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PERFORMANCE EVALUATION OF ACTIVATED SLUDGE PROCESS IN TREATING SEWAGE

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ABSTRACT

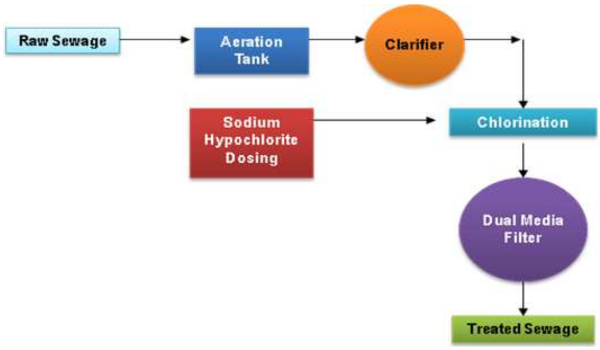
This research work aims to study the efficiency of activated sludge process in treating sewage A typical sewage has BOD & COD concentrations in the range of 200-300 mg/l and 450-700 mg/l respectively. However, in this lab scale research study, the sewage waste water was directly treated to aerobic treatment- activated sludge process and its performance has been evaluated. A aeration tank of 40 lit of capacity was fabricated and a plastic jar of capacity 10 lit was used as a setteling unit. aerobic microorganisams was generated from cow dung slurry and sewage. artificial aeration was provided on a continues basis for mixing and oxygen transfer a dual media filter of dimeter 20 cm and height 100 cm was also fabricated for removal of TSS from final treated waste water. The activated sludge process achieved BOD reduction of 95.50% & COD reduction of 94.19%. however after aerobic treatment the TSS concentration were 82%. Thus the aerobically treated waste water was passed through a dual media filter, which achieved 94.29% of TSS removal.

KEYWORDS: Chlorination, Clarifier, Dual Media Filter, Activated Sludge Process, Sewage

INTRODUCTION

The activated sludge process has been widely used as a standard method for treating domestic waste water. This process though efficient, is costly in terms of capital cost, operational cost, and require more power than other comparable biological processes. In the asp, the role of the recirculation pumps is to recycle the biological flocs from the secondary clarifier into the aeration tank for maintaining requisite concentration of biomass for metabolic reactions. It is possible to keep the biological flocs into the aeration tank by arresting to carry over the solids into the secondary clarifier the recycle of pumping system is not necessary this is possible if the units of asp are integrated and the geometry shall play the important role.

The objective of this paper is to present treatment of sewage by biological treatment process and its reuse for b grade purposes. The suggested treatment scheme is important to achieve the required degree of performance of the treatment system. The clarifier does the function of sepra tion of solids from the liquid. This project is aimed at treatment of waste water by Activated sludge process and removal of suspended solids from aerobically treated waste water, by dual media filtration, in order to make the treated waste water suitable for re-use such as gardening, toilet flushing, landscape development etc. In this project, a lab scale study has been conducted for treating waste water generated from nag river Nagpur.



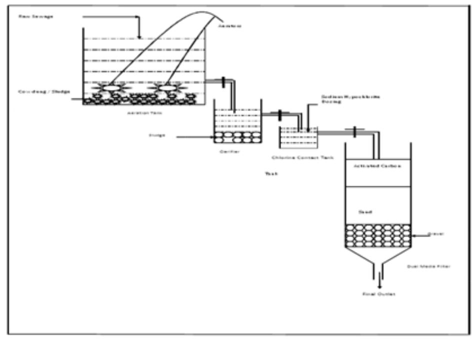


Figure 1: Sewage Treatment Plant Design **Figure 2: Experimental Set up Diagram**

As per the mentioned treatment scheme in figure 1, the waste water is passed through the screen for removal of floating matter. The waste water is then taken into Equalization tank for equalizing the organic load of the waste water so that waste water with uniform organic load can be pumped to further units. The waste water is then taken into Buffer tank for pH neutralization as well as pumping waste water to anaerobic reactor. In the second step, the performance of dual media filter for removal of total suspended solid has been explored. Thus, removal of suspended solid will make the aerobically treated waste water suitable for gardening, road washing, toilet flushing, landscape developing etc. Hence, by doing this, they can have following advantages: Need not have to purchase fresh water for above purposes Can have a step towards Zero Discharge.

