International Journal of Environmental Planning and Management
Vol. 1, No. 3, 2015, pp. 90-94
http://www.aiscience.org/journal/ijepm

The Study on Textile Mill Effluent

Ghayas K.[1], Ayaz K.[1], Arshad A.[2, *], Naveed A.[1], M. Jawad A.[1], H. Shahab[1], H. Umaira S.[3]

[1]Department of Environmental Sciences, University of Haripur, District Haripur, Pakistan
[2]Civil Engineering Wing, MCE, National University of Sciences and Technology, Islamabad, Pakistan
[3]Department of Environmental Sciences, Northern University, Nowshera, Pakistan

Abstract

This study was design to investigate the wastewater characteristic of the textile mill effluent. Various samples were collected at regular interval for a period 0f6-7 weeks and were tested for various wastewater quality parameters. It was observed that the wastewater generated by the textile mill is highly polluted in terms of releasing a high strength effluent. The mean average values COD, BOD, TSS and TDS observed was 9000mg/L, 6850mg/L, 1890mg/L and 2378mg/L, respectively. The effluent is slightly acidic in nature, with a pH of less than 6.10, and has objectionable odor and smell. Moreover, a moderate temperature, i.e., 21^{o}C, at the point of its disposal into the receiving streams was noticed. The effluent was observed to have very critical DO concentration, i.e., 6.0mg/L. That can adversely effects entire water ecosystem, having such high organic pollutant strength. The results of this study suggest an end pipe treatment of the final effluent prior to its disposal in the receiving streams. The proposed, wastewater treatment plant suggested by this study consists of medium screens chamber, PST operating at SLR of 2.50ft^3/ft^2-hr, and the UASB reactor with diameter of 9.5m. The biogas yield capacity of the UASBR was estimated to be 1920m^3/day.

Keywords

Wastewater, BOD, Treatment, Cost-Effective

Received: April 5, 2015 / Accepted: April 25, 2015 / Published online: June 30, 2015

1. Introduction

Pakistan is a water deficient country, the quantity of available water resources has been declining day by day, the year 1960 was 5654 m^3/capita, in the year 2000 it was 1400 m^3/capita and in the year 2010 the capacity is expected to be 1000 m^3/capita [1,2]. The water quantity (flow rate) is decreasing day by day due to different factors like temperature, atmospheric pressure, wastage due to improper management and pollution.

The available water in our country is being polluted at an alarming rate. The pollution mainly occurs due to untreated domestic and industrial effluents and agricultural/surface runoffs etc. Domestic effluent includes sewage as well as sullage while industrial effluents only include waste sewage. The runoffs may include garbage and sediments. Due to all these effects of pollution, the only clean and potable water available is 18% and the rest 82% is unfit for drinking purpose. Besides water deficiency it is an admitted fact that Pakistan is deficient in energy though it has a substantial potential of energy. The energy is not only confined to electrical energy but the bio-gas has also a significant share in this sector. However bio-gas has not been given attention as it deserves [3,4,5].

Biomass is the most important sources in Pakistan as it is about 37% of its total primary energy supply. The growing acceptance of anaerobic digestion as a simple, low-cost high rate and effective waste treatment technology makes it a viable solution for pollution control, in addition to give support to energy resources sector.

* Corresponding author
E-mail address: aliarshad08@yahoo.com (Arshad A.)

Since, Pakistan is facing an acute shortage of energy; therefore, encouraging the technologies like UASB technology, will not only prevents the water pollution but it can help to tackle the problem of energy crises to a certain extent [6,]. For the treatment of textile mill effluent the anaerobic technology seems to be more reliable, effective and economical. Hence, a long-term comprehensive study is required to investigate the treatment feasibility of the actual textile mill effluent using single-stage UASB reactor. This study was design to study the wastewater characteristic of the textile mill effluent, and to design a low-cost wastewater treatment plant for the textile mill effluent based on the data obtained.

