Sci.Int.(Lahore),28(4),4255-4258,2016 ISSN 1013-5316;CODEN: SINTE 8 4255

COMPARISON OF DIFFERENT TREATMENT METHODS TO TREAT TEXTILE EFFLUENT

Tariq Ali[1], Ali Ajwad[4], Arfa Iqbal[2],Mehran Khan[3],M.Usman Farooq[2], Nazir Zada[2], Naeem manzoor khan[2]

[1] The University of Lahore, Lahore

[2]University of South Asia, Lahore

[3] Muhammad Ali Jinnah University (MAJU), Islamabad

[4]University of Management and Technology, Lahore

Corresponding Author: Ajwad1989@gmail.com

Abstract: *Textile processing industry is one of the most important industries of Pakistan with regard to production, export and labor force. Environmental degradation by the textile industry sector is a matter of serious concern in Pakistan. The waste generated from the textile industries is very dangerous for the life existing on the earth.In this research suitable and appropriate method of treatment was adopted. The different parameters like nitrogen, chemical oxygen demand (COD) was investigated in this research. The mean value of COD was taken 1253 mg/L and Average daily flow was 4582 m^3/day. In this research the secondary treatment feasibility was analyzed for the treatment plantsi.e. Waste Stabilization Ponds and Trickling Filter. Furthermore, an effort has been made to propose a wastewater treatment technology which is relatively cheap, indigenous and easy to operate by comparing them on the basis of different parameters i.e.Overall efficiency, Cost and Environmental aspects.*

Keywords: Secondary treatment, wastewater treatment, Waste Stabilization Ponds, Trickling Filter

1. INTRODUCTION

According to a survey we came to know this fact that, Textile sector is almost most important and largest industry of Pakistan in sense of production, source of GDP and labor employment. Pakistan is the 8th largest country which exports textile products from Asia. This sector produces 9.5% of the GDP (Gross Domestic Product) of our country and provides employment to nearly 15 million people. Pakistan is the 4th largest producer of cotton and third largest spinning capacity in Asia after China and India, which is 5% to the global spinning capacity [1].

The textile industry is characterized by the vast quantity of water consumption and variety of chemicals used. Pretreatment, large amount of water and variety of chemicals is required generally for coloration and post treatment of fibers [2].

Pollutants which could present in textile wastewater are generally detergents, caustic soda, ammonia, starch, wax, urea, pigments and dyes that increase its BOD, COD, toxicity and Solid contents. Direct discharge of these effluents into aquatic bodies can cause decrease in level of dissolved oxygen, threatening aquatic life and downstream water users [3]. Unfortunately most of these industries do not have proper wastewater treatment plants to treat their effluents. Yet there are some limited companies having plants based on different technologies but more of these are using activated sludge method due to its ease of operation [4].

Industries want to treat their effluents at low cost. Due to that reason research and comparison is necessary as it is helpful in taking appropriate decision.

2. RESEARCH SIGNIFICANCE

The aims of this research are:

- Study of process operation within the textile industry and existing wastewater management system.
- Analysis of the given options to decide most effective and suitable wastewater treatment.
- Based upon the characterization a treatment methodology will be proposed.

3. METHODOLOGY

Sapphire textile industry was selected for this research, having peak flow of 4870 m^3/day. Grab samples were taken and composite samples were prepared by mixing of collected grab samples. Major parameters tested for evaluation of wastewater were pH, BOD, TDS, and TSS. Design approaches adopted were Wastewater Stabilization Ponds (WSP) and Activated Sludge Process (ASP). Performances of these technologies were compared with each other in order to select most suitable treatment option.

Samples were taken from Sapphire textile industry located at a distance of 35 km from ThokarNiazBiag at Raiwind-Chonia road by pass shown in Figure 1. It is a large scale textile industry Daily flow is 4582 m^3/day.

Figure 1 Sapphire Textile Mills ltd, Lahore.

3.1 Sampling of Wastewater

Flow proportionate grab samples of wastewater were collected at time interval of 1 hour for a period of 8 hours. Composite sample of wastewater was prepared by mixing of collected grab samples in volume proportionate to the flow at that time. The sample was preserved using appropriate sampling techniques.

4256 ISSN 1013-5316;CODEN: SINTE 8 Sci.Int.(Lahore),28(4),4255-4258,2016

4. DESIGN OF TREATMENT TECHNOLOGIE

4.1 Secondary Treatment System

a) Design of Trickling Filter

Q = 4582 m^3/day

= 3.18 m^3/min

Taking recirculation ratio as 1, Q_r= Q

Total flow to the filter =Q + Q_r

Q + Q_r = 4582 + 4582

= 9164 m^3/day

$$H.L = \frac{Q+Q_r}{Area}$$

Hydraulic loading of a high rate trickling filter = 10-40m^3/m^2.day (Metcalf and eddy)

Assuming a value of 12

$$12=\frac{9164}{Area}$$

Area = 763.67m^2

For a circular T.F, Area = $\frac{\pi D^2}{4} = 763.67\, m^2$

$$\Rightarrow D = 31.19\, m$$

$$F = \frac{1+r}{(1+0.1r)^2} = \frac{1+1}{(1+0.1\times 1)^2} = 1.65$$

Depth of trickling filter = 4m[Metcalf and Eddy]