Table 1: Items Inside Dual Media Filter

Sr. No.	Item	Particle Size
1	Gravel	20 mm to 40 mm
2	Gravel	10 mm to 20 mm
3	Gravel	05 mm to 10 mm
4	Gravel	02 mm to 05 mm
5	Sand	0.40 mm to 0.70mm
6	Activated carbon	0.55 mm to 0.90 mm

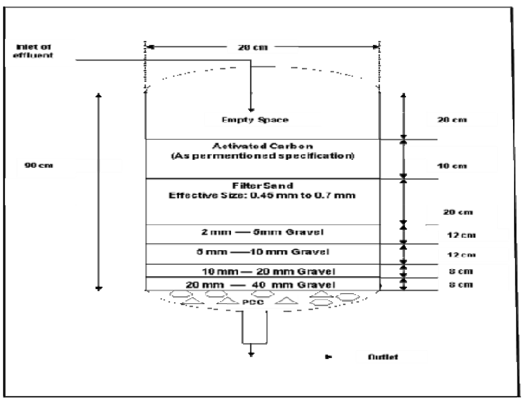


Figure 3: Dual Media Filter Diagram

Experimental Work

Figure 2 represents the small scale experimental setup. a lab scale study was conducted for treating sewage from nag river by Activated sludge process and further, removal of suspended solids from aerobically treated waste water, by dual media filtration, in order to make the treated waste water suitable for re-use such as gardening, toilet flushing, landscape development etc. A specially fabricated aeration tank in mild steel dimensions: 44 cm X 44 cm X 44 cm respectively. Cut to suit artificial aeration system figure 3 represents A specially design dual media Filter in mild steel of height 90 cm and diameter 20 cm with inbuilt stand. table 4 shows the items inside the dual media filter with their respective particle sizes. Forty liters of sample was collected from nag river of Nagpur city. The sample collected was grab sample and was transported to the laboratory. Artificial aeration system was purchased from market (aquarium pump). A plastic jar of capacity 10 Lit was taken representing the clarifier, Sand activated carbon & Gravel were placed inside the dual media filter. The collected sample was estimated for pH, BOD, COD, TSS, & total coli form. Properly sieved cow dung slurry was prepared. Aeration systems were used to aerate the cow dung slurry so that oxygen (air) can be pumped in. The aeration system was placed at two corners so that the entire content of the tank can be oxygenated.

The cow dung slurry was kept undisturbed (except aeration) for Four days for development of aerobic bacterial culture. The aeration was continuous in order to avoid the development of anaerobic pockets in the aeration tank. In chlorine contact tank the dose for one liter of sewage is 1mg/l. the chlorine is use in the form of hypochlorite solution. Simultaneously, the dual media filter was charged with Gravel at the bottom and Sand at the middle and activated carbon at the top. After Four days, 30 Lits of waste water was added in the aeration tank. The content of the tank was aerated for 24 hours. After 24 Hours, some quantity of the content of the aeration tank was taken into the clarifier. The content of clarifier was kept undisturbed for 2 Hours for felicitating settling. After two hours, the supernatant was collected and analyzed for pH, COD, BOD & MLSS. The supernatant is then passed through chlorine contact tank. after chlorination it passes through dual media filter. The sample after passing through the dual media filter was collected in a beaker and analyzed for TSS. The same procedure was repeated after each 24 hours till there is no further reduction in COD / BOD values.

Table 2: Charectoristics of Initial Sewage

Sr. No.	Parameter	Unit	Value
1	PH	_	7.7
2	TSS	mg/l	170
3	COD	mg/l	310
4	BOD	mg/l	200
5	PATHOGEN COUNT	CFU/ml	10^7

Table 3: Charectoristics of Final Sewage

Sr. No.	Parameter	Unit	Value	%Reduction Achieved
1	pH	_	7.8	
2	TSS	mg/l	8	95.29
3	BOD	mg/l	9.3	95.5
4	COD	mg/l	18	94.19
6	Pathogen count	CFU/ml	10^4	99.9

