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Analysis of Physical and Chemical Parameters of Textile Waste Water

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Abstract: Sample was collected from Textile Industry and analyzed for various physical and chemical parameters such as pH, total dissolved solids (TDS), biochemical oxygen demand (BOD) and chemical oxygen demand (COD), Suspended Solids (SS), oil and grease, calcium, magnesium, iron, manganese, sodium, potassium, total hardness etc. Results indicated that textile wastewater is basic. BOD and COD levels are high. TDS and SS levels exceed the permissible limits. Irrigation with high TDS water will result in decrease in optimal crop production. Sodium levels are quite high in textile effluent, if soil is irrigated; soil becomes poorly drained and tends to crust. Textile waste water was found to be very hard. Chloride and Sulphate levels are high. Some methods like Electro-dialysis, ion exchange method, biochemical purification etc. can be employed for the treatment of such wastewater.
Key Words: Textile waste water; Chemical oxygen demand; pH; Biochemical oxygen demand,TDS.

1. Introduction

Textile industries have been placed in the category of most polluting industries by the Ministry of Environment and Forests, Government of India[1].

Textile industry is a very diverse sector in terms of raw materials, processes, products and equipment and has very complicated industrial chain.[2] Wet processes like bleaching, dyeing and screen printing are being carried out by these industries[1] Main pollution in textile wastewater came from dyeing and finishing processes. These processes require the input of a wide range of chemicals and dyestuffs, which generally are organic compounds of complex structure. As all of them are not contained in the final product, they become waste and caused disposal problems. Major pollutants in textile wastewaters are high suspended solids, chemical oxygen demand, heat, colour, acidity, and other soluble substances[2].

These effluents released on the land as well as dumped in to the surface water which ultimately leaches to ground water and lead to the accumulation of toxic metallic components and resulted in a series of well documented problems in living beings because they cannot be completely degraded[3].

Untreated effluent are highly toxic to the plant, fish or other aquatic organisms at higher pH and the sulphide in the effluent are of environmental concern[4] because they can lead to poor air quality of an area if not properly taken care of thus becoming threat to vegetation, human, and materials. The same is applicable to other parameters such as BOD, COD that has been identified to raise health issue if water available for human use is not of the required level[5].

A huge amount of effluent from textile mills is being discharged on land or into water courses. This effluent is characterized by high biological oxygen demand (BOD), chemical oxygen demand (COD), sodium and other dissolved solids as well as micronutrients and heavy metals[1].

Pollutants of textile effluent (untreated) are likely to be present include suspended solids, biodegradable organic matter, toxic organic compounds and heavy metals[6]. Suspended solids can clog fish gills, either killing them or reducing their growth rate; they also reduce light penetration which reduces the ability of algae to produce food and oxygen[7].

Sulphates are not considered toxic to plants or animals at normal concentrations. In humans, small concentrations cause a temporary laxative effect[8].

2. Experimental

The study was carried out by systematic collection of Textile effluent (untreated). The collected samples were analyzed for pH, BOD, COD, TDS, SS, oil and grease, calcium, magnesium, iron, manganese, etc.

Effluent were collected and stored in a clean polythene bottles that had been pre-washed with 10% nitric acid and thoroughly rinsed with de-ionized water and then standard methods were used for analysis of effluents[4].
The effluents were stored at 4^{o}C during storage period to avoid any change in its characteristics[1].

Following parameters were analysed according to APHA-AWWAWPCH, Standard Methods for the Examination of Water and Waste Water.

1. *pH* using a pH meter.
2. *Total Dissolved Solids(TDS) & Total Suspended Solids(TSS)* using 'Filtration method'
3. *Dissolved Oxygen (DO)*: For DO analysis, the sample was collected in BOD bottle; the DO was fixed by the addition of 2 mL of Manganous

Sulphate solution and 2 mL of alkali-iodide-azide reagent to the sample in the BOD bottle. The fixed sample has to be transported to laboratory by keeping it in ice. It was kept in dark[9].

4. *Biochemical Oxygen Demand (BOD)* using 'Winkler Method' using suitable modifications like 'azide modifications' to eliminate the interference caused by NO_2,'alum flocculation modification' to remove the interference caused by suspended materials present.
5. *Chemical Oxygen Demand (COD)* using 'Dichromate reflux method'. Removal of interference caused by Chloride was done using mercuric sulphate. Sulphuric acid was added as a catalyst to oxidize straight chain aliphatic and aromatic compounds.
6. *Total Hardness* by 'Titrimetric method using EDTA'. Interference caused by 'metal ions' was removed by 'hydroxylamine hydrochloride'. Eriochrome black indicator was used.
7. *Calcium Hardness* by 'Titrimetric method using EDTA', raising the pH to 12.0 and using murexide as indicator.
8. *Magnesium Hardness* was equalled to 'Total hardness-Calcium Hardness'.
9. *Iron and Manganese* using 'Atomic Absorption Spectrophotometer'.
10. *Sodium and Potassium* using 'Flame Emission Photometer'.
11. *Chloride* by titration with standard 'Silver nitrate' using potassium chromate as indicator. Special reagent, '$AlNH_4(SO_4)_2$' was used to remove colour and turbidity.
12. *Sulphate* ions were precipitated as '$BaSO_4$' in acidic media with $BaCl_2$.The absorption of light by this precipitated suspension was measured by spectrophotometer at 420 nm.

