Analysis of physico-chemical properties of textile effluents collected from Sanganer, Jaipur

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Abstract

The printing and dyeing industries in the area of Sanganer (Jaipur) have been imposing harmful effects on the environment. This study is aimed to compare the physico-chemical properties of textile effluents collected from different sites of Sanganer (Jaipur) with the discharge limits prescribed by World Health Organization. Various parameters like pH, color, temperature, electrical conductivity (EC), biological oxygen demand (BOD), chemical oxygen demand (COD), total hardness, chloride and Total dissolved solids have been determined by prescribed methods. The temperature range was found from $40°C$ to $43°C$, pH from 6.7 to 9.3 and electrical conductivity from 3.42 to 4.67 µS/m. Total suspended solids (TSS) total dissolved solids (TDS) were found in the range of 4509 to 6370 mg/l and 2300 to 3200 mg/l respectively. Level of chloride content found from 425.7 to 528.2 mg/l and hardness from 535 to 760 mg/l. Thus all the parameters are in the high range as compared to the limits prescribed by WHO guideline for textile industrial effluent. Hence, there is a need for the treatment of textile effluents before discharging them into the environment.

Keywords: Textile effluents, Physico-chemical parameters, Textile Dyes, RPCB, Sanganer (Jaipur)

1. Introduction:

In this age and time of rapid industrial, technological and urban development, the world is facing a huge problem of disposing of generated wastes. This waste serves as a pollutant and leads to environmental pollution. Water pollution is a considerate example of such pollution. Polluted water is a mixture of sewage water, industrial effluent and household discharge (Ashraf et al, 2010; European Public Health Alliance, 2009). As WHO report around 1 billion people in the world used polluted water for drinking and around 2.4 billion people lack basic sanitation (WHO, 2004; European Public Health Alliance, 2009).

Industrialization plays a very significant role in a nation's GDP. But rapid industrialization has its own adverse effect. Industries which require water for production purposes use tons of water and discharged it as an effluent in nearby water bodies. Effluent discharged from leather, textile, paper, food and Pharma industries is a mixture of harmful chemical compounds which introduce pollutant to the environment. But textile industries are known to be the most polluted industries as they used verities of chemical and large quantities of water (Qin et al., 2007).

Textile industries are found all over the world and their numbers are increasing day by day. Different types of dyes and dyestuff, including both organic and synthetic, are extensively used in various textile industries. During the processing of textiles, due to the inefficiency of dyeing, a large amount of dyes are being wasted along with wastewater that gets accumulated in the environment (McMullan et al., 2001). This has led to severe pollution in the environment, especially in the aquatic. Effluent discharged from textile industries is one of the

most serious issues in front of the world (Sriram and Reetha, 2015). Treatment of textile effluent is necessary to get rid of the environmental problem before discharging it into the nearby aquatic system.

Textile Industrial effluents are a mixture of aniline, caustic soda, acids, bleaching powder heavy metals which required at the time of processing and finishing of textiles. After the processing, these chemicals reach to the aquatic system as an effluent discharged from industries. Some of the trace element and heavy metals are required for better growth of microorganism but in very less quantity (Akpoveta et al, 2011). Higher quality of such chemicals leads to bioaccumulation in aquatic animals.

India's largest state Rajasthan represents an authentic art of Sanganer (tie and die printing) which is quite popular in the area. Textile industries present in Sanganer represents an important economic sector of Rajasthan state. The Sanganer town situated (26^o49'-26^o51' N latitude and 75^o46'-75^o51'E longitude) about 20 km south of the Jaipur (Rajasthan, India) (Jaishree and Khan, 2014).

Textile industries used a various types of azo dyes which are less biodegradable in nature and persist in environment longer period due to more half-life (Goyal and Chauhan, 2014) At the time of processing and finishing, workers of these industries are directly exposed to these dyes and chemicals without any precaution measures (Newhouse, 1978). These industries used gallons of water for processing and they discharged it as an effluent to Dryavati River also known as amani saha nala without any treatment (Joshi and Kumar, 2011).