Table 4: Charectoristics of Sewage after Activated Sludge Process

Sr. No.	Days	PH	TSS (mg/l)	BOD (mg/l)	%BOD Reduction	COD (mg/l)	%COD Reduction	MLSS (mg/l)
1	Initial	7.7	170	200		310		
2	Day1	7.6	110	180	10.0%	282	9.03%	3400
3	Day2	7.8	95	158	21.0%	244	21.29%	3400
4	Day3	7.8	90	136	32.0%	212	68.38%	3600
5	Day4	7.8	90	118	41.0%	170	4 5.16%	3800
6	Day5	7.8	86	89	55.5%	142	54.19%	4000
7	Day6	7.8	85	58	71.0%	122	60.64%	4000
8	Day7	7.6	86	39	80.5%	102	67.09%	4100
9	Day8	7.6	90	21	89.5%	96	69.03%	4000

Table 5: Charectoristics of Sewage after Chlorination

Sr. No.	Days	pH	BOD (mg/l)	% BOD	COD (mg/l)	%COD	TSS (mg/l)
1	Initial(after activated sludge treatment	7.6	21		96		90
2	Sample-1	8.0	11	94.5	64	79.35	8
3	Sample-2	8.2	12	94	68	78.06	86
4	Sample-3	8.2	10	95	60	80.64	84
	Average	8.2	11	94.5	64	79.35	82

Table 6: Charectoristics of Sewage after Dual Media Filter

Sr. No.	Days	PH	BOD (mg/l)	%BOD Reduction	COD (mg/l)	%COD Reduction	TSS (mg/l)	%TSS Reduction
1	Initial before chlorination	7.6	21		96		82	
2	Sample-1	7.8	9	95.5	18	94.19	8	95.29
3	Sample-2	7.8	9	95.5	20	94.54	10	94.11
4	Sample-3	8.0	10	95	16	94.80	8	95.29
	Average	7.8	9.3	95.5	18	94.19	8	95.29

