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Comparative Studies of Some Physicochemical Characteristics of Raw Water and Effluents of Textile Industries of Bhilwara, Rajasthan

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***Abstract*: The textile industry generates effluents in huge amounts so it is the most important consumer of water. In this paper, various significant physicochemical characteristics such as pH, electrical conductivity (EC), total dissolved solids (TDS), biological oxygen demand (BOD) of raw water, and the textile industry's effluents were analyzed. These parameters of the textile industry's effluent samples compare with raw water samples. In this study physicochemical parameters were found greatly larger than the acceptable limits as given by CPCB and WHO. The high values of pH, TDS, BOD, and COD have harmful effects on human health as well as on aquatic life. So, it is necessary to treat water properly before disposal of this type of effluents into the water bodies.**

***Index Terms*: Characteristics, Effluents, Biological Oxygen Demand (BOD), Electrical Conductance (EC).**

1 Introduction

In the present scenario, India's environment is flattering delicate and environmental pollution put is one of the adverse side effects on the environment. So, the protection of the environment becomes the main need of society. In environmental pollution textile industries play a major role due to the large consumption of water. As the population increases the requirement of textile products increases, which makes the textile industry one of the most important sources of relentless contamination troubles globally [1, 2].

The textile industries are divided into two groups one is the dry fabric industry and the other is the wet fabric industry. In the manufacturing process, various harmful chemicals are used that are the major cause to become water pollution. Also, the various color regents are used in the manufacturing process for dying. This is the problem because wastewater containing dyed becomes hazardous to biotic and abiotic life. Because dye-containing water produces resistance in the path of sunlight entered in the water that slows down the rate of photosynthesis. So, the rate of photosynthesis is decreased.

It increases the toxicity in aquatic life and stops the activity and growth of microorganisms [3]. The amount and character of waste generate depend on the various operational units used in textile industries [4, 5]. The wastewater produce in the manufacturing process of textile industries has a higher concentration of physicochemical parameters [6,7]. In general, the use of this type of sewage effluents from industries and municipal origin for irrigation purposes increases the EC, organic carbon content, and heavy metals in soils, and the probability of their entry into the food chain increases that is the cause of significant health concern. So, it becomes essential to study the untreated effluent with the help of advanced techniques. In recent years great interest is build up in

the enlargement of recyclable wet handing out textile methods [8]. To fulfill this requirement a rule has been given by the "Central Pollution Control Board" of India. The aim of the present research work is to evaluate the toxic waste perspective appropriate to waste matter discharge in Jaipur city from textile industries.

2 Materials:

2.1 Study Design Area:

The industrial town of Bhilwara, situated in the Mewar region of Rajasthan, is a famous hub for textiles in India. The textile industries of the Bhilwara district displays an annual growth rate of 8 to 10 percent and are widely popular for exporting textile products like synthetic yarn, woollen commodities, cotton yarn, and fabrics. The export sectors which comprise the mills of Bhilwara fetch a sum of Rs.1300 crores per year. With textile being the main industry in the district, the area has more than 400 manufacturing units, making it a major textile centre specialising in synthetic fabrics for trousers. Total Six different textile industries were selected in the Bhilwara area for gathering the samples. The selected industries were direct as IND1, IND2, IND3, IND4, IND5 & IND6.

2.2 Sampling:

The delegate effluent of different industries samples was collected in clean polythene bottles independently in the intervals of one hour. The collected samples were mixed individually to obtain the compound samples. Two types of samples were collected for the physicochemical analysis one is borewell water samples and the other is effluent samples collected from the outlets of textile industries. For further analysis, the samples were conserved by refrigeration at 4^0C without chemical addition for further analysis After initial analysis of color, temperature & pH.

2.3 Sample analysis

The Physicochemical examinations of the effluent samples were conceded in the laboratory. The nature of bore well water samples is found to be colorless & odorless. In other side, the textile industry effluent samples found to be extremely dyed, pungent-smelling & muddy. The standard methods were used for analyzing the different physicochemical and biological parameters for the assessment of water and wastewater. The electrode method is used for ph determination, biochemical oxygen demand (BOD) was determined at standard temperature 20^0ssC for 5 days by dilution method, the refluxed method was used for chemical oxygen demand (COD), total dissolved solids (TDS) by gravimetric method. The other parameters like Total hardness, alkalinity, calcium, and magnesium are determined titrimatrically.