2. Materials and Methodology

For the wastewater quality analysis of the textile mill effluent, various composite samples were collected from the local region. The samples were collected at regular interval for a period 0f 6-7 weeks. All the samples were collected in a proper sterilized 10.L capacity bottles and was immediately shifted to the nearest Public Health Engineering Laboratory for the analysis. Some of the parameters, like temperature, pH, DO and turbidity, were tested on the site [8]. And the rest of the wastewater quality parameters were analyzed in the laboratory, as shown in the Table 1.

Table 1. Astewater quality parameters used.

Parameter	Technique
pH	pH meter
Temperature	Thermometer
BOD	Dilution method
COD	Open Reflux
Chlorides	Argentrometric method
TDS	Gravimetric meter
TSS	Filter paper
Nitrates	Spectrophotometer

3. Results and Discussion

The wastewater characteristics of the textile mill effluent were studied by collecting various composite and representative samples from it. The findings indicated that the textile effluent is polluted both in terms of physcio-chemical and aesthetic parameters. The samples were highly turbid, with objectionable odor. The average COD and BOD concentration was recorded as 9000mg/L and 6850mg/L, respectively.

Figure 1-10 illustrate the wastewater quality of the various locations of the local textile mill. Temperature is an important indicator with regards to the survival ability of aquatic life. The temperature values depend upon the process of production of the industry. Refer to Figure 1.0, the temperature values ranged from 18-24^{o}C with a mean value of 21^{o}C. The highest value was found in the effluent of textile mill effluent during the 4th week of the sampling period. This value is beyond the standards NEQS, and is very critical due to its adverse impacts on the material of the conduits. Such a high temperature value has adverse impacts on the existing flora and fauna of the receiving body ecosystem [9]. Therefore, proper measure needs to be taken for reducing its temperature before the final discharge of the wastes in the streams or rivers etc.

Refers to Figure 2.0 and 3.0, the turbidity color concentrations are shown. Though, both the color and the turbidity concentrations of the subject sample are reasonable, but still efforts are required to further reduce them, by means of some physcio-chemical processes. The NEQS has no defined standards for both of these parameters. The maximum turbidity and color concentration was observed to be 20.5NTU and 33units, respectively. However, the mean observed value was found to be 19NTU and 30units for turbidity and color, respectively.

Biological oxygen demand (BOD) is expressed as weight of oxygen consumed per unit volume of water during a defined period of time at a defined temperature was calculated. It measures the biodegradable materials in water and helps in the development of bacteria and other organic byproduct [10,11]. The BOD of effluent ranged from 5900-8100mg/L with a mean value of 6850mg/L, as shown in the Figure 4.0. The effluent with highest BOD value was observed during the 5th week of sampling, whereas, the minimum value was noticed on the 4th week. Throughout the study period, it was observed that a BOD value of the effluent was far beyond the NEQS limits. It indicates that if such effluent is disposed of directly into fields and river it will have an adverse effect on aquatic life due to the depletion of oxygen level in water.

The Figure 5.0, illustrate the concentration of the pH observed during the study conducted on the effluent of textile mill. The pH of the samples was measure at the site of waste disposal by the mill, with the help of potentiometric, which was standardized by using buffer solutions of known value before analysis. The pH values of samples ranged from 5.7-6.4. The maximum pH value was observed during the 4th week of the study, with a concentration of 6.4. The value of the pH is critical in light of the available NEQS of Pak-EPA. But the same wastes could be easily treated by biological means, as having comparatively favorable pH for the treatment processes. Most of the values of the pH noticed during the study period were beyond the limits of NEQS.

The COD values of are shown in the Figure 6.0, recorded from 7980mg/L to 9845mg/L during the course of study period, with a mean value of 9000mg/L. The maximum value

was observed during the 3rd week of the study period, with a concentration of 9845mg/L. The minimum value of 7980mg/L was observed during the 6thweek, which is still beyond the limitations of the NEQS. The NEQS limit for COD is 150 mg/L which shows that all these values are beyond the permissible limits. High COD levels decrease the amount of dissolved oxygen available for aquatic organisms. It also causes reduced cell functioning, disturbs circulatory fluid balance in aquatic species and can result in death of individual organism. Hence, a proper mechanism for the treatment of the textile mill effluent is proposed prior to its final disposal in the receiving streams [12]. The concentration of nitrates also seems to be critical, as the mean value observed during the study was 5.0mg/L, as shown in the Figure 7.0. Since, excessive nitrates causes eutrophication when combines with the phosphates in the water or wastewater courses. Therefore, it also needs to address too.