3. Results and Discussion

The results pertaining to various physical and chemical characteristics of textile effluents are shown in Table 1.

Textile effluent is found to be basic (Figure 1), pH of effluents affects physical and chemical properties of water which in turn adversely affects aquatic life, plants and humans. This also changes soil permeability which results in polluting underground resources of water[10].

Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) values of textile effluent are high and exceed the permissible limits. (Figure 2) .This can deplete dissolved oxygen from streams, lakes and oceans; may cause death of aerobic organisms; increases anaerobic properties of water[2].

Total Dissolved Solids (TDS) and Suspended Solids (SS) in textile effluent are also very high exceeding the allowed limits, (Figure 2).

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.

Sodium levels are quite high in the effluent (Figure 4), if soil is irrigated with this effluent; soil becomes poorly drained and tend to crust. High sodium levels compete with calcium, magnesium, and potassium for uptake by plant roots. Therefore, excess sodium can prompt deficiencies of other cations.

Chloride levels and sulphate levels are also high (Figure 5). High chloride contents are harmful for metallic pipes as well as for agricultural crops if such wastes containing high chlorides are used for irrigation purposes. Moreover, high chloride contents also kill some micro-organisms which are important in some food chains of aquatic life.[11]

Textile effluent is 'very hard' indicated by high value of Total Hardness,(Figure 2). The hardness in textile effluents is due to the presence of divalent metallic cations like Ca^{+2} and Mg^{+2}(Figure 4).These salts may increase the soil salinity. Iron and manganese are in little amount (Figure 3).

Table1.Physical and chemical parameters of Textile Waste Water

S. No.	Parameters	Textile waste water	Standards (ISI 2490-1981)
1.	Colour	Brownish-Black	
2.	Odour	unpleasant	
3.	pH	8.3	5.5 to 9.0
4.	BOD mg/L	350	100
5.	COD mg/L	770	
6.	TDS mg/L	2352	2100
7.	TSS mg/L	270	200
8.	Oil & grease	60	10
9.	Iron mg/L	0.37	
10.	Manganese mg/L	0.070	
11.	Sodium mg/L	520	5(ISI 2490)
12.	Potassium mg/L	24	60(ISI 2296)
13.	Calcium as Ca mg/L	62.4	75
14.	Magnesium as Mg mg/L	61.5	50
15.	Total Hardness as $CaCO_3$ mg/L	408	
16.	Chloride mg/L	378	600
17.	Sulphate mg/L	348	1000

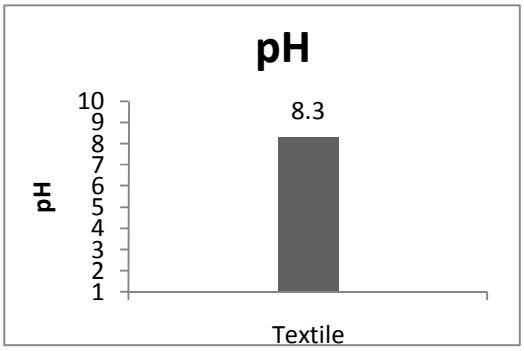
pH
8.3
pH
10
9
8
7
6
5
4
3
2
1
Textile

Fig. 1

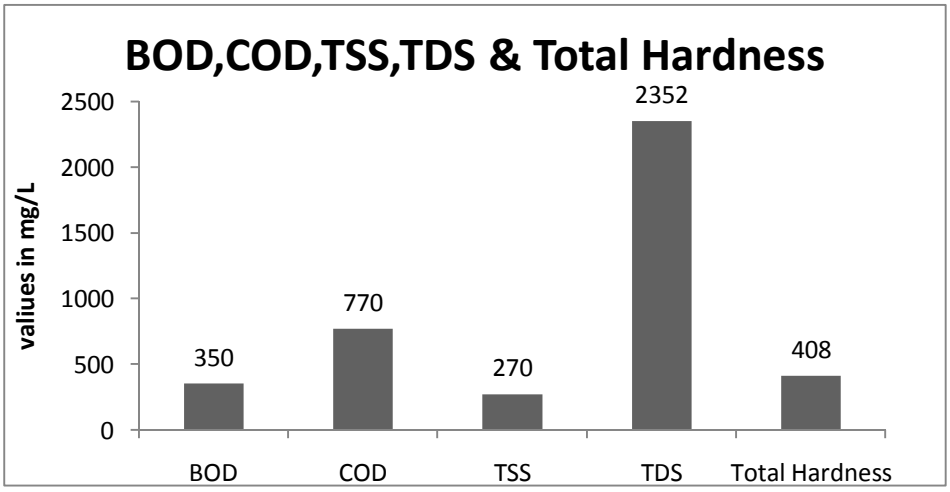
BOD,COD,TSS,TDS & Total Hardness
valiues in mg/L
2500
2000
1500
1000
500
0
350
770
270
2352
408
BOD
COD
TSS
TDS
Total Hardness