Industrial waste treatments are harsh and chemical oriented which have harmful effects on the environment. Treatment of textile effluent is necessary to get rid of the environmental problem before discharging it into the nearby aquatic system. Therefore, the search for natural ways to tackle waste management is the need of the hour.

2. Methods and Methodology

2.1 Screening of sampling sites

For the present study, Sanganer was selected as a study area a very famous town in north India for its beautiful tie and dye technique. Sanganer present nearby world famous city of India "Pink City" Jaipur. Every year thousands of visitors visit Jaipur. Tradition and culture of pink city attracted almost every visitor. Dravyavati river which turns now a drainage system flow throughout the city now known as amani saha nala. sanganer is facing a problem nowadays because of a large number of textile industries present in Sanganer. These industries discharge their effluent into amnai saha nala which affected nearby aquatic life and as well as human.

2.2 Collection of Samples

The effluent as a parent source of the sample was collected from Sanganer textile industrial region. For error-free sample collection sample was collected according to sample collection method (APHA, 2005). The sample was collected in sterilized air thigh bottles from the end of the discharged point of textile industries for the present study. After sampling, samples were brought to the laboratory as early as possible and were tested for various physico-chemical parameters. Samples were stored aseptically at 4°C after collection. For the present study samples were collected from seven different sites which illustrated in **table 1**.

2.3 Analysis of Physico-chemical parameters

Physico-chemical parameters of the textile effluents collected from Sanganer were carried out. parameters such as temperature, color, pH, Conductivity (EC), Chloride, acidity, alkalinity, hardness, chemical oxygen demand (COD), biological oxygen demand (BOD), total dissolved solids (TDS) and total suspended solids (TSS) as prescribed by APHA (2005).

2.4 Statistical analysis

All the parameters were performed in triplicates to reduce the degree of error. For Statistical analysis of data software, Microsoft Excel (version 2010) was used. Study of correlation and test of significance has been performed. Correlation coefficient "r" was calculated through below formula:

$$r = \frac{\sum xy}{\sqrt{\sum x^2 \times \sum y^2}}$$

A significant level of obtained correlation coefficient has been tested through "t" test.

Table 1: Location details of 7 different sites of sample collection in Sanganer

S. No.	Sites	Location	Location on Map
1	Site 1	Near Sanganer bridge (Sanganer Road)	26°49'08.4"N 75°47'25.0"E
2	Site 2	Near Printing Unit beside High Sec. road Sanganer	26°49'01.1"N 75°47'24.5"E
3	Site 3	Near Printing Unit beside High Sec. road Sanganer	26°48'58.6"N 75°47'24.7"E
4	Site 4	Near Printing Unit beside High Sec. road Sanganer	26°48'40.4"N 75°47'27.6"E
5	Site 5	Near Sanganer Thana	26°48'38.3"N 75°47'28.8"E
6	Site 6	Near Bambolla Road	26°48'16.9"N 75°47'35.5"E
7	Site 7	Near Ankit public School	26°48'06.0"N 75°47'31.9"E

3. Result and Discussion

Table 2 illustrated the physic-chemical parameters observed in the textile effluent.

3.1 Temperature and Color:

The effluent samples collected from different sites of Sanganer were differentially colored. The temperatures of the effluent samples were found in the range of 40.2^0 C to 42^0 C. temperature is an important factor as it fluctuates on daily basis. It affects the biotic life present in water as some microorganism requires a specific temperature for growth (Saxena, 1990).

3.2 pH:

Strength of hydrogen ion concentration in a solution is known as pH. The pH of the effluent samples was in the range of 6.7 - 9.3, which is slightly more than the prescribed limit of wastewater by WHO (6.0 – 9.0) (2006). pH plays a significant role in the growth of microorganism. Quality of water indirectly depends upon the pH as it affects the solubility of water (Fakayode, 2005).