The Figure 8.0 and 9.0 illustrates the values of TDS and TSS, respectively. Total suspended solids are the portion of solids that usually remains on the filter paper. Total suspended solids of various samples ranged from 1860-1918mg/L with a mean value of 1890mg/L. The results clearly shows that the TSS values of all the samples are beyond the permissible limits of NEQS. The highest value was recorded during the 7th week of the study, while the lowest was noticed during the 4th week of the study period. The results suggest that this effluent will cause handling issues if used directly in fields or disposed off in river will cause damage to the aquatic life as it will reduce visibility and absorb light [13]. TSS will also increase the temperature and reduce photosynthesis. Fine particles may also clog and abrade fish and insect gills and tissue and interfere with egg and larval development. Similarly, the TDS concentration, of the textile mill effluent ranges from 2250-2460mg/L with a mean value of 2380mg/L. The maximum value was observed during the 7th week, whereas, the minimum value was noticed during the 3rd week of the study period. When compared with the NEQS, it was observed that the TDS values in the effluent of maximum samples are still within the permissible limits of 3500mg/L. The wastewater with high TDS value can cause salinity problem if discharged to irrigation water. It may also add a laxative effect to the water or cause the water to have an unpleasant mineral taste. Moreover, it can impart undesirable color to the wastewater too.

The concentration of the dissolved oxygen (DO) observed during the study period is shown in the Figure 9.0. Roughly speaking, the effluent is found to have sufficient DO to sustain its quality, but owing to excessive BOD and COD concentration, the same can dropped drastically with few hours, once the biological decomposition of the wastes take place. It will also aggravate the DO concentration issues of the receiving stream, if not properly treated prior to its disposal. The mean value observed during this study was 6.14mg/L. The effluent seems to be more reliable for the anaerobic treatment owing to its low DO concentration and high polluting load in terms of high concentration of BOD and COD.

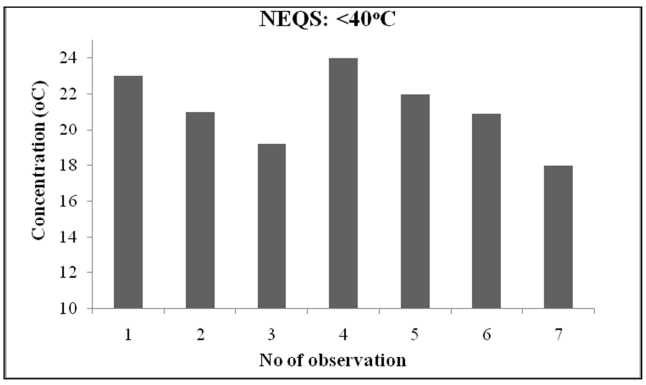

Fig. 1. Temperature concentration.

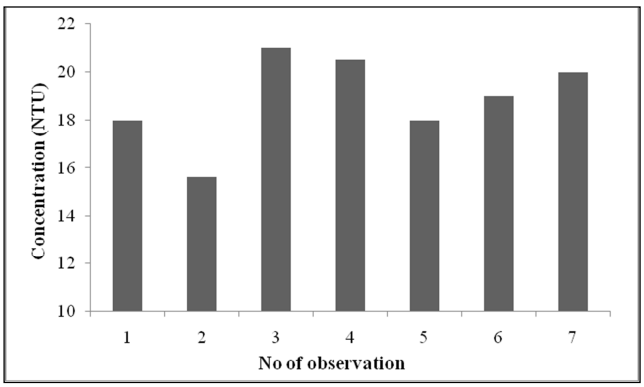

Fig. 2. Turbidity concentration.