Fig. 2

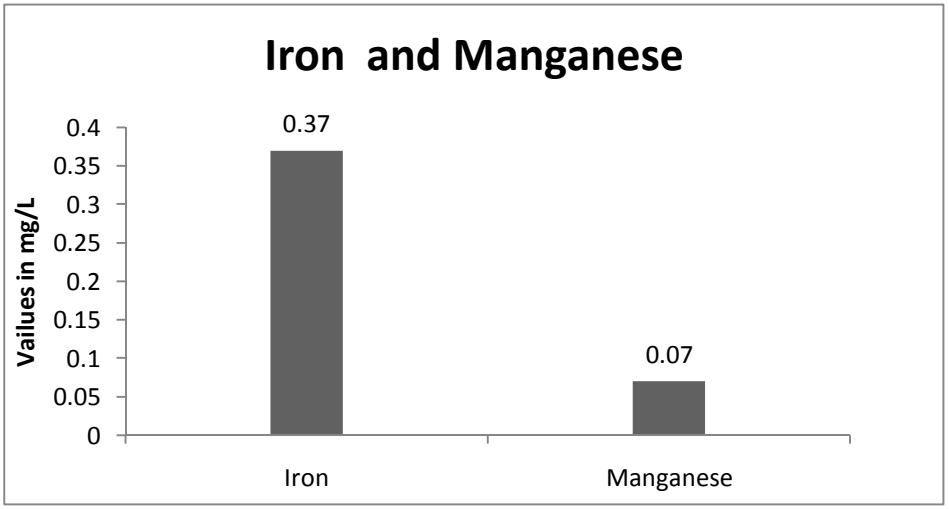

Fig. 3

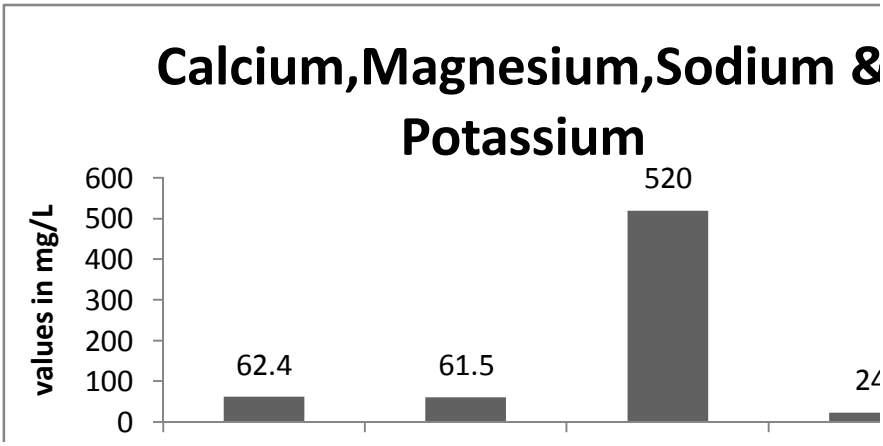

Fig. 4

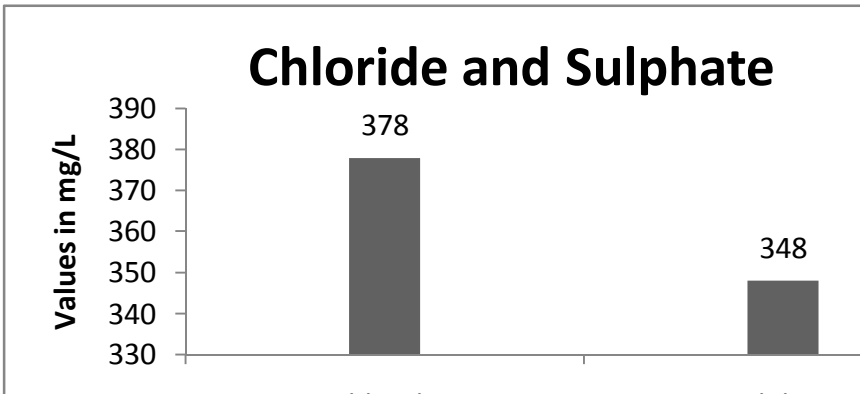

Fig. 5

4. Conclusion

Wastewater is not recommended for irrigation in agricultural fields. Water with high sodium content, high TDS, BOD, COD values is unsuitable for irrigation.

Few methods like electro-dialysis, ion exchange method, biochemical purification etc. can be used for treatment of such type of wastewater.

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