

Wastewater characterization of grossly polluted textile industries located at main stem of River Ganga in Uttar Pradesh, India

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ABSTRACT

River Ganga is considered as one of the holiest and sacred rivers of the world since time immemorial. Deterioration in the Ganga river water quality caused by increasing water pollution has given rise to the alarming situation in the country since the last few decades. The present study is aimed at identifying water consumption and wastewater generation of selected Textiles units of ten districts of Uttar Pradesh state and to assess district-wise pollution potential of Textile effluents. In the present study, the Textile units in the Chandauli district generate about 86% of wastewater. This is followed by Hapur (80%), Kanpur (72%), Gorakhpur (68%), Mirzapur (66%), Farrukhabad (65%), Unnao (62%), Bhadoi (57%), Jaunpur (50%), and Ghaziabad (21%). The maximum pollution load in term of BOD & COD was observed in the wastewater generated by Textile units of district Mirzapur followed by Bhadohi, Unnao and Gorakhpur.

Key words : Textile, Grossly Polluting Industries, Wastewater, Pollution load

Introduction

Ganga is the most sacred and iconic river of India, originating from the peaks of the mighty Himalayas at an elevation of 4100 m. It covers a distance of around 2525 km flowing from the western Himalayas to south and east of India and Bangladesh and in due course, it flows into the Bay of Bengal. The river with its well-knit tributaries drains the Ganga basin which comprises an area of more than a million square kilometers. (10,60,000 km²) spread over four countries- India, Nepal, Bangladesh and China (Joshi *et al.*, 2009). The Ganga river basin is the largest river basin in India, extending over the states of Uttarakhand, Uttar Pradesh, Haryana, Himachal Pradesh, Delhi, Bihar, Jharkhand, Rajasthan, Madhya Pradesh,

Chhattisgarh and West Bengal (MOEF, 2009; Bhutiani *et al.*, 2016). Deterioration in the river water quality caused by increasing water pollution has given rise to the alarming situation in the country from the last few decades. It is reported that in India, around 70% of the available water quality is deteriorated and not suitable for human consumption (Joshi *et al.*, 2009). Municipal sewage and Industrial effluents are the greatest sources of Ganga river water pollution.

In the 21st century, industrialization is a backbone of country's economic growth and development as it manufactures varieties of products with an increased volume and improves the standard of living of the natives by increasing employment opportunity (Binta and Bazza, 2018). In India, Textile industry is one of the most popular industrial sectors and

plays crucial in the Indian economy. As per the report published by Central Pollution Control Board (2007), there are in total 2,324 Textile industries are currently running in India. These industries consume around 830 million m³/year of freshwater (Jegatheesan *et al.*, 2016) and varieties of dyes primarily azo dyes for dyeing and printing of fabric. The Textile industries located in line to the main stem of Ganga basins and are categorized under Grossly Polluting Industries (GIP) under E (P) Act, 1986 has been selected for the present study. Therefore, the present study aims at (a) characterization of wastewater of different Textile industries of ten districts of U.P. to assess their pollution potential (b) physical and chemical characterization of treated effluent of selected Textile industries.

Methodology

Description of the Study area

On the basis of operational status of the units and availability of data, Textile units have been selected from ten districts namely Ghaziabad, Gorakhpur, Jaunpur, Kanpur, Mirzapur, Unnao, Bhadohi, Farrukhabad, Chandauli and Hapur from a total of 188 units located near the main stem of river Ganga in 18 districts of Uttar Pradesh. Descriptive type of data have been considered in the current study for the year 2019-20. Wastewater samples were collected from different units to determine the pollution load caused by the discharged effluent. Information pertaining to freshwater consumption, wastewater discharge and analytical results were obtained from the respective industry personnel. Physicochemical parameters such as pH, TSS, Colour, BOD, Oil & Grease, COD, Sulphide, TDS, SAR and Ammonical Nitrogen were analyzed.