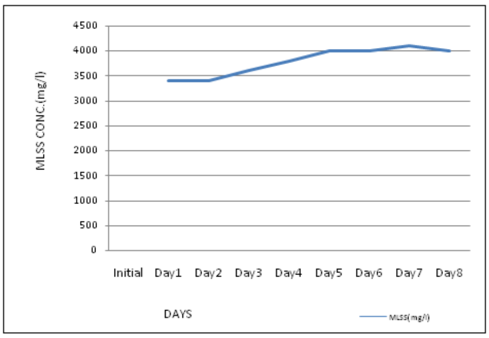


Figure 4: MLSS Conc. Inside the Aeration Tank

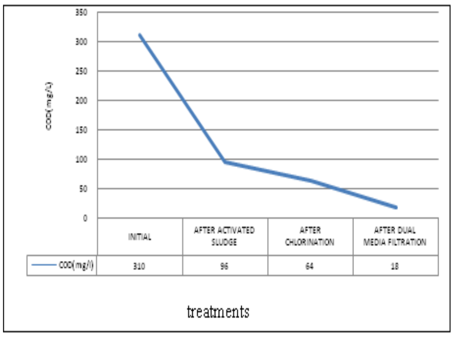


Figure 5: Reduction of COD by Various Treatments

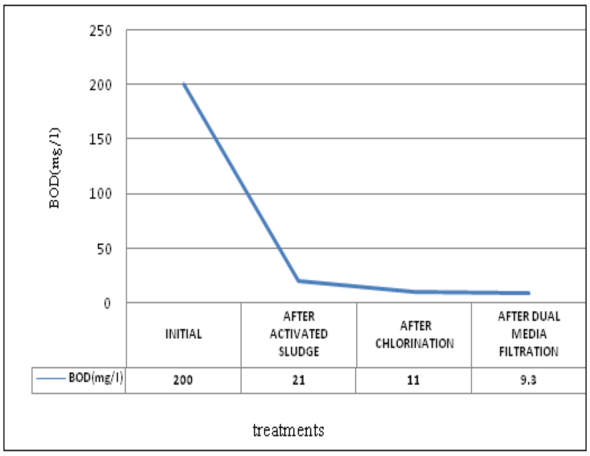


Figure 6: Reduction of BOD by Various Treatments

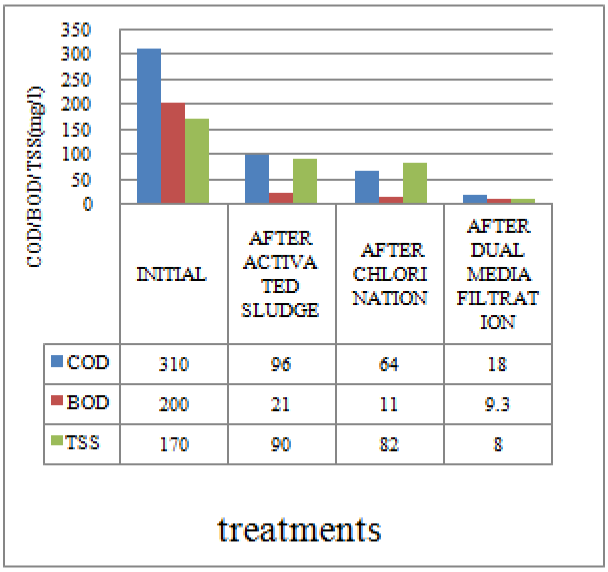


Figure 7: COD, BOD & TSS Reduction by Various Treatments

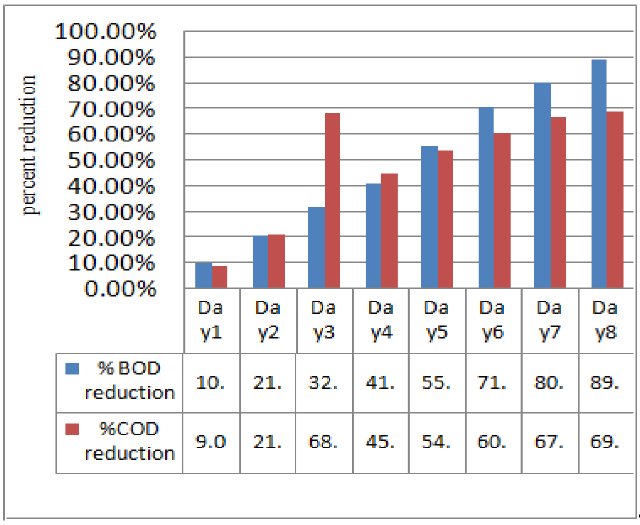


Figure 8: % Reduction in COD, BOD after Activated Sludge Process

RESULTS & DISCUSSIONS

Treatment of waste water has been made compulsory by Govt. of India. Although Govt. of India, Ministry of environment is advocating zero discharge but till now, it has not been made compulsory. It depends on the industry, whether they need to reuse the treated water or discharge the same after conforming to the discharge norms. Current water reclamation strategies incorporate multiple measures to minimize health and environmental risks associated with various reuse application. A combination of source control, advanced treatment process flow schemes, and other engineering controls provides a sound basis for increased implementation of water reuse applications. The feasibility of producing reclaimed water of a specified quality to fulfill multiple water use objectives is now a reality due to the progressive evolution of technologies and risk assessment procedures[13]. Table 2 shows The waste water may be termed as low strength waste water stream as the COD of the raw waste water was 310 mg/l and BOD was 200 mg/l. figure 8 shows

The day wise COD reduction achieved by activated sludge process was 69.03% and BOD reduction achieved was 89.50%. table 6 shows The COD of final treated waste water was reported to be 94.19% whereas the final BOD values were 95.50%. table 3 records the day wise reduction of COD, BOD & TSS by activated sludge process. In manual for Sewerage and Sewage Treatment the BOD removal from sewage has been reported as 90% by activated sludge process[8]. Table 5 shows the degree of treated waste water after chlorination. Chlorination shows the 99.9% reduction of total coli form but it also gives an advantage of saturating the slimy layer at the upper surface of dual media filter. In this study the main aim of given chlorination is to remove the slimy layer from the top of the dual media filter because it get chocked the dual media filter. the role of activated sludge final settling tanks by conducting multiple batch settling tests with the various initial suspended solids concentrations of the activated sludge. Based on the study, it was reported that a proper settling of sludge will enhance the performance of activated sludge process. 77% COD removal & 85% total BOD removal by activated sludge process in Environmental Engineering handbook[12]. The initial TSS of the raw waste water was 110mg/l, whereas after activated sludge followed by proper settling. The TSS values were reported in the range of 82 mg/l. No coagulant or flocculent was used for settling of sludge. It shows, with proper settling by gravity, TSS removal can be achieved significantly.