Base on the results of wastewater characteristics of the textile mill effluent, a wastewater treatment plant was designed as a proposed solution in order to reduce the load of pollution and to contribute to the energy sector too. Table 2 shows the various design assumptions and specification being practiced during the design process of the study [14]. The layout of the proposed wastewater treatment plant consist of pumping station, an approach channel, screening chamber, PST and UASB reactor. The wastewater characteristics and data employed in the design have been extracted from the results obtained during the laboratory analysis of this study, i.e.,

pH = 6.05

COD = 9000mg/L

BOD = 6850mg/L

TSS = 1885mg/L

Nitrates = 5.90mg/L

Temp = 21°C

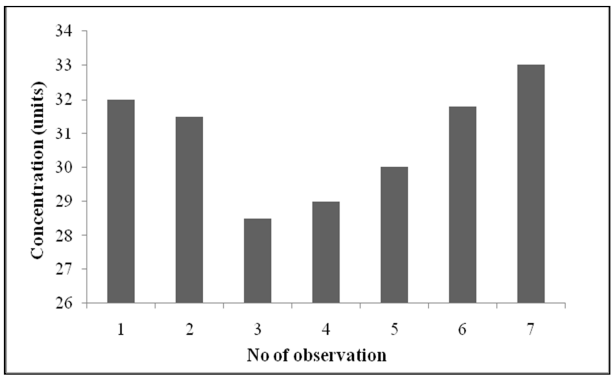

Fig. 3. Color concentration.

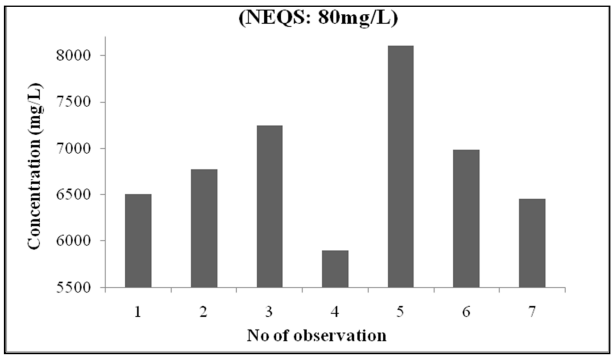

Fig. 4. BOD concentration.

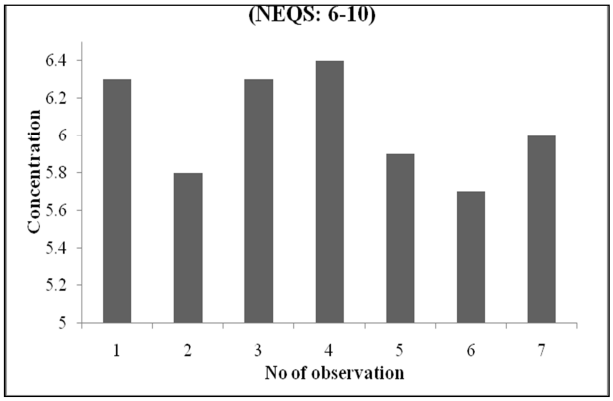

Fig. 5. pH concentration.

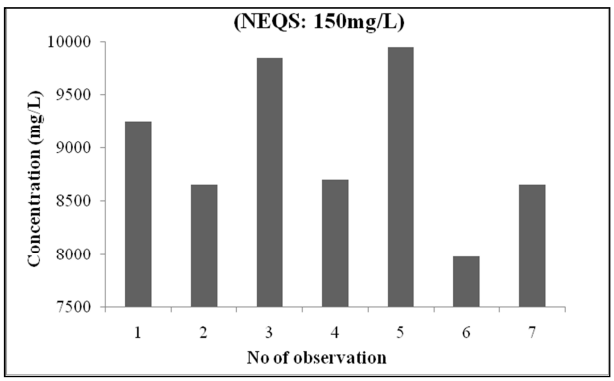

Fig. 6. COD concentration.