3 Results & Discussions

The individuality of raw water and effluents are associated with standard limits given by the central pollution control board, CPCB. Psychoanalysis is given away in Table 4.1 & Table 4.2.

Table 4.1: Physicochemical characteristics of Raw Water (Bore Well).

Industries	pH	EC(µS/cm)	TDS (mg/l)	BOD (mg/l)	COD (mg/l)
IND1	6.93	583	294	1.34	8.42
IND2	7.08	392	195	0.91	7.71
IND3	7.04	782	443	1.72	8.95
IND4	7.01	474	232	1.28	8.32
IND5	7.06	435	408	1.36	7.84
IND6	6.98	498	302	1.32	8.36

Table 4.2: Physicochemical characteristics of textile industries.

Industries	pH	EC(µS/cm)	TDS (mg/l)	BOD (mg/l)	COD (mg/l)
IND1	7.96	4762	2728	226	594
IND2	9.92	7523	4872	352	862
IND3	9.16	6829	3848	476	1620
IND4	8.58	5616	3518	554	1120
IND5	8.92	6790	3924	294	980
IND6	8.12	4820	2782	388	684
CPCB standards	5.5-9.0	2250	2000	30	250

After examination of these different industries samples, it has been observed that the wastewaters collected from textile industries show great fluctuations from the limits of the standard prescribed by the CPCB. Thus, the relative study of bore well water and effluents of textile industries has been in use to review the effect of industries on water.

Fig1. Plot showing the variation of the concentration of pH parameter of Textile Industry effluents and raw water sample with standard parameters recommended by CPCB.

pH may be a determinant of the acidity or alkalinity of water. All metabolic reactions are dependent on the pH values so if the nature of water is highly alkalinity, then it affects aquatic life [11]. It has been experiential that soil permeability is also affected by pH which may cause to leads polluted underground water [12]. So pH is the primary parameter to decide the feature of wastewater. In the present study, the pH of the raw water varied in the range of 6.93 to 7.08 and for effluents samples, it ranges from 7.96 to 9.92. These results show that the textile industry's effluent is decidedly basic in character relative to the raw water. The industry two samples were observed as a much higher value of as the industry one sample has a minimum value. The experimental values replicate its incompatibility for marine life and used for all kinds of water uses. The tolerable limit of pH for irrigation water is from 6.5 to 8.4. So, on the source of calculated pH samples are not suitable for long-term irrigation purpose.

The widely use of various bleaching agents and chemicals in the manufacturing process of textile industries like NaOH, NaOCl, and sodium phosphate are causes for the high alkalinity nature of wastewater [13]. So it is necessary for the treatment of wastewater to overcome its pH up to the limits of the standard prescribed by CPCB.

