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Use Chlorine Doses as Disinfection of Filamentous Bacteria By Eliminating Physio- Chemical Parameters in Activated Sludge Wastewater Treatment

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Abstract

Activated sludge process is widely used for treatment of mixed types of wastewater like industrial, domestic and municipal wastewater. The treatments are done byway a huge numbers of microbial population. One of more defect problems in the operation of it is filamentous bacteria, which hang the suspended solid. Current approaches for controlling growing filamentous bacteria includes controlling dissolved oxygen levels and chlorination doses. In this research the chlorination dose which used (3, 4 and 5 mg Cl_2/l) in finial settling tank (position of chlorination addition). Stable chlorination dose is 4 mg/l in finial settling tank. The average of SV_{30}decreased from 750 to 300 cm^3 (60%), DO from 0.4 to 1.2 mg/l (66.6%) and MCRT from 1.5 to 4 day (62.5%).

Keywords: Sludge volume after 30 min (SV_{30}); Dissolved Oxygen (DO); Filamentous bacteria; Mean cell residence time (MCRT) and Dissolved oxygen; Wastewater treatment

Introduction

One of most famous technology which can treatment both municipal and industrial wastewater [1] . Activated sludge is aerobic treatment which reduces organic matter from wastewater by using microorganisms. aeration tanks is place which microorganisms is grown to convert organic matter into their own biomass such as Achromobacter, Aeromonas, Bacillus, Flavobacterium, Alcaligenes, nitrifying organisms; Nitrosomonas and Nitrobacter, Micrococcus and Pseudomonas, Thiobacillus, Acinetobacter, [2,3] The most problems related to activated sludge process are Foaming (biological) , sludge bulking, rising solids and Pin floc. Filamentous micro-organisms may be the main causes [4,5]. In healthy activated sludge filamentous bacteria with low levels of filaments are important component that need for solid settling. But at high number that aim to heavy foam which has brown color [6]. The thick rabish layer is formed on the surface of settling sludge by acid which producing by filamentous bacteria and this can lead to various operational problems [7] . Lipids and organic material are wastewater components of the significant factors on foam formation, [7,8]. Sludge age from labs tests were reduction on filamentous bacteria growth infection in large number [9] so, that attended to microbiological seeing which provided[10]. Some of scientists have fact that the foaming in treatment of wastewater stations and physical control, biological and chemical method [11]. Al chlorine used as treatment of filamentous bacteria provides the oil and grease treatment in waste water can be surface ways [5]. For fabrication of permanent froth triplet materials which needs, bubbles air, surface tension and cell which afraid. Gain of surface tension reborn one forming foam by peeling the surface. The troika

materials can be found by mouth materials and aeration in al waste and the surface tension products by filamentous bacteria [12]. In absence of foaming organisms at activated wastewater sludge plant, globules with white color which production from grease and fats can appear in the surface of finial clarifiers. This bubbles which in the surface went to effluent and cannot blocking it. The organisms in the Foaming are very important for processing treatment because they are playing on Crumbling oils & greases and fats [13].This provide by [13] is, that is very important to control in filamentous bacteria but cannot disinfection. Unstable foam will be created with unaffected cells, a greasy surface scum is formed by cells in the absence of surfactants, while adding surfactants can convert a group of skimming into one to form a stable foam [12] .Even though the grow of filamentous bacteria is slowly in presences of fats, grease and oil, the bacteria foaming grow faster in presences of this material [13]. In activated sludge treatment plants early, 1-fixed on biological and oxygen demand as organic removal. 2- sludge age was shortly between 3-5 days, but now the nutrients removal in activated sludge treatment plant needed age of bacteria between 10-15 days that to active de-nitrification and nitrification[13]. The presence of unfavorable conditions in the activated sludge system, such as toxic conditions (pH below 6.5 or above 9.0), insufficient DO, nutrient deficiencies, or seasonal (winter/summer) temperatures ultimately lead to the foaming problem. Subsequent pollution of the clarifier effluent with suspended solids has a negative impact on plant productivity and efficiency [14].

