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Research Article

Identify the Indicators for Sustainability in Textile Effluent

A.Bhuvaneswari [1], B.Asha [2]

[1]Assistant Professor, Department of Civil Engineering, Annamalai University, Annamalainagar-608002, Tamil Nadu, India.
[2]Associate Professor, Department of Civil Engineering, Annamalai University, Annamalainagar-608002, Tamil Nadu, India.

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Abstract: Usually environmental sustainability is assessed through calculation of greenhouse gas release, waste discharge and energy use. We are considering the wastewater discharge from textile industries. Samples from four industries were collected and the physicochemical characteristics of the parameters were analyzed. The results showed that, the textile industrial wastewater containing pollution indicator parameters considerably higher than the Standards stipulated by IS 10500 Standards. The results revealed that most of the parameters were not within the permissible limits of Standards. The main motive of this paper is to reduce contaminants as maximum as possible to the acceptable limit that will not impact negatively on the environment. The objective of this work is to assess the sustainability for evaluation of indicators (parameter concentrations) in textile effluents. From the results, it can be concluded that the indicators present in the effluents can be applied to wastewater treatment processes to achieve sustainability.

Keywords: Biochemical Oxidation Demand, Chemical Oxidation Demand, Dyeing effluent, Heavy metals, Physico-Chemical characteristics, Textile wastewater, Total Suspended Solids, Sustainability indicators.

1. Introduction

People on globe are under tremendous threat due to desired changes in the physical, chemical and biological characteristics of air, water and soil. Due to increase in human population, industrialization, use of fertilizers and man-made activity, water is highly polluted with different harmful contaminants. The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life. Since times immemorial, the three basic needs of mankind have been food, cloth and shelter. The units producing cloth by any mechanisms are called textile units. Textile industry is one of the oldest and largest industries of India. The textile industry in India is a fast growing industry. As per the recent data published by the textile commissioner's office there are 1569 textile industries in India; of these 1294 are spinning industries while 275 are composite industries (Hussain,2001).

Environmental pollution due to different types of industries is one of the vital problems presently facing in India and all over the world. Textile industries are major source of environmental pollution (Ghoreish S.M.i and Haghighi. R. 2003). As the textile industries consume large quantities of water and generates the wastewater in proportionate order (N. L .Nemerow, 1978), (J.Karthikeyan and mohan S. Venkata, 1999). Moreover the dyes used in textile industry are important sources of environmental pollution. It poses serious problems because of its strong color, high COD, BOD and low biodegradability (Z.M.Shen et al., 2006, Venceslau et al., 1994)

The water consumption and wastewater generation from textile industry depends upon the processing operations employed during the conversion of fiber textile fabric. On the basis of waste generation, the textile industries can be classified into two Groups viz dry and wet fabric industry (C.M.Noorjahan, 2011). During each stage different type of chemicals are used such as strong acids, strong alkalis, inorganic chlorinated compounds, hypochlorite of sodium , organic compound such as dyestuff, bleaching agent , finishing chemicals, starch, thickening agent, surface active chemicals, wetting and dispersing agents and salts of metals (A.I.Ohioma et al., 2009,D.Doyan and H.Turkdemir,2005).

The rapid growth of urban areas has further affected the groundwater quality due to over exploitation of resources and improper waste disposal practices (Sekar P et al., 2008, Yadav and Singh,2009). Therefore, pollution of water resources needs a serious and immediate attention through periodical check up of water quality. The present research work is aimed at characterization of wastewater with the help of important pollution indicator parameters like pH, BOD, COD, TDS, Sulphate, Hardness, Calcium and Magnesium. It is also aimed to assess the pollution potential due to effluent discharged by textile industries in Tirupur District.

2. Material and Methods

2.1 Sustainability indicators

Indicators play a major role in assessing whether a process is moving toward sustainability. Indicators used in sustainability reflect three aspects of sustainability: the environment, economy and society.

2.2 Study Area

Study area are selected was Tirupur district situated at west region of Tamil Nadu. Four Textile Industry were selected at different places in Tirupur. Wastewater from those industry were collected.

2.3 Sample Collection

The effluent sample were collected separately with one hour interval in working period of each industry from 9am to 5pm. Samples collected from each industry are kept separately and used for characterization study.

Four major textile industries were selected for the study of characterization of textile wastewater at different places in Tirupur District.

