

Study of Physico–Chemical Characteristics of Effluents Generated From Dyeing and Printing Units at Tarai Region of Uttarakhand

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ABSTRACT

Dyeing and printing are two most common techniques of colouring the textile materials that consume huge amount of water, chemicals, different types of dyes and auxiliaries. After completion, these processes discharge waste material either in solid form or liquid form or gaseous form. In the present study, the liquid waste (effluent) collected from community disposal channel of three different types of units namely, dyeing unit only, printing unit only and dyeing and printing unit (composite unit) of Jaspur area were tested to know the physico-chemical characteristics [temperature, pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Solids (TS), Total Dissolved Solids (TDS) and Total Suspended Solids (TSS)] of effluent samples. The overall mean of the physico-chemical characteristics of effluents collected from different types of units were beyond the permissible limits in term of all the parameters when compared with the standards given by CPCB (1995) indicating highly polluting nature of the dyeing and printing units located at Jaspur. The mean values of physico- chemical characteristics of the effluent collected from dyeing units only were lower than the mean values of all the parameters of the effluents collected from printing units only and dyeing and printing unit (composite unit). Thus the dyeing units were causing less pollution as compared to other two types of units. The higher pollution load may be due to the presence of thickening agent and dye content in the effluent stream. The results revealed that the parameters such as temperature, pH, DO, BOD, COD were non-significant while TS, TDS and TSS were significant on basis of One way ANOVA.

Key words: Printing, Dyeing, BOD and COD etc.

INTRODUCTION

In man's life colour has played a dominant role by psychological and cultural development of human species. Dyeing and printing, most common techniques of colouring the textile materials differ in the method by which colour are applied to textile

materials. In the dyeing process, fibre, yarn, or fabric is immersed in a solution of dyestuff and is thus saturated with the dye. There are majorly two styles of dyeing process that are practiced by the dyers, namely, direct (fabric, article) and resist (batik, tie and dye).

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However, in printing, a pattern or a design is imprinted on the fabric in one or more colours by using dyes in paste form by employing different means like blocks, rollers, screens, etc. There are mainly three styles of printing that are practiced by the printers namely, direct, resist and discharge resulting in different effects in colour on textiles⁴. The dyeing and printing units are the enterprises which not only provide a means of livelihood but also offer lots of exciting challenges from the ever changing fashion market. The fabric that is to be dyed or printed must be scoured and bleached before applying any type of colour, for efficient colour application. The modern chemical dyes (synthetic dyes) that are used in the dyeing and printing units have resulted in chronic health hazards not only to workers but also to consumers and has a major contribution in polluting the environment throughout the globe. The pollution is mainly created due to the chemicals used during different steps of dyeing and printing processes like; preparatory, colouring and post colouration processes where they are not consumed completely and are released in effluent streams as waste. The effects of these chemicals in the effluent are well established in large cities and abroad where large scale units are located but small scale and cottage level units are either unaware or have less knowledge about it. Such polluting conditions require safety measures to be adopted for the workers while working in these units and proper treatment methods for effluent prior to its release in water bodies.

The large scale units follow the safety measures and provide protective equipment as per the requirements. But the small scale and cottage level units overlook such practices which increase possibility of incidence of health hazards among workers of these units. After observing these problems, the buyers have started testing of the products and dyes to identify the harmful ingredients for humans as well as for the environment. Also the consumers now a day avoid the fashion fabrics using chemical dyes and have started switching over to fabrics manufactured out of eco-friendly processes.

To some extent, the pollution enforcement agencies are responsible for these emerging situations that follow a lenient attitude to industries on account of its socio economic contributions and low investment capacity towards pollution control. Such clusters of textile dyeing industries have led to serious problems in towns situated on small rivers like Pali, Balotra and Jodhpur in Rajasthan, Jetpur in Gujarat and Tiruppur in Tamil Nadu.

Uttarakhand state comprises of hilly as well as plain terrain wherein textile colouration units are located at different places. Majority of the dyeing and printing units are located in Jaspur block of Udham Singh Nagar district. A few units are also situated at Dharchula, Munshyari, Chamoli, Uttarkashi, Dehradun, Nainital, Champawat and Kashipur. All these units are small scale or tiny scale industries which are being operated from either the households of workers or small units located in residential areas. The effluent generated from these units is released in the surroundings of the units or in the community disposal channels.

The present study was conducted to assess the physico - chemical aspects of the effluents collected from tiny scale dyeing and printing units operating in Uttarakhand state.