Experimental Method

Description of Wastewater Treatment Plant

Housh Eissa waste water plant, El Beheria, Egypt has design capacity 20000 m^3/day, operation by activated sludge. It has two operation streams, every stream capacity 10000 m^3/day similarity. In fig (1) shown section from Housh Eissa waste water treatment plant which consists of 5 tanks (influent tank, aeration tank, finial settling, thinker tank and dry beds. The plant operating by fills design capacity (20000m^3/day). The biological treatment system is activated sludge (extended aeration).

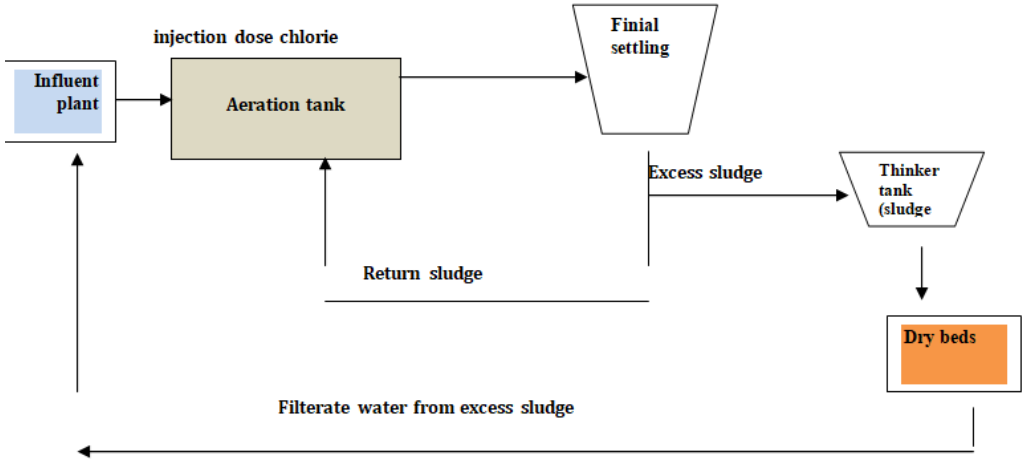

Figure 1: Shown section of the plant design and injection chlorine

Collection and Analysis of Waste Water Samples

Waste water samples were collected using poly ethylene bottles which were washed with tap water at the first and then were rinsed using double de-ionized water. The raw and treated waste water samples are collecting as grab samples from the influent after sand removal ,aeration tank, finial settling waste water treatment plant and return sludge at Hoshe Easa, Beheira governorate, Egypt and all the analysis by using the ***standard methods by the American Public Health Association[15]*** . The samples were analyzed for biochemical oxygen demand (BOD_5) after ***5 day(5- Day BOD manometer method),*** total chemical oxygen demand (***Closed reflux, 5220 D–5–18 method***), total suspended solids (TSS), dissolved oxygen (DO) by using ***a digital oxi meter kit (WTW OXI 323-B / Set)***), sludge volume after 30min (SV_{30}) ,pH by using ***(a probe (WTW pH 323-B / Set-2)***, Temperature, and MCRT.

Method of calculation of MCRT (mean cell residence time):

$$MCRT = \frac{Mlvss\ x\ V}{WAS\ x\ Q\ was\ x\ Evss\ x\ EQ}$$

Where:

MLvss : mixed liquid volatile suspended solid conc. (mg/l).

V:volume of aeration tank (m3).

WASvss : volatile return sludge (mg/l) .

Qwas: the quantity of return sludge m^3/day.

Evss: volatile suspended solid conc. In effluent (mg/l).

EQ : effluent quantity.

