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Re-use of Spent Filter Backwash Water by Micro strainer in Water Treatment Plants

Noushin Osouleddini[*]
Islamic Azad University, Ardabil, Iran

Mohammad Abdollahzadeh
Tehran Water & Wastewater supply & Treatment Co. , Tehran, Iran

Maryam Safaei
Maintenance and Operation of Tehran Water Treatment Plants Directory, Tehran, Iran

Raheleh Sajadipoor
, Maintenance and Operation of Tehran Water Treatment Plants Directory, Tehran, Iran

ABSTRACT

In this study, microstrainer application in recycle of Spent Filter Backwash Water (SFBW) has been investigated. The results show that physicochemical and biological quality of SFBW can be added to the inlet water but it must be treated with microstrainer filter. The SFBW was passed through standard membrane with 5,18,40,70 µm size and filtered SFBW was analyzed. 5, 18 and 40 µm membrane showed respectively the best results. Applying 5 µm membrane that the best results found removing amount of biological factors include: diatom 85.77 to 90 percent, Cyanophyceae 100%, Crustacean 100%, Rotifer 100%, and removing percent of physicochemical parameters include: Turbidity 44.78%, Iron 51.24% and Manganese 35.35%. In present study 18 µm membrane is economical membranes because after filtering the SFBW with 18 µm membrane can be added to the inlet water.

Keywords: Water Treatment; Spent Filter Backwash Water; Micro strainer

Correspondence: Noushin Osouleddini, Department of Chemistry, Ardabil Branch, Islamic Azad University, Ardabil – Iran

Email: Osouleddini.n@gmail.com

INTRODUCTION

The Filter Backwash Recycling Rule (FBRR) establishes regulatory provisions governing the way that certain recycle streams are handled within the treatment processes of conventional and direct filtration water treatment systems. The FBRR also establishes reporting and recordkeeping requirements for recycle practices that will allow States and EPA to better evaluate the impact of recycle practices on overall treatment plant performance, EPA(2002). Iran water resources are limited because it is located in arid and semi-arid climatic zone. In one hand, shortage of drinking water, and low rain fall mean (about 250mm yearly) in comparison with world mean (about 750 mm), non-normative withdraw groundwater, water pollution with domestic SFBW, agricultural SFBW and industrial SFBW are major challenges in water resources management [1][2][3].

Increasing population and limited water resources on one hand, Reduced per capita share of water than 14,000 m^3 at the beginning of this century to 1800 m^3 if that this trend continues, this share reaches to 1360 cubic meters [4][5][6]. So, reuse of renewable resources is very important. By studying water treatment process, filter backwash recycling is necessary. In order to prevent water lose, usually SFBW is collected in small pond then returned to inlet water of water treatment plant after removing water impurities. Backwashing is the process of reversing the water flow and the velocity of the water as it passes through a filter. For dewatering of sludge produced in water treatment plant sludge drying beds and sludge dewatering equipment are used [7].

In conventional water treatment process, about 2 to 3 percent of treated water is intended for filter backwashing. Before 1965 SFBW returns to water resources was common. But after 92-500 rule and reform in law of water pollution control in 1972, this act be forbidden. As a result, SFBW from washing (backwashing) of filters and outlet sludge from sedimentation tanks be grouped in industrial SFBW and water treatment plant is obligated to regard laws. These laws are published by National Pollutant Discharge Elimination System (NPDES) [8][9]. After 92-500 general law approval, many of water treatment plant return SFBW from washing (backwashing) of filters to beginning of line with or without sedimentation.

For this purpose, its pollutants and suspended solids should be removed. Removal and treatment usually is done in primary and secondary sedimentation tanks or thickener tank which requiring large land and is time consuming, [10][11]. To solve problems of land and time, microstrainer can be used. All water treatment plant which use surface water and underground water have proper and direct filtration or reuse overflow water in thickener tank or water from sludge drying beds should regard to filter backwash recycling Rules (FBRR). The Filter Backwash Recycling Rule (FBRR) establishes regulatory provisions governing the way that certain recycle streams are handled within the treatment processes of conventional and direct filtration water treatment systems. The FBRR also establishes reporting and recordkeeping requirements for recycle practices that will allow States and EPA to better evaluate the impact of recycle practices on overall treatment plant performance. Water recycling is effective in treat ability to removal and to inactive pathogens; return flow has high concentration of pathogens and other pollutants which they are trapped by filters. So, recycled water control chemically and

biologically is very important. About FBRR rules, reporting information on recycled water include: number of nematode, Giardia and Cryptosporidium per liter, total suspended solids (TSS), heavy metals like Manganese (Mn), Zinc (zn), Iron (Fe), Aluminum (Al), Total organic carbon (TOC), Dissolved organic carbon (DOC) and Trihalomethanes (THM$_S$).