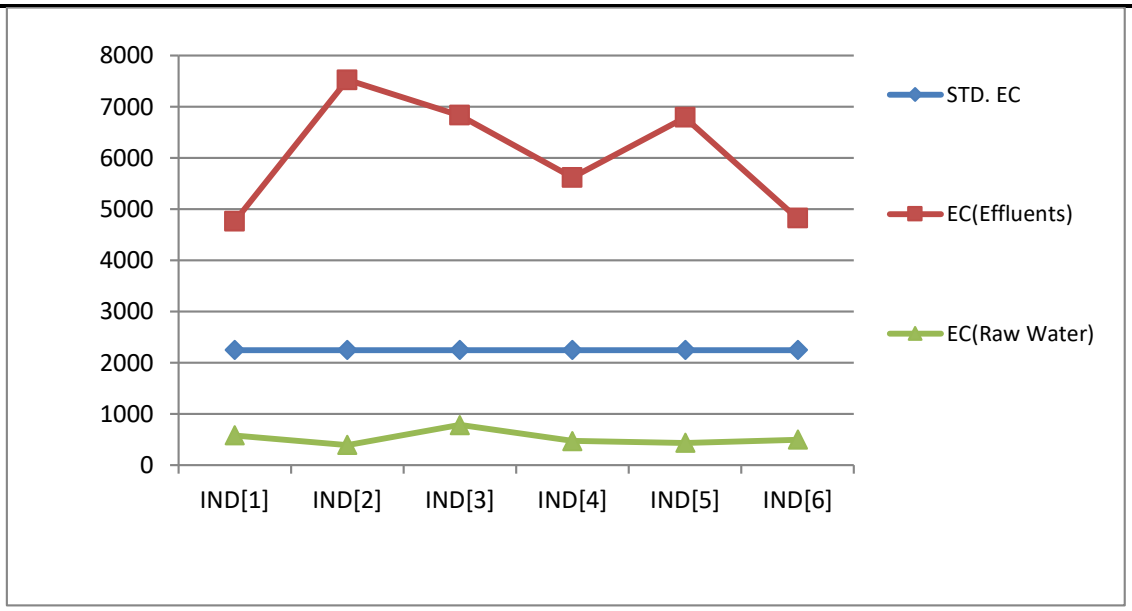

Fig2. Plot showing the variation of the concentration of EC parameter in µS/cm of Textile Industry effluents and raw water sample with standard parameters recommended by CPCB.

In the present study, the concentration of EC of the raw water varied in the range of 392 to 782 µS/cm and for industries effluents samples, it ranges from 4762 to 7523 µS/cm. The industry two samples were observed as a highest value of electrical conductance was 7523 µS/cm as industry one sample has a minimum value of 4762 µS/cm. The higher value of electrical conductance indicates the dissolved solids present in the textile industry's wastewater samples. The higher value of Electrical conductance also affects plant growth [14]. The water contains the higher values of EC that have been originating to cause osmotic stress within the plants roots, which makes it harder for a plant to soak up water for growth. So the water content with higher values of EC and TDS is not suitable for irrigation because it decreases the crop production rater [15].

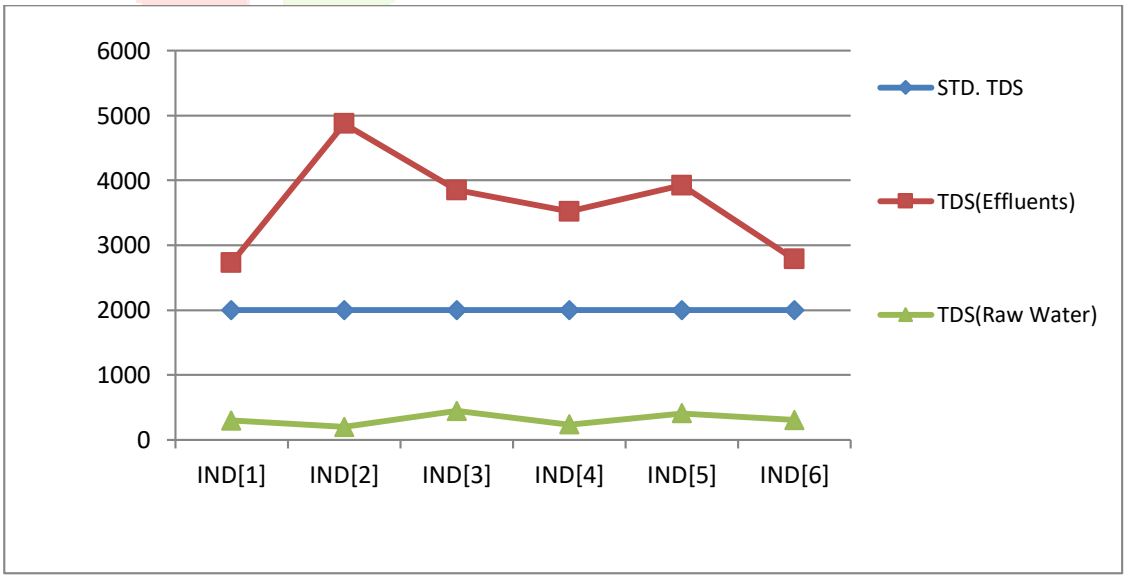

Fig3. Plot showing the variation of the concentration of TDS parameter in mg/l of Textile Industry effluents and raw water sample with standard parameters recommended by CPCB.