Result and Discussion

The chlorine doses (3mg/l, 4mg/l and 5mg/l) were addition in the finial settling as shown in fig (2), every dose was studying for 3-5 day. the parameters of (finial settling tank, aeration tank and influent tank) were studying where in finial settling's parameters were (PH,TSS ,COD,BOD and MCRT) , aeration tank's parameters were (DO, SV_{30}, MLSS and MCRT) and influent tank's (Temp. ,pH , TSS, flow, COD ,BOD and MCRT).

Finial Settling

Table 1: Shown the parameters (average) were PH; Temp;TSSeff; COD; BOD; WAS in the finial settling.

Parameters (average)	Before Cl_2 dose	After Cl_2 dose			Percentage efficiency %		
		3mg/l	4mg/l	5mg/l	3mg/l	4mg/l	5mg/l
PH	6.8	6.6	6.48	6.46	------	------	---------
Temp.	23	23.1	22.8	23.5	------	-------	---------
TSS_{eff} (mg/l)	66.14	53.01	39.14	25	19.85	40.66	62.20
COD (mg/l)	102	84.20	72.92	60.07	17.45	28.50	41.10
BOD (mg/l)	59.88	49.52	42.89	35.33	17.30	28.83	40.99
No. bacteria (unit/l)	2500	2000	1500	890	20	40	64.4

The foaming and the bulking of filamentous are controlling by specific and nonspecific strategies. Specific control strategies are preferred because they are selective and provide a permanent solution to the problem while unspecified methods tend to offer only temporary solutions. [16] , From table (1) and fig(2) indicate that Tss performance treatment after Cl_2 doses (3 ,4 and 5 mg/l), (19.85,40.66 and 62.2%), The COD mg/l performance treatment after Cl_2 (17.45,28.5 and 41.1%) and BOD (17.30, 28.83 and 40.44%). Generally speaking, foaming problems from filamentous bacteria occur in wastewater treatment plants at the operating at low temperatures (<15 ° C) with sludge loading rate less than 0.1 kg BOD5 / kg SS / d. from the result of the ideal chlorine dose is 4 mg /l in the finial settling where the account number of bacteria was 1500 where that not effect in the number of bacteria. And the TSS concentration was 39.14 mg/l but in the dose 3 mg/l the the TSS conc. Still the concentration above the limit of law 48/82 where the dose 5 mg /l the account of bacteria was very low that mean a lot of it dead.

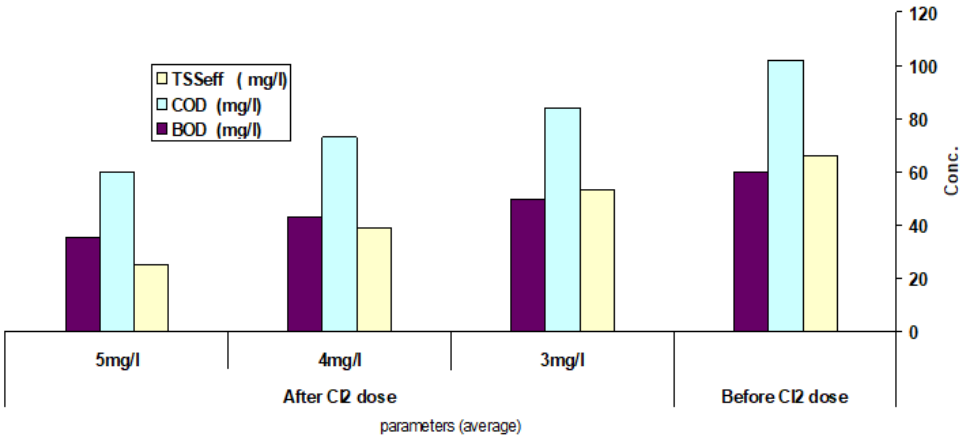

Figure 2: Shown the effect of chlorine doses 3,4 and 5 mg/l on the finial settling