The microstrainer filter (MF) is a part of the tertiary stage of the waste water treatment process. It is used in processing industry, cooling water circuits and processes where it is necessary to reduce the quantity of insoluble substances in the hydro-mixture, possibly BOD and COD.

The design of the filter utilizes many well-tried features of foreign manufacturers complemented with the latest developments in the field of water filtration; the focus is on reliability, corrosion-proof quality, automatic operation and easy maintenance. The polluted water flows into the microstrainer filter while the insoluble substances are separated on the inner side of the filter. Filtrated water flows through the microstrainer and leaves the filtrating device. The flow capacity of the filter is gradually reduced due to increasing layer of the entrapped sludge.

Thus the difference of water levels before and behind the device is increasing. The difference is scanned by a level sensor that triggers the cylinder drive and a rinsing pump; the pump cleans the micro strainer using the filtrated water and special cleaning nozzles with controlled flat stream. Sludge water flows out to another section of the device where a sewage pump controlled by level sensors drives the water out of the filter. The sludge water can flow out of the micro strainer filter by means of gravitational forces, according to local conditions[12][13][14][15]. There is very little head to force the fluid through a micro-strainer, so the mesh size of the screen must be coarse to get a practical filtration rate. Consider the screen shown in the sketch and some algae of different sizes and shapes. Some algae have beautiful spiral components, but this was too hard to draw[15][16][17].

Micro strainers can be used to remove algae and planktons from water which stored behind dams [18][19][20]. The alga marked is only slightly larger than the mesh opening. It is likely to clog the mesh, and some may pass through if the screen is not uniform. Compression of the filtered material is not likely to be too bad because that is the idea of the micro strainer to minimize forces.

Some of the shapes and sizes should collect well while others will pass the screen easily. The cylindrical organisms are of particular interest because their orientation is important. If they hit the screen on their long side, they are captured easily. When they approach lengthwise, they go right through.

Raw water has large amount of algae and planktons which are problematic for coagulation, they are usually suspended because their specific weights are less than1.

Therefore, micro strainers be installed before coagulation and improves the performance of sedimentation tanks. If we chlorination raw water its alga create unpleasant flavor and odor due to forming substitute compounds. Algae removal before chlorination and coagulation has beneficial effects on the taste and odor control and more reduced Trihalomethanes (THM$_S$) and

other compounds from the chlorination. Also using micro strainers reduces chlorine consumption in the pre-chlorination.

MATERIAL AND METHODS

- Standard sieves with 5-18- 40-70 μm mesh, for passing flavor samples with 15 cm diameter.
- Sampling dishes from simple crystal or borosilicate and PTF according to table I: standard method book for performing flavor and water testes.
- Microscope with zees Brand, primo star model.
- Knf brand 0-1200 mbar vacuum pump, LABOPORT model and its accessories.
- Spectrophotometer, HACH brand, DR/4000 model
- HACH turbidity meter system, 2100 AN model
- METROHM brand PH-meter system, 780 model
- HACH brand magnetic mixer, IKA-RCT basic model
- HACH brand electrical direction- system, session 5 model.
- BRAND treansferpipette and micropipette

Sampling is compound and samples be passed instantly in standard meshes with 70 mm, 40mm, 18mm and 5mm sizes in lab.

Sampling And Samples Protection

According to standard methods book, 21 editions in 2005, sampling be done, then with regard to "sample should be part of whole rule. Experiments were done in Physicochemical and microbiological laboratory Fifth Tehran water treatment plant. Sampling basis (dishes, sample volume, storage time and condition) according to table I: 1060 standard meted book and US Environmental Protection Agency (US.EPA) is determined.