Observations and Findings

Water consumption and wastewater generation

The allowance limit of effluent generation was considered as 85% of the total amount of water consumed. The average water consumption and wastewater generation of Textile units of selected districts shown in Fig. 1. The recorded values of wastewater generation by all the Textile units of different districts were found within the limit except for Chandauli district. Due to scarcity of freshwater availability, it is necessary to reduce or minimize the

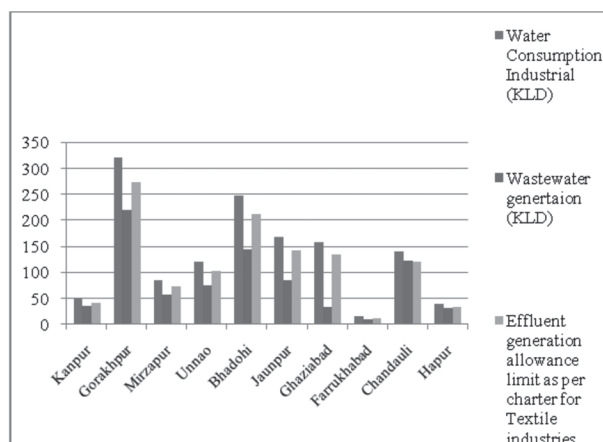


Fig. 1. Characterization of Textile industry on the basis of freshwater consumption and wastewater generation

water consumption by adopting cleaner technology and reuse the treated wastewater for different processes and achieve zero liquid discharge system. The Textile units in the Chandauli district generate about 86% of wastewater. This is followed by Hapur (80%), Kanpur (72%), Gorakhpur (68%), Mirzapur (66%), Farrukhabad (65%), Unnao (62%), Bhadohi (57%), Jaunpur (50%), and Ghaziabad (21%).

Physico-chemical characterization of Textile effluent

The physicochemical parameters of the treated effluent are shown in Table 1.

pH

The average value of pH of effluent collected from different Textile units of the selected districts of Uttar Pradesh ranges from 6.91 to 7.45 and was found within the permissible limit. The pH of effluent was slightly acidic to slightly alkaline.

Total suspended solid (TSS)

The average value of TSS of Textile Effluent of Mirzapur district was found to have a higher level of total suspended solids followed by Unnao, Hapur Ghaziabad, Farrukhabad and Bhadohi. The highest amount of TSS is due to increased suspended particles in effluent which shows increasing turbidity of water bodies and it depletes the oxygen level in the water.

Colour

The colour unit of effluents was found within the permissible limit for all the selected districts. The

colour of effluent is due to the presence of a variety of dyes used in the dyeing and printing of fabric and colour producing metals and compounds.

Biochemical oxygen demand (BOD)

The analytical results of the present study showed high BOD of Textile effluent of Hapur followed by Unnao, Ghaziabad, Farrukhabad and Bhadohi. The elevated level of BOD in the effluent is may be due to the presence of organic matter.

Chemical oxygen demand (COD)

COD concentration in treated effluent of selected units of selected districts was found within the permissible limits indicating the efficiency of treatment plants in removing oxidizable compounds, which are used in different steps of dyeing and printing of fabric, except for Chandauli district. Increases in COD can be due to the huge amount of industrial wastes such as detergents, softeners, non-biodegradable dyeing chemicals, formaldehyde-based dye fixing agents etc.

Oil & grease (O & G)

Except for Jaunpur all the selected units situated in the Gorakhpur, Bhdaohi, Ghaziabad, Kanpur, Mirzapur and Unnao, Farrukhabad, Chandauli and Hapur district were found exceeding the permissible value. The presence of O & G on the water surface blocks penetration of natural light, reducing the

oxygen level in an aquatic ecosystem.