Aeration Tank

Wastewater that contains slowly biodegradable organic materials such as fats, proteins and fats is preferred using filamentous microorganisms [7].The factors which describe the average time in days are Mean cell retention time or MCRT which is mean cell residence time that microorganismsstay in an activated sludge treatment which depend on the concentration of MLSS in aeration tank [16]. The most used the foamingcan be adjustby MCRTreducing. Whenthe MCRT reduction between 8 and 10 days

adjust the growth of M. parvicella can often be controlled by reducing MCRT reduction to <8 days. On the other hand to combat Nocardia, the Activated Sludge Plant (ASP) should reduce MCRT to <3 days [7].However, this method has been successful in reducing foaming in large-scale wastewater treatment plants. Gradually increasing the Food / Microbe ratio (F / M ratio) and reducing MCRT but it is desirable and not difficult to apply as shown in the following table 2.

Table 2: Shown the parameters (average) were DO; SV_{30}; MLSS; and WAS in the aeration tank.

Parameters (average)	Before Cl_2 dose	After Cl_2 dose			Percentage efficiency %		
		3mg/l	4mg/l	5mg/l	3mg/l	4mg/l	5mg/l
DO(mg/l)	0.96	1.32	1.54	1.76	------	------	------
SV_{30} (cm^3)	870	650	520	327	25.28	40.22	62.41
Mlss (mg/l)	2300	2150	1980	1740	6.52	13.91	24.34
WAS	2650	2500	2350	2100	5.66	11.32	20.75

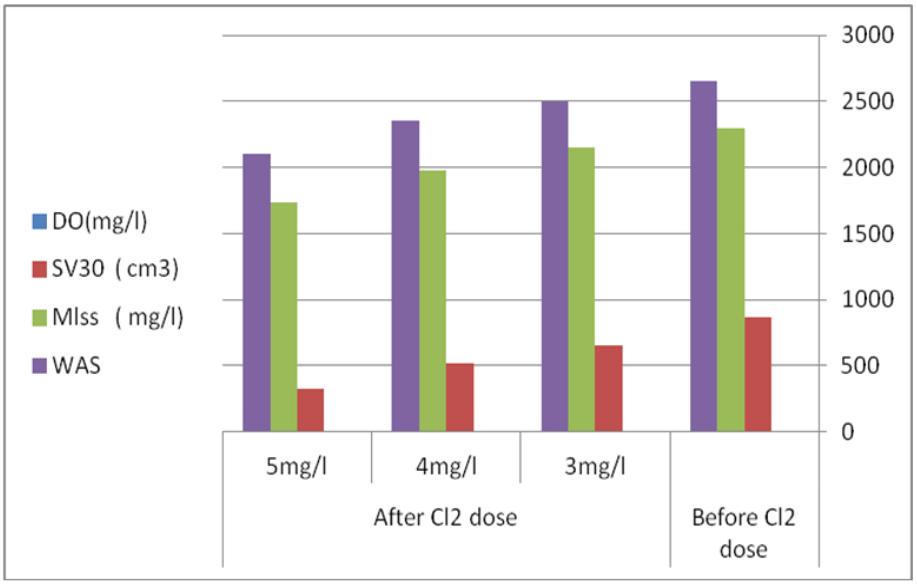

Figure 3: Shown the effect of chlorine doses 3,4 and 5 mg/l on the aeration tank

It advance that requires min sludge of filamentous bacteria have average between 8.5 to 6 days to stable population form but there is no bulking happen in MCRT is less than 4days[16] .Which that occur as in table (2) and figure (3)as dose of chlorine increase that help the conc. Of TSS in all treatmentstage. In raw treatment before the CL_2 dose the MLSS in aeration tank was 2300 mg/l but after 3 mg/l of chlorine decrease to 2150 mg /l (6.52%), at 4 mg/l dose was 13.91% and with 5 mg/l was 24.34% from analysis of data the 5 mg/ l dose is affections one but in we take all the result of DO, MLSS, SV_{30} and WAS that clear the affection one was 4 mg/l.