Volume of filter = V = area x depth

= 763.67 x 4

= 3054.68 m^3

$$\frac{C_i - C_e}{C_i} = \frac{1}{1+0.532\sqrt{\frac{QC_i}{V \times F}}}$$

$$= \frac{1}{1+0.532\sqrt{\frac{3.18x458}{305468\times 1.65}}}$$

= 0.7776 = 77.76%

$$\frac{458 - C_e}{458} = 0.7776$$

Ce = 101.85 mg/L

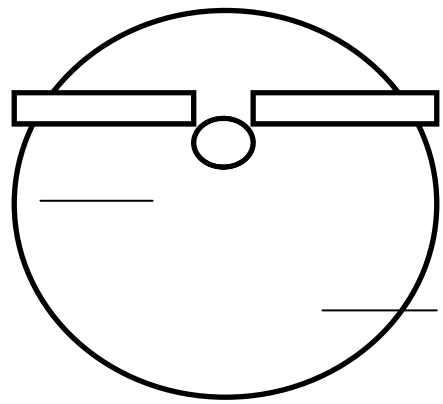

Figure 2 Layout of Trickling Filter

b) *Waste Stabilization Pond*

Approach 2: Effluent will be used for unrestricted irrigation

Here we will add maturation ponds after A.P and F.P to reduce fecal coliform and conform to WHO guideline values of <1000 MPN/100mL

Initially adopt a detention time of 4 days and depth of 1m.

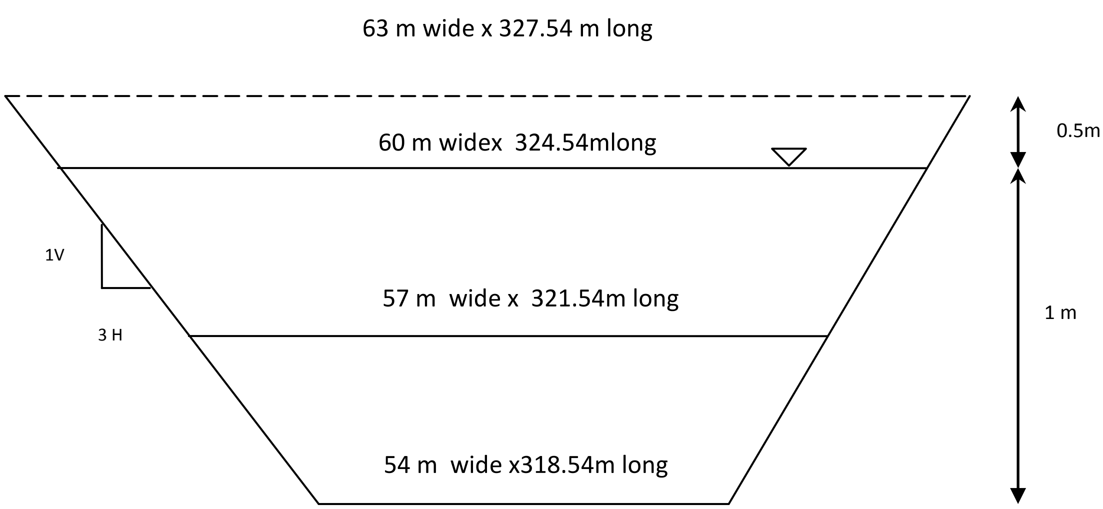

Figure 3 Cross section of Maturation Pond

$t_d = \frac{V}{Q}$

V=t_d x Q

= 4 x 4582

= 18328 m^3

Mid-depth area = V/depth

= 18328/1
= 18328 m^2
Dimensions;
Extreme top-width = 63 m
Take a free board of 0.5 m
Therefore, top width = 63-3=60 m
Mid-depth width = 60-3=57 m
Bottom width = 57-3=54 m
Now mid-depth length = 18328/57=321.54 m
Top length = 321.54 +3=324.54 m
Extreme top length = 324.54+3=327.54 m
Bottom length = 321.54-3= 318.54
Area of M.P = 63 x 327.54
= 20635.02 m^2
= 20635.02/10000
= 2.06 hectare
Fecal coliform removal in one M.P

$$\frac{N_e}{N_i} = \frac{1}{1+Kt} at\ 20°C$$

K_{20} = 2.6 per day
K_{15} = $K_{20}(1.19)^{15-20}$
= 2.6x0.419
= 1.089 per day

Let $N_i = \frac{5\times10^7}{100mL}$ $(value from Mara, 1997; page\ 33)$

Trial No. 1**:** Take one M.P

Therefore $Ne = \frac{5\times10^7}{(1+1.089\times2.29)(1+1.089\times25)(1+1.089\times4)}$

$= 94{,}666.47/100mL$

Trial No. 2:Take 4 equal ponds

Therefore $Ne = \frac{5\times10^7}{(1+1.089\times2.29)(1+1.089\times25)(1+1.089\times4)^4}$

$= 616.13/100mL$

Total area of Approach 2
Using 4 maturation ponds;
= area A.P + area F.P + area M.P
= 7.25 + (2.06 x 4)
= 15.49 ha
Take 50% additional for services and buffer zone etc.
Total area of Option 2 = 15.49x1.5= 23.24 ha

5. RESULTS AND CONCLUSIONS

Typical Performance

First of all we discussed general values and characteristics for different secondary wastewater treatment technologies installed all over the Pakistan and then discussed and tabulated our results and concluded merits and demerits of selected wastewater treatment technologies during their application and working with respect to their appropriateness and performance.