2.4 Preservation of samples

The textile industrial wastewater samples were collected in pre-cleaned poly-propylene bottles with necessary precautions (Brown et al., 1974) and are preserved by refrigeration @4°C without chemical addition.

2.5 Sample Analysis

The Physico-chemical and biological parameters are analyzed as per the method described in Standard Methods for the examination of water and wastewater (APHA 2005).

3. Results and Discussions

The characteristics of four different effluents from textile industries were analyzed. Light brown colour liquid effluent under the study area the pH of the effluent varied from 7.88 to 16.This shows that the wastewater from textile industry under study area is alkaline in nature. The pH variation caused may be different kinds of chemicals used during processing steps in those industries. As per IS 10500 standards the permissible limits of pH is 6.5 to 8.5

The chloride levels are more than the permissible limits of IS 10500 Standards, Effluent Concentration lies between 4005-4320 mg/l. The required desirable limit 250mg/l which may be extended up to 1000mg/l as per standards (Fig. 1). High chloride contents are harmful for metallic pipes as well as for agricultural crops if such wastes containing water are used for irrigation purposes. Moreover, high chloride contents also kill some micro-organism which is important in some food chains of aquatic life. Chloride in textile wastewater also increases due to water softening process of when sodium chloride is used to recharge softeners. Moreover some chlorides containing compounds are also used in the wet processes of cloth. Similar work was carried out (Rajeshwari et al .,(2013), the concentration was from 1134 to 2865mg/l. Excess chloride in potable water is not particularly harmful and the criteria set for this anion are based primarily on palatability and its potentially high corrosiveness (Bhujangaiah and Nayak,2005). Chloride in excess (>250 mg/l) imparts a salty taste to water and people who are not a costumed to high chlorides may be subjected to laxative effects.

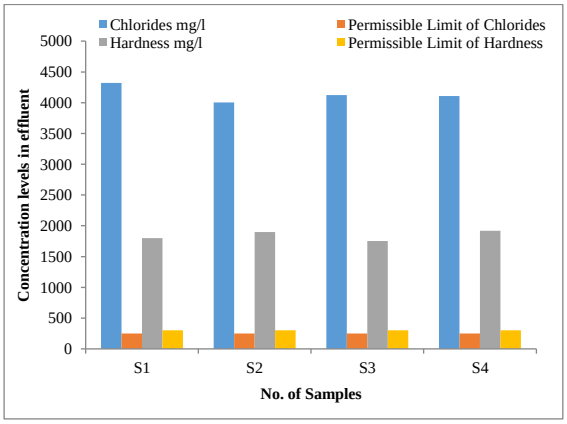

Figure. 1. Variations of concentration levels (Chlorides and Hardness) with respect to samples

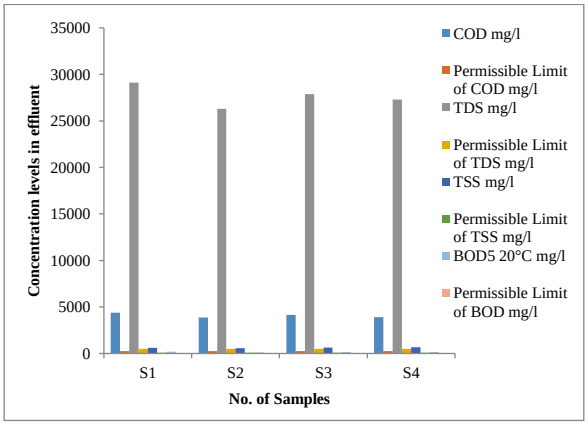

Figure. 2. Variations of organic concentration (COD, TDS, TSS, BOD) with respect to samples

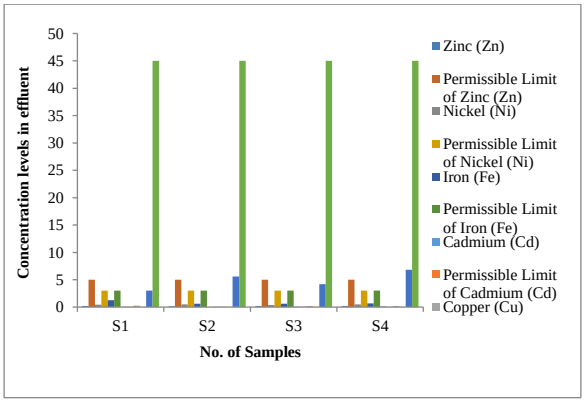

Figure. 3. Variations levels of Concentration (Zn, Ni, Fe, Cd) with respect to samples