The results of this study show that the concentration of TDS of textile effluents were greatly above limits of the standards given by the CPCB. The concentration of total dissolved solids of the raw water varied from 195 to 443 mg/l whereas, for textile industries effluents samples, it varied from 2728 to 4872 mg/l which is above CPCB standards. The industry two samples were observed as a maximum value of total dissolved solids was 4872 mg/l as the industry one sample has a minimum value of 2782 mg/l. The presence of higher TDS concentration indicates the occurrence of dissolve salts in water [16]. The higher concentration of total dissolved solids also affects the concentration of water, decreases the oxygen gas concentration in the water, influences the osmoregulation of freshwater organisms. Thus, the water having a higher concentration of TDS is not suitable for drinking and irrigation purposes [17].

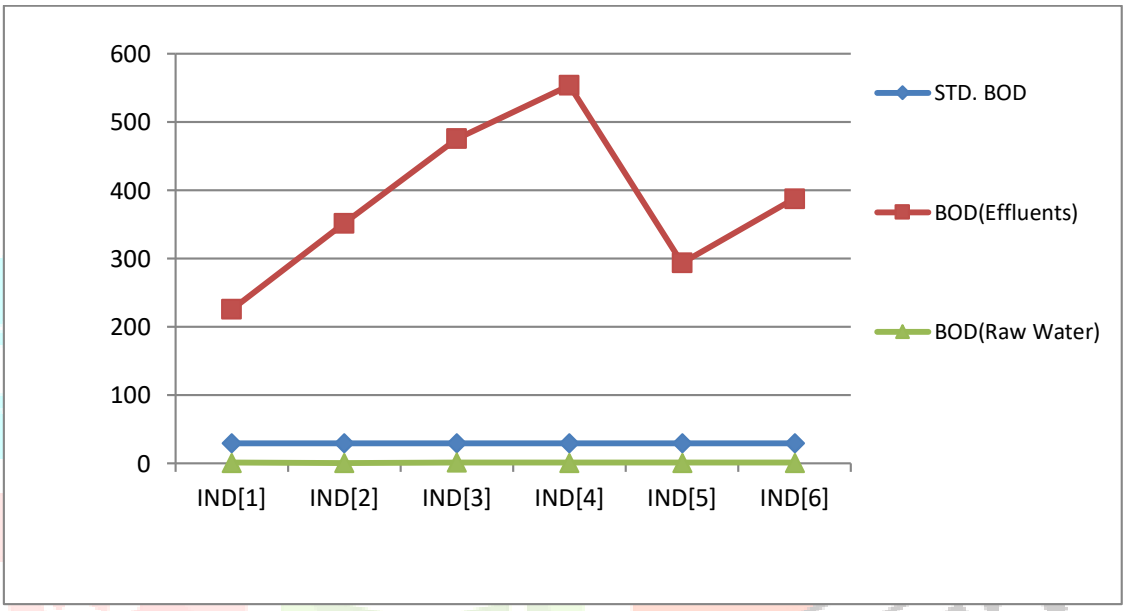

Fig4. Plot showing the variation of the concentration of BOD parameter in mg/l of Textile Industry effluents and raw water sample with standard parameters recommended by CPCB.

For calculating the pollution load of industrial effluents, the most important parameter is BOD. BOD is defined as calculating the oxygen concentration used in the deprivation of untreated stuff by microorganisms. The concentration of Biochemical oxygen demand of the raw water varied from 0.91 to 1.72 mg/L whereas, for textile industries effluents samples, it varied from 226 to 554 mg/l. The industry three samples were observed as a maximum value of BOD was 554 mg/l as the industry two sample has a minimum value of 226 mg/l. The presence of higher BOD concentration shows that the biodegradable substances are present in the textile effluent samples. As the decomposable matter increases it means oxygen concentration requirement is more thus the BOD value is [18]. The value of BOD is excess then it will impact harmful effects on aquatic animals like fish and microorganisms.