In following table there are the average values for the power required to operate Trickling filter and Waste Stabilization Pond all over the Pakistan;

Table 1 Power Requirements of plants of different treatment methods

Process	Process Power requirement (kWh/person-year)
Trickling Filter	12-15
Wastewater Stabilization Pond	Nil

The purpose of installing textile wastewater treatment plant is to reduce the harmfulness of the textile effluent. The degree to which a treatment technology could remove harmful materials is known as its performance. Average performances of selected three secondary treatment technologies are tabulated below according to different parameters;

Table 2 Typical performance characteristics for various treatment methods

Parameters	Trickling Filter	WSP
BOD Removal %	75-85	75-85
COD Removal %	43 - 88	69-74
Nutrient Removal %	Nil	95 - 100
Coli Form Removal %	60-90	60-99.9
Sludge Handling	Mechanical Dewatering Devices	Manual desludging once in 5-10 years
Equipment Requirement	Sprinklers only	Nil
Operational characteristics	simple	simple
Area required	Large	Small

Experimental Performance

Performance of these treatment technologies which is calculated in lab is tabulated below accordingly;

Table 3 Performance of treatment plants calculated

Parameters	Waste stabilization	Trickling Filter
BOD removal %	50	72.42
COD removal %	80.13	89.04
Solids Generated in SST (Kg/d)	1589	2638
Fecal Colifrom removal %	99.9999	---

BOD of Activated sludge and Waste stabilization ponds are chosen from some specific ranges as mentioned above. While the efficiency in terms of BOD for trickling filter is calculated during its design. COD removal is simply calculated by following relation;

$$\frac{BOD}{COD} = 0.92$$

TSS removal is calculated for each treatment technology according to the instructions given by METCALF and EDDY. Fecal coli form removal is not calculated for Activated Sludge and trickling filters because they give poor fecal removal efficiency. After checking here comes the most important part which is to check the environmental issues due to our treatment technology and they are tabulated as under accordingly;

Table 4 Environmental aspects for various treatment methods

Parameters	Trickling Filter	Waste Stabilization Pond

Noise	**	*
Flies and others	*	***
Odor problem	*	***
Ground Water pollution potential	-	***

Where
* Poor
** Medium
*** Good

At the end here is the graphical comparison of chosen conventional treatment plants;

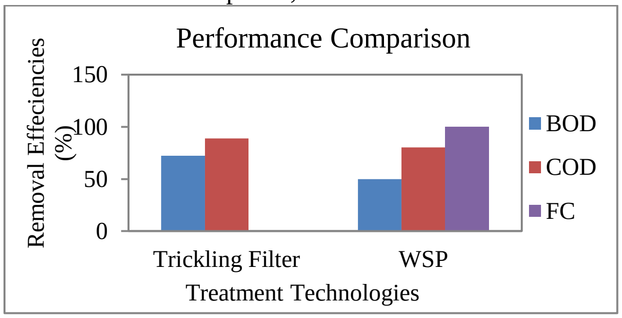

Figure 4 Performance comparison

6. CONCLUSION AND RECOMMENDATION

6.1 Conclusion

Solid production after secondary treatment in the form of sludge is very high in the case of trickling filter and the reason is Sloughing.

After comparing results of both conventional treatment technologies we concluded that Trickling Filter is best for these conditions. It is giving best BOD removal, efficiency in terms of COD and TSS removal. As we compared both treatment technologies on the basis of performance so trickling filter is chosen as the best option.

6.2 Recommendations

- A fore mentioned conventional wastewater treatment technologies for textile wastewater are compared on the basis of performance.
- It is recommended that cost analysis of these technologies must also be conducted.
- Moreover, it is further recommended to check nutrient removal from textile effluent.
- Modern and advanced treatment technologies should also be considered for treatment of textile industrial effluent and comparison on the basis of performance and cost analysis should also be carried out.

REFERENCES

[1] Ahmed, Y. (2008). "Textile Industry of Pakistan."Horizon Securities.

[2] Naveed, S., et al. (2006). "Membrane technology and its suitability for treatment of textile waste water in Pakistan." J. Res. Sci17(3): 155-164.

[3] Gray, N. F. (2008). Drinking water quality: problems and solutions, Cambridge University Press.

[4] Irfan, M. (2009). "Wastewater Treatment in Textile, Tanneries and Electroplating Industries especially by Activated Sludge Method-A technical report." Journal of Pakistan Institute of Chemical Engineers: 35-50.