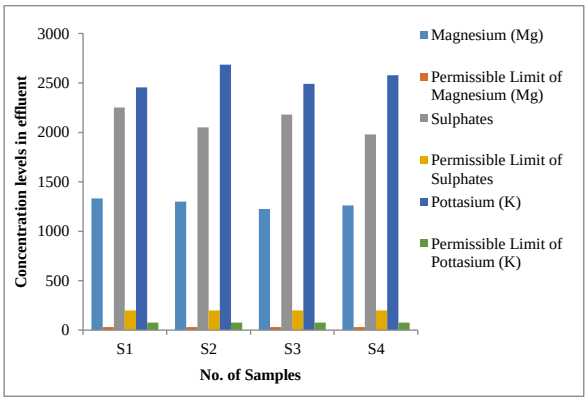

Figure. 4. Variation's level of Concentration (Mg, SO_4, K) with respect to samples

The higher chloride concentration is responsible for increase in Total dissolved solids which is in between 26280-29100 mg/l (Fig. 2).

Sulphates are an important anion importing hardness of water. In all effluent the sulphate concentration varied from1980-2250 mg/l (Fig 3). Hardness of effluent is 1750-1920 mg/l (Fig 1). It may undergo transformation to sulphur or hydrogen sulphide depending largely upon the redox potential of water. Hydrogen sulphide is commonly originates in water owning to the decomposition of organic matter or bacterial reduction of sulphate under anaerobic condition (Metcalf and Eddy 1999).

The Concentration of BOD is between 120 to 175 mg/l, these values are higher than prescribed Standards stipulated by IS 10500. The value of COD the textile effluent ranging from 3880 to 4400 mg/l and average value is 4080 mg/l which is very high value as compared to Standards. The elevated concentration of COD is due to especially from dyeing section of textile processing industry. Similar work Rajeshwari et al., (2013) was studied COD was in the range of 997-1124 and 1987-2865 mg/l in dyeing and CETP effluent respectively. The values were much higher than maximum permissible limit of 120-400mg/l according to IS Standard.

Total dissolved solids of given textile effluents is in between 26,280 to 29,100 mg/l` which is higher than Standards of IS 10500. If the roots of a plant are placed in water with a high salt concentration, the water from the plant moves into the salt water and the plant wilts so irrigation with high TDS water will result in decrease in optimal crop production. (Fig 2) Similar work Prabha et al., (2013) was studied in Kasipalayam and Anaipalayam, high TDS was observed in the range of 3012-6080mg/l.

Phosphate ranging from 62.50 to 85.0 mg/l in all samples. The high enrichement of phosphate can leads to eutrophication and depletion of oxygen in water bodies. The phosphate content in water may lead to kidney damage and osteoporosis in human. The range of Nitrate in the textile effluents was found respectively 3 to 6.80mg/l.

The concentration of cadmium was vary from 0.10 to 0.12mg/l which is above the permissible level. Sodium levels are quite high in the effluent, if soil is irrigated with this effluent; soil becomes poorly drained and tend to crust. High sodium levels complete with calcium, magnesium, and potassium (Fig. 4) for uptake by plant roots. Therefore, excess sodium can prompt deficiencies of other cations. Apart from the above concentration levels Nitrates, Nickel and Zinc are within the permissible levels (Fig. 4).

4. Conclusion

The results from the Physico-Chemical characteristics of the textile effluent revealed that the most of the parameters were not within the permissible limits of IS 10500 Standard. From this analysis it may be concluded that proper environment management plan may be adopted to control the release of effluent. Hence it is suggested to exercise all the necessary precaution before the water is used for irrigation otherwise, it may lead to much adverse health effect. The results of the parameters indicated that the wastewater is alkaline in nature. Organic concentrations were in elevated level. The solids in the form of TDS, TSS are also higher level. The parameters such as sulphate, Nitrate, phosphate etc as well as heavy metals such as zinc, Nickel, Iron, Cadmium and Copper are identified that they are exceeds the permissible limits. To obtain a sustainable environment we have to reduce the indicators by any wastewater treatment methods because most of the sample parameters are in biodegradable only.

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