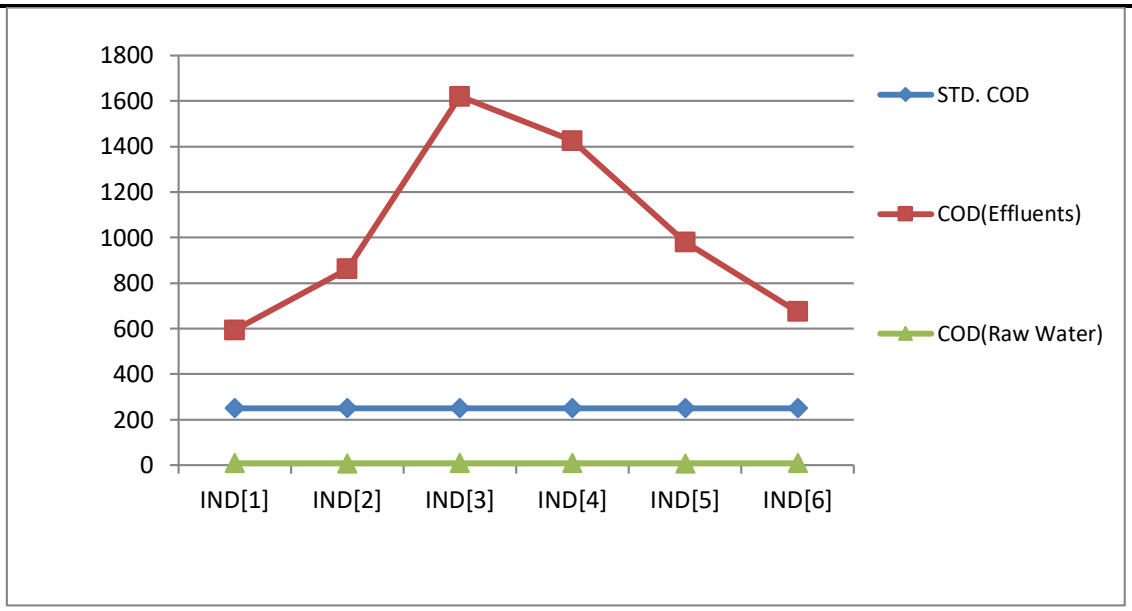

Fig5. Plot showing the variation of the concentration of COD parameter in mg/l of Textile Industry effluents and raw water sample with standard parameters recommended by CPCB.

The concentration of chemical oxygen demand of the raw water varied from 7.71 to 8.95 mg/l whereas, for textile industries effluents samples, it varied from 226 to 554 mg/l594 to 1620 mg/l which is greater than the limits of the standards given by CPCB. The industry three samples were observed as a maximum value of COD was 1620 mg/l as the industry one sample has a minimum value of 554 mg/l. The reason behind the more concentration of COD relatively to raw water sample because of widespread use of dyes in the various operation using in the manufacturing process of textile industries [19]. The continuous discharge of effluents that have higher concentrations of COD may be given a negative impact on aquatic animals' life especially fish [20]. The ratio of BOD: COD is greater than 0.5 that indicates water is needed biological treatments [21]. If the ratio of BOD: COD is less than 0.3 that indicates some toxic components are present in effluent [22, 23]. The results of the present study indicate the wastewater may be treated with microorganisms.