The MLSS concentration inside the aeration tank was studied throughout, There has been a sharp increase in MLSS concentration inside the aeration tank in figure 4. The MLSS concentration on Day – 1 was reported as 3500 mg/l whereas on Day- 7, it increased up to 4000 mg/l. The increase in MLSS concentration shows a steady growth in microbial population inside the aeration tank, which has directly influenced the BOD / COD removal efficiency. Another advantage of activated sludge process is that it can absorb moderate shock load and can be restarted within 48 hours after a shut down period of even 30 days. Table 6 shows the performance of dual media filtration was significantly good.

The treated waste water was crystal clear. The TSS at the inlet of dual media filter was reported around 82 mg/l whereas the TSS at the outlet of dual media filter was in the range 8 mg/l, showing 94.29 % TSS removal. the performance of sand filter and Dual media filter for removal of TSS from Lake Water. In their paper, “amelioration of lake water pollution & strategy for re-use”, they have studied TSS reduction by various techniques such as Gravity settling, coagulation & flocculate-on and Dual / Sand Filtration.

They have reported removal of TSS by sand Filtration[10]. the performance of activated sludge process followed by sand filtration in removing COD, BOD and TSS from sewage. In their paper treatment of sewage by activated sludge process followed by sand filtration, they achieve a considerable reduction in COD, BOD and TSS[[11]]. Sand filtration of wastewater for tertiary treatment and water reuse” has reported of COD reduction due to removal of considerable quantity of TSS from the waste water[[6]. the Performance of a stratified sand filter in removal of chemical oxygen demand, total suspended solids and ammonia nitrogen from high-strength wastewaters. They have reported 95% removal of suspended solid by dual media filter[2].

Copyright 1979 the secondary effluent as cooling water makeup for inland manufacturing industry in Australia. Approximate economic evaluations were made for a number of pretreatment alternatives and for internal treatment with chemical conditioning agents. Internal treatment with biocide dosing appeared to be the most promising option. The pilot plant was operated successfully at 5 cycles of concentration without any other supplementary treatment being required[4].

CONCLUSIONS

The main philosophy of this research study was based on water conservation and sustainable development. Hence, a new concept was thought of in the form of treating sewage and reusing the treated sewage for various purposes other than reuse in process. The genesis of this project was evolved keeping in mind the scenario of those industrial sectors, such as cement factories, which are having continuous need of cooling tower, make up water. All mega cement factories and similar establishments, needs huge amount of water every day for using it as cooling tower make up water. Hence, they need to purchase fresh water every day. Considering continuous escalation in water price, this exercise has become a costly affair for all such industries. Additionally, for all mega industrial establishments, a considerable quantity of water is being used for various non process purposes such as gardening, landscape development, toilet flushing, road washing etc. This also adds up to the water demand. In this research study, one such cut to suit treatment philosophy has been suggested and evaluated. Normally, big industrial units has a full fledge colony for their employees.

Thus, good quantity of sewage gets generated everyday from the colony. Treatment and disposal of the sewage adds up additional environmental problems for the said industrial unit. In this research study, an attempt has been made to address both the problems i.e handling and treatment of sewage and reusing the treated sewage for various non process use. The final treated sewage was colour less as the yellow tinge colour got removed due to presence of activated carbon in dual media filter. It may be highlighted that in this particular case, the TSS concentration before dual media filter was reported around 82 mg/l. In case, the TSS before chlorination is more than 150 mg/l then a flash mixer along with clariflocculator may be proposed before chlorination, otherwise, dual media filter might get clogged very often. In case of clogging of dual media filter, backwashing remains the only option for cleaning the dual media filter.

However, it also has its limitation upto certain extent. If back washing fails then the only option remains is changing the media, which is a costly affair. Thus, it may be concluded that Dual media filter is one of the best option for removal of TSS and colour from aerobically treated sewage. One more important aspect of this research study was to evolve a cost effective treatment scheme. In a large scale commercial application, the basic cost involved in the proposed scheme may be divided into three major heads: Mechanical items such as aerator, clarifier, dual media filter, pumps & motors and related piping and valves. Electrical items including MCC panel, cables, local push button switches etc. Construction of civil units such as aeration tank, clarifier, chlorine contact tank and also primary units like grit chamber, inlet sump etc.It is to be noted that in this research study, the treated sewage shall be used for Non Process purposes; hence, expenditure on tertiary treatment is not required. Thus, it may be concluded that the treatment scheme as proposed in this research study is more cost effective as compared to other available tertiary treatment technologies.

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