Influent Tank

Wastewater can be conveyed to treatment plants via pipelines and in flow with the help of gravity and pumps. The first part of wastewater filtration usually includes a bar screen to filter solids and large things that are then collected in landfills and disposed of in landfills. Fat and grease are removed before the initial treatment of wastewater.

The activation of the activated sludge system at the ages of sludge greater than 10 d is assumed to enhance the problems of bloating and threading. Based on complete experiments and laboratory [7], In raw treatment before the CL_2 dose the TSS in influent tank was 345 mg/l but after 3 mg/l of chlorine decrease to 339 mg /l (1.73%), at 4 mg/l dose was 4.92% and with 5 mg/l was 7.53% ,from analysis of data the 5 mg/ l dose is affections one but in we take all the result of COD, BOD that clear the affection one was 4 mg/l which can show in fig.(4).

Table 3: Shown the parameters (average) were PH; Tem; TSS; COD; BOD and Flow in the aeration tank

Parameters (average)	Before Cl_2 dose	After Cl_2 dose			Percentage efficiency%		
		3mg/l	4mg/l	5mg/l			
PH	6.85	6.73	6.71	6.69	----	------	--------
Temp.	23.1	23.09	23.21	23.20	----	------	--------
TSS (mg/l)	345	339	328	319	1.73	5.01	7.53
COD (mg/l)	640	630	625	600	1.56	2.34	6.25
BOD (mg/l)	380	370	360	350	2.63	5.26	7.89
Flow	$20*10^3$	$25*10^3$	$25*10^3$	$25*10^3$	-------	------	----------

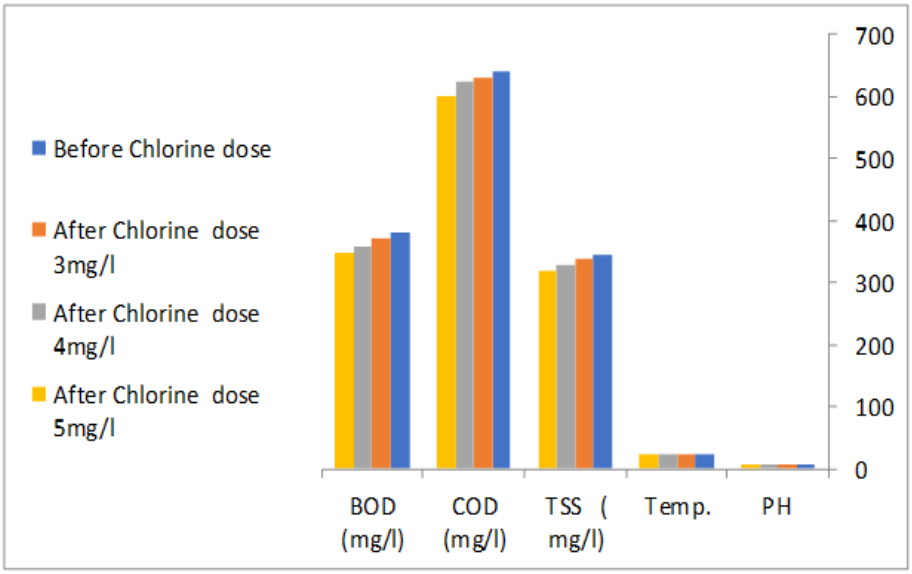

Figure 4: Shown the effect of chlorine doses 3,4 and 5 mg/l on the aeration tank

Conclusion

Foam due to filamentous organisms and dispersed gas bubbles that create a dense brown scum layer on the surface of activated sludge ponds and secondary filters to control or reduce the harmful effect of foam, chemical methods have been used. Mainly used methods are given below: Chlorine is added in the final tank where some water parameters such as the Food / Microbe ratio (F / M ratio), to provide conditions to prevent excessive growth of unwanted filamentous microorganisms.To achieve 60-82% removal of soluble BOD_5 Then the mixture is passed to the aeration basin [11].

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