteria, then flowed into Huangyan River automatically.

5.7.4 Chengdu Jianganhe wastewater treatment plant

The size of this project was 100,000 m^3/d, Kz=1.3. The domestic wastewater was treated to Ⅰ-A criteria, then flowed into Jiangan River automatically.

6. Conclusion

(1) Advanced treatment program should be designed by adopting mature technics which must be technology advanced, requiring low investment and less operating cost, taking small area, operating easily etc.

(2) D-filter has many advantages such as high filtration speed, low investment, operating cost low and saving energy etc, and its capability was prior to the traditional sand filters and fiber bundle/ball filter.

(3) Because of adopting key technology and special structure, D-filter was possible and credible in wastewater treatment plant's reconstruction for Ⅰ-A criteria, whether in terms of theoretical or engineering examples.

(4) In the application of advanced treatment for municipal wastewater treatment plants, D-filter could create huge economic benefits and social effects.

Thus, D-filter is a new kind of gravity-filter with high filtration speed and high-precision filter, it has the capacious application perspective.

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