MATERIAL AND METHODS

The waste material (effluent) disposed from dyeing and printing units of Jaspur block was taken to assess its physico – chemical characteristics to find out the status of pollution there due to them. The sample was collected from community drains (disposal channel) in liquid form by using Grab sampling method from three different types of units viz; dyeing unit only, printing unit only and dyeing and printing unit (composite unit). The collected effluent samples were used to find out the relation between the type of unit and the effluent generated from them. The physico-chemical characteristics namely, temperature, pH, DO, BOD, COD, TS, TDS and TSS were assessed for these collected samples in the laboratory at Pantnagar. Three liters of effluent samples

were collected from each type of unit. The collected samples were ready for analysis of their physico – chemical characteristics namely, temperature, pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Solids (TS), Total Dissolved Solids (TDS) and Total Suspended Solids (TSS). The temperature of effluents was measured by thermometer in degree centigrade ($^{\circ}\text{C}$) on the spot immediately after collecting the sample. The pH value of the effluents was measured by pH meter; Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD) was determined by using Azide Modification of Winkler method in mg/l and g/l respectively; Chemical Oxygen Demand (COD) was determined by using COD digestion unit in g/l; Total Solids (TS), Total Dissolved Solids (TDS) by evaporation and weighing method in g /l and Total

Suspended Solids (TSS) was calculated as the difference between the values of the Total Solids and the Total Dissolved Solids⁵. The collected data was analyzed by using statistical measures namely, percentage and one way ANOVA¹.

RESULTS AND DISCUSSION

The results obtained from the study are discussed as follows:

Table 1 reflects the mean of values of physico-chemical characteristics of different effluent samples.

It is clear from data in Table 1 that the mean values of physico-chemical characteristics of dyeing units only, were lower than the mean values of all the parameters of the effluents collected from printing units only and dyeing and printing unit (composite unit).

Table 1: Mean of values of physico-chemical characteristics of different effluent samples

Effluent sample	Physico-chemical characteristics							
	Temperature ($^{\circ}\text{C}$)	pH	Dissolved Oxygen (DO) (mg/l)	Biochemical Oxygen Demand (BOD) (g/l)	Chemical Oxygen Demand (COD) (g/l)	Total Solids (TS) (g/l)	Total Dissolved Solids (TDS) (g/l)	Total Suspended Solids (TSS) (g/l)
Dyeing units	28.2	10.2	2.3	61.7	349.3	1.8	1.3	0.5
Printing units	29.2	10.1	2.6	76.7	349.3	6.4	5.4	1.0
Dyeing and Printing units (Composite units)	28.8	10.7	2.8	63.3	366.7	4.3	2.7	1.6

The higher mean values of the physico-chemical characteristics of effluent collected from printing units only and from dyeing and printing unit (composite unit) indicated higher pollution load of these units. The higher pollution load may be due to the presence of thickening agent and dye content in the effluent stream. The thickening agent used was *arrawrot*, being cellulosic in nature it might had resulted in higher BOD, TS and TDS of the effluent stream. Besides this the use of salt and its release in effluent added towards

higher TDS. The use of caustic soda (NaOH) might have resulted in higher pH of the effluent streams at Jaspur.

The physico-chemical characteristics of collected effluents were beyond the permissible limits in term of all the parameters when compared with the standards given by CPCB, and shown in Table 2. This indicates that the dyeing and printing units located at Jaspur are causing high pollution in the region. The polluting streams of the waste are being released in the community disposal system

consisting of open drains that aggravates the pollution problems owing to the direct contact of the population with the drain silt that was removed and left at the edge of the drain. The pollution load of the units did not include pollution due to washing which was carried at bank of water body in the region. Thus, pollution due the dyeing and printing units at Jaspur was affecting both the residential area as well as the farm lands which were being

irrigated with the polluted water of the local water bodies in the area. It is imperative to segregate the polluted streams at both the places for their treatment to reduce the pollution load resulting from these unit's activities at Jaspur.

Khopkar². had also stated that the textile waste is usually coloured, alkaline with high BOD and suspended solids.

Table 2: Physico-Chemical parameters of 100% untreated textile effluent

Sl. No.	Parameters	CPCB (1995)
1.	Colour	Colourless
2.	Odour	Odourless
3.	pH	5.5-9.0
5.	Total Suspended Solids(mg/l)	100
6.	Total Dissolved Solids (mg/l)	2100
7.	Biochemical Oxygen Demand (mg/l)	30
8.	Chemical Oxygen Demand (mg/l)	250

(Source: Indian Streams Research Journal)