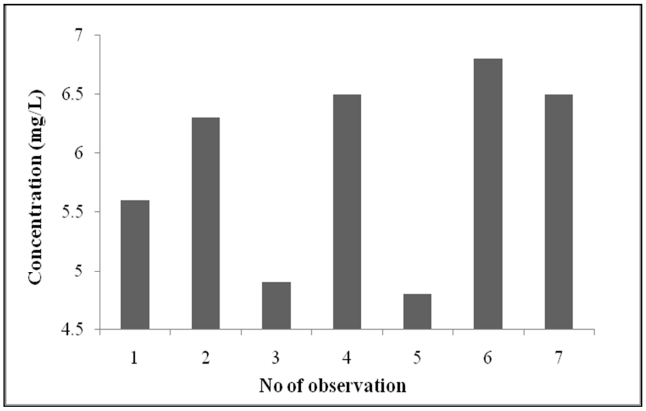

Fig. 7. Nitrates concentration.

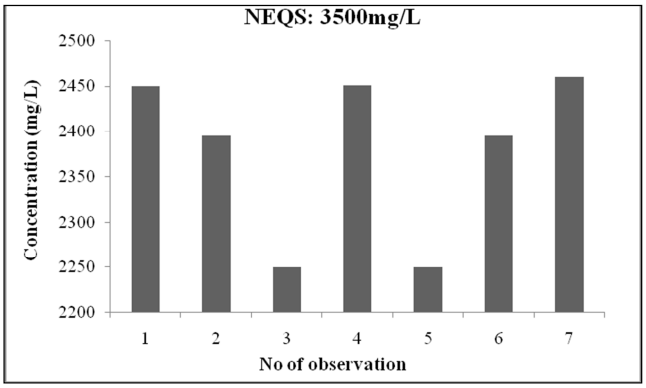

Fig. 8. TDS concentration.

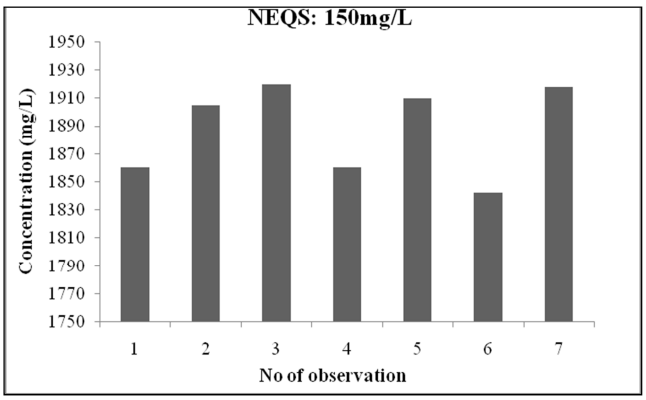

Fig. 9. TSS concentration.

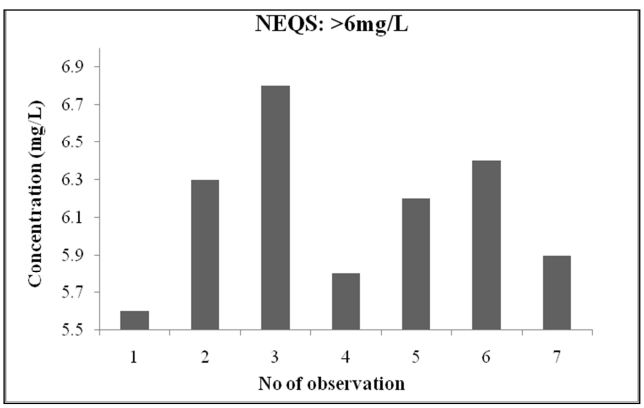

Fig. 10. DO concentration.