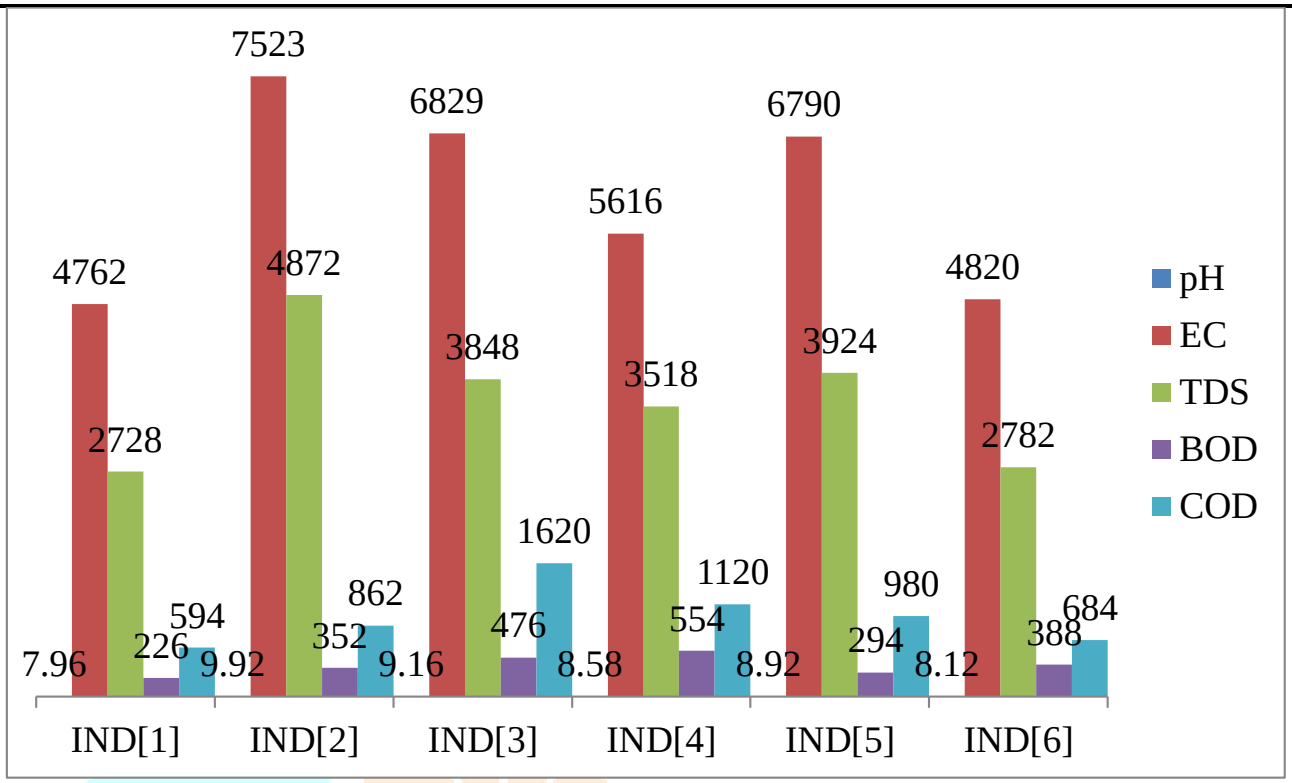

Fig6. Physicochemical characteristics of Textile Effluents

4 Discussions

After analysis the result it becomes necessary to treat this type of effluent in proper way and using the new techniques. Similar type is study done in another city solapur, india. The results of solapur city show that effluents outcome from the textile industries of solapur city have BOD concentration between 170 to 450 mg/L. The concentration of COD lies between 455 to 1349 mg/L. Total dissolved solid of given textile effluent is in between 2264 and 5752 mg/L. So the results of solapur textile industry are to a great extent upper than the standard limit given by CPCB. In our results the concentration of BOD of all textile effluents lies between 226 to 554 mg/l while in solapur city textile industry effluents BOD lies in the range of 170 to 500 mg/l that is approx similar to our results. The COD concentration of solapur city effluent varied from 490 to 1548 mg/l that is higher than our results.

5 Conclusion

After the analysis of the results of bore well water and textile effluent samples of different industries, it has been noted that industrial effluent samples show tremendous deviation from the standards limit prescribed by the CPCB. These results show that extra contamination load of effluents that affects the water quality and becomes it polluted. Polluted water increases environmental pollution and also gives a harmful impact on the health of humans. So, it is become necessary to treat the effluent before disposing into surrounding water bodies. The various effluents treatment methods are adsorption by activated carbon, treatment by mixed culture of bacteria & advanced oxidation processes. The effectiveness of the Physico-chemical or biological

treatment process mainly depends upon the quality, nature, and concentration of the organic compounds present in the effluents.

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