3.3 Electrical Conductivity:

Electrical conductivity directly related to the number of ions present in a solution. The Electrical conductivity of the effluent samples was in the range 3.42 - 4.67 s/cm, which was

Table 2: Physiochemical parameters of effluent samples collected from Sanganer

Sample Parameters	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Mean	Standard Deviation
Colour Appearance	Brownish	Yellowish	White milky	Pale yellow	Dark yellow	Yellowish	Dark black	-	-
Temp. (^{0}C)	40.2	42	42	43	40	41	41	41.3142	1.0761
pH	8.44	6.9	9.3	9.1	7.8	6.8	6.7	7.8628	1.106
EC (ms)	3.87	3.44	3.52	3.6	4.67	3.42	4.32	3.8342	0.485
BOD (mg/l)	455	464	425	457	474	455	431	451.571	17.510
COD (mg/l)	1532	1408	779	755	2490	1943	2131	1576.85	660.494
TDS (mg/l)	2839	2759	2322	2300	2937	3100	3200	2779.57	352.971
TSS (mg/l)	4809	4856	4548	4509	5445	6260	6370	5256.71	785.685
Chloride (mg/l)	437.6	461.4	425.7	448.3	463.5	467.6	528.2	461.75	32.956

higher than the prescribed limit of WHO. High EC found Due to the higher concentration of dissolved salt present in effluent (Tekade et al, 2011). A higher value of Electrical conductivity affected plant growth (Ademoroti, 2011).

3.4 Biological oxygen demand:

The biological oxygen demand shows the value of organic matter present in water. A higher value of organic matter leads to higher BOD value (Savin

and Butnaru, 2008). BOD of all samples was found in the range 425-474 mg/l which is much higher than the limit prescribed by WHO. It indicates the oxygen level in water is very less in the effluent-affected area. Less oxygen level in water affects the aquatic life.

3.5 Chemical oxygen demand:

For Chemical oxygen demand WHO set a limit of 150mg/l but in present effluent samples COD

found 755-2490 mg/l much higher from prescribed limit. A higher value of COD showed the presence of a toxic substance which is biological resistant (Lakhande et al, 2011).

3.6 Total Dissolved Solids:

Total dissolved solids (2300-3200 mg/l) were also found with higher range than the prescribed limit by WHO. Higher concentration of dissolved solids in water is harmful to plant growth as it affected the aeration, permeability and soil structure (Suriyanarayanan et al, 2012).

3.7 Chloride and Hardness:

Chloride content of all the samples collected from Sanganer were in the range of (425.7 - 528.2 mg/l) which was quite high in comparison to the standard value of drinking water (250mg/L). Level of chloride found more due to the presence of chlorine content like hypochloric acid and hydrochloride acid was used extensively in textile industries at the time of processing. The higher amount of chloride effects on biotic life. Total Hardness values observed for textile effluents samples were in the range of (560 - 760mg/l).

Table 3: Effluent parameter quality correlation matrix

Parameters	pH	EC	BOD	COD	TDS	TSS	Chloride	Hardness
pH	1	-0.1607	-0.1943	-0.7111	-0.8691	-0.8032	-0.7573	-0.7382
EC		1	0.1887	0.7213	0.4562	0.3590	0.4691	0.3901
BOD			1	0.3577	0.1478	-0.0845	-0.1472	-0.2658
COD				1	0.8965	0.7784	0.6241	0.5875
TDS					1	0.8916	0.7393	0.7029
TSS						1	0.8157	0.8653
Chloride							1	0.9699
Hardness								1

3.8 Statistical analysis

"t" test has been used to calculate the degree of significance in the observed correlation coefficient. Between two parameters total 28 correlations were observed illustrated in **table 3**. Total 10 cases showed a negative correlation. pH showed a negative correlation with each parameter.

4. Conclusion

Textile industries a major economic zone of India generate opportunity to lots of people. Many lives depend upon the textile industries. But textile industries became problematic as they consider the most polluted industries. A solution is required for effluent which is discharged by these industries as it is a major pollutant to water pollution. Textile effluent is hard to treat as it is a mixture of chemicals. It is a high time to control textile pollutant as they make the environment bad to worse. This study shows all the physiochemical parameters were not in the range. They found very high as a comparison of prescribed limit of WHO. This is a hard time we have to take the action to get rid or get reduce this textile pollutant. High level of these parameters affected aquatic life as well as human life. Before discharging it into the nearby aquatic system or a stream, effluent needs to be treated carefully.

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