4. Collusion and Recommendations

The following are the main conclusion extracted from this study The wastewater generated by the textile mill is highly polluted in terms of releasing a high strength effluent. The mean average values COD, BOD, TSS and TDS observed was 9000mg/L, 6850mg/L, 1885mg/L and 2378mg/L, respectively. The effluent is highly acidic in nature, with a pH of less than 6.20, and has objectionable odor and smell. Moreover, it has very high temperature, i.e., 21^{o}C, at the point of its disposal into the receiving streams. The effluent of the textile is also found to have very critical DO concentration, i.e., 6.0mg/L. That can adversely effects entire water ecosystem, having such high organic pollutant strength. The proposed wastewater treatment plant for the textile comprises of medium screens, PST and the UASB reactor. The required dimension of the PST operating at SOR of 2.5ft^3/ft^2-hr was calculated to be LxWxH: 16mx9mx3.5m. The UASB reactor of 9.5m diameter and 3.4m height will be able to remove more than 65% of the COD and BOD from the effluent of the textile mill. Additionally, it will generate a biogas for the domestic requirements of 3500 persons, by an estimated biogas yield 1920m^3/day.

However, a comprehensive and long term study is suggested to determine the relation of polluting strength of the textile mill, and to evaluate more cost-effective technique options for the pollution reduction of the same point.

References

[1] Vieira, S.M.M., (1988). Anaerobic treatment of domestic sewage in Brazil. Research results and full-scale experience. In: Hall, E.R., Hobson, P.N. (Eds.). Proceedings of Fifth International Symposium on Anaerobic Digestion, Bologna, Italy, pp. 185–196.

[2] Scholz-Muramatsu, H., Neumann, A., MeBmer, M., Moore, E., Diekert, G., (1995). Isolation and characterization of Dehalospirillum mutivorans gen. non.sp.nov, a tetrachloroethene utilizing, strictly anaerobic bacterium. Arch. Microbiol. 163: 48-56.

[3] Ali, M. Sreekrishnan, and T.R. (2001). Anaerobic toxicity from pulp and ghee mill effluents: A review, Adv. Environ. Res., 5:175-196.

[4] Bryant, M.P. (1979). Microbial methane production – theoretical aspects. J. Animal Sci., 48: 193-201.

[5] Chernicharo A, (2001). An innovation conversion of full scale extended aeration activated sludge plant by UASB reactor as a first step treatment: case study of Botucatu city, Brazil. In: Proceedings of ninth world congress on Anaerobic Digestion/Anaerobic conversion for sustainability, Antwerpen, Belgium, 2-6 September, pp, 531-534.

[6] Freire, C.S.R., Silvestre, A.J.D., Neto, C.P., (2003). Carbohydrate derived chlorinated compounds in ECF bleaching of hardwood pulp: Formation, degradation and contribution to AOX in a bleached kraft pulp mill. Environ. Sci. Technol. 37: 811-814.

[7] Bajpai, P., (2000). Microbial degradation of pollutants in pulp mill effluent. Adv. Appl. Microbiol. 48: 9-134.

[8] Fitzsimons, R. Ek, M., Eriksson, K.E.L., (1990). Anaerobic dechlorination/degradation of chlorinated organic compounds of different molecular masses in bleach plant effluent. Environ. Sci. technol. 29: 1744-1748.

[9] Hakulinen, R., (1982). Enso-Fenox process for the treatment of kraft pulp bleaching effluent and other wastewaters of the forest industry. Pap. Puu. 65:5, 341-345.

[10] Khallas, J. Munter, R., (1994). Post-treatment of pulp and ghee industry wastewater using oxidation and adsorption process. Water Sci. Technol. 29: 259-272.

[11] Lee, E.G.H., Crowe, M.F., Stutz, H., (1993). Pilot study of sequential anaerobic/aerobic biological process for dechlorination of whole mill kraft effluent. CPPA Ann. Meeting 1993 Montreal, Canada 79 (A), 53-60.

[12] Lettinga, G., Velsen, L.V., Zeeuw, W.D and Hobma, S.W. Staffed, D.A, Whealtley, B.I., and Huges, D.E.Eds (1980). The application of anaerobic digestion to industrial pollution treatment. Appl. Sci. Pub. London. 167-186.

[13] APHA, AWWA, and WEF, 1995, Standard Methods for the examination of water and wastewater, 19th edition, Washington DC.

[14] Eckenfelder, W.W.Jr (2nd Ed) 1989: Industrial water pollution control, McGraw Hill Book Company.