Sampling duration is 20 minutes and each minute 20 liter of flavor sample re over and after homogenizing it will be analyzed biologically and physic- chemically. Table 1 show average amount of turbidity and quality parameters of SFBW from backwashing of filters.

Samples should be taken at different time intervals and Compound because turbidity of SFBW from backwashing of filters in 2-3 minutes the first backwashing stage reaches its maximum.

MEASUREMENT METHODS

Turbidity was measured according to standard methods with nephelometric method by N_{2100} machine, HACH brand. pH and temperature were measured by METROHM brand pH-meter machine, 780 models by using standard buffer solutions was calibrated daily. Electrical conductivity (EC) is measured METROHM brand pH-meter machine. TSS and TDS were measured according to the instruction of the standard methods book. Total organic carbon (TOC) is measured by spectrophotometer, HACH brand, DR/4000 model. To removal organic materials from dishes such as Beaker and pipette which be used along with Sulfochromic acid according to the instruction of the US.EPA washed at first by distilled water then by demineralised water with electrical conduction less than %5 μs/cm.

Fe, Mn, Cu and Zn were measured by spectrophotometer, HACH brand, DR/4000 model by 8008, 8149, 8026 and 8009 methods respectively. Machines before using accordance with the instructions of machine guide were calibrated.

MESH PROPERTIES USED IN RESEARCH

Standard meshes which were used in research include SEFAR (filtration solution- open mesh fabrics- precision wren synthetic monofilament fabrics).

RESULTS AND DISCUSSION

The physicochemical characterization of filtered samples with different sizes micro strainer was found that reducing the size micro strainer turbidity, iron and manganese are reduced. In tables 1 and 2, this process has been shown. This decreasing process is seen in biological organisms by doing experiments on meshes with different standard pore size that table 2 shows them.

Table1. Physicochemical characteristic of Filter Backwash SFBW before using micro strainer and after treatment by micro strainer with different pore size

Parameter	Before Micro strainer	After Micro strainer with different pore size			
		5 μm	18 μm	40 μm	70 μm
Turbidity (NTU)	22.4	3.03	4.77	14	18
pH	8.02	8.02	8.02	8.02	8.02
T (°C)	14.20	14.2	14.2	14.2	14.2
EC(μs/cm)	359	357	362	360	359
TDS(mg/l)	230	229	232	230	229
Fe(mg/l)	9.71	1.016	1.571	3.3	3.855
Mn(mg/l)	1.03	0.028	0.033	0.082	0.098

Table2. Biological characteristic of Filter Backwash SFBW before using micro strainer and after treatment by micro strainer with different pore size

Parameter	Before Micro strainer	After Micro strainer with different pore size			
		5 μm	18 μm	40 μm	70 μm
Diatom	46800	6200	12300	18430	23000
Chlorophyceae	22800	7800	10600	14500	20500
Cyanophyceae	24	0	1	10	10
Protozoa	25	1	2	10	20
Rotifer	2	0	1	0	0
Crustacean	72	0	1	6	10
Nematode	24	0	1	1	4

Microbiological and physicochemical result show that except color factor which is due to chloroferric, other parameters of SFBW from backwashing of filter are less than inlet water to water treatment plant. So, the inlet raw water has the ability to accept the SFBW. Maximum removal efficiency in studied meshes with pore sizes 5-18-40-70 μm belongs to 5 μm membrane. Minimum removal efficiency in studied meshes with pore sizes 5-18-40-70 μm belongs to 70 μm membrane.

CONCLUSION

During the investigation it was found that biological and physicochemical water quality of the sedimentation tank and filters outlet is better than water quality from micro strainer outlet (using a 5μm mesh), so the idea that sand filters can be replaced with micro strainer is rejected but using micro strainers in comparison with other SFBW treatment methods is more economical. According to the results obtained in this study 18 μm membrane is economical membranes that removal efficiency of physicochemical parameters with using 18 μm mesh for Turbidity 30-50%, Iron 22-50%, Manganese 25-35% and TOC is 5% and removal efficiency of Biological parameters with using 18 μm mesh for diatom 49-96.7%, Protozoa 67-100%, Rotifer 67-100%, Cyanophyceae 100%, Crustacean 83-100% and nematode is 67-100%.

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