Sulphide as S

Sulphides as S value in the treated effluent of the

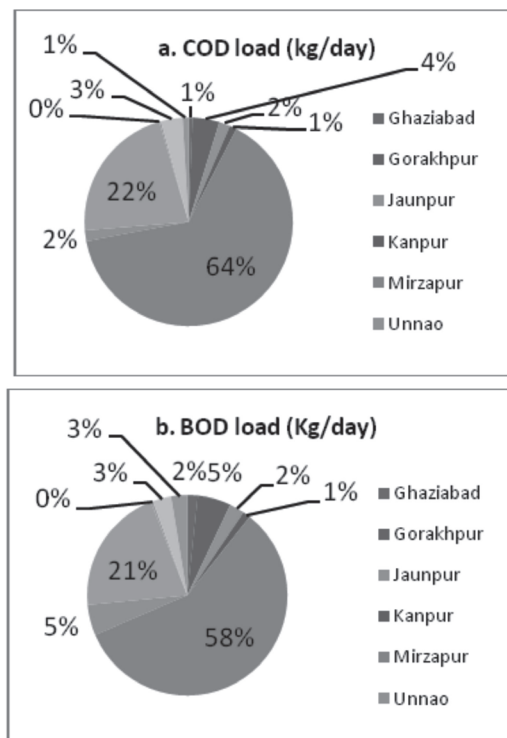


Fig. 3. (a&b). District-wise contribution of Textile industries to COD & BOD load on receiving water bodies.

Table 1. district-wise analytical results of Textile industrial wastewater of Uttar Pradesh

Parameters	Standards for Discharge of Effluent from as per Gazette notification dt.10/10/2016	Ghaziabad	Gorakhpur	Jaunpur	Kanpur	Mirzapur	Unnao	Bhadohi	Farrukhabad	Chandauli	Hapur
pH	6.5-8.5	7.3	6.91	7.32	7.3	7.45	7.2	7.3	7.665	7.31	7.1
TSS	100	170	43.6	29.4	62.7	531.4	193.7	112.2	116	131.4	190
Color	150	3	97.9	8.2	47.6	25.12	40.6	58.1	91.83	49.56	5
BOD	30	44	24	30	40.1	13.5	64.3	35.9	39	30	85
COD	250	120	139.5	161	240.9	98.6	222	242.1	224.75	444.25	230
O & G	10	23.6	32.4	5.2	19	17.8	14.9	24.8	28	21	10.8
TDS	2100	1140	1102.6	640	1429	51793.5	1353.5	5545.8	1350	1787	2414
SAR	26	11	16.3	16.1	33.6	17.8	14.25	26	13.885	17.505	14
NH3-N	50	16	1.1	19.1	7.9	7.21	3.4	9.4	12.32	4.2	66.5
Total Sulphide	2	0.07	1.6	0.8	1.3	1.2	0.4	2.5	<0.1	0.4	0.2

*All values of parameters are in mg/l except for pH, SAR & colour (colour unit)

units of selected districts were found within the permissible limit of 2.0 mg/L except for Bhadohi.

Total dissolved solids (TDS)

The wastewater in the selected units of Mirzapur, Bhadohi and Hapur district showed an elevated level of mean total dissolved solids while the values of the mean total dissolved solids in Ghaziabad, Gorakhpur, Jaunpur, Kanpur, Farrukhabad, Chanduli and Unnao district were found within the permissible limit. Generally, Textile industries show higher TDS value than the other industries mainly due to the fixing, bleaching and dyeing agents used for fabric processing on different stages.

Sodium adsorption ratio (SAR)

The mean value of SAR of selected units of Kanpur district was found beyond the permissible limit of 26 while others were found within the permissible limit.

Ammonical nitrogen

The mean value of ammonical nitrogen of treated effluent of selected units of all the districts ranges from 1.1 to 66.5 mg/L and was found within the permissible limit of effluent discharge except at Hapur.

As indicated in Fig. 3 the maximum pollution load in term of BOD was observed in the wastewater generated by Textile units of Mirzapur followed by Bhadohi, Unnao and Gorakhpur while the maximum pollution load in term of COD was observed in the wastewater generated by Textile units of Mirzapur followed by Bhadohi.

Conclusion

The present study illustrates the status of freshwater consumption and wastewater generation in the

selected Textile industries located at different districts of Uttar Pradesh, indicating the stress on groundwater and discharge of wastewater generated in nearby water bodies and on the land. However, the wastewater generation was found within the limits, in terms of industrial freshwater consumption. The district-wise physical and chemical characterization of Textile industrial wastewater indicated non-compliance status of Textile unit with respect to the discharge norms in some way shows the unsatisfactory performance of effluent treatment plants of the selected units. The present study concluded that industrial sectors must comply with the guidelines and policies formulated by government intermittently and adopt basic management practices and adequate treatment facilities to eliminate or reduce the pollution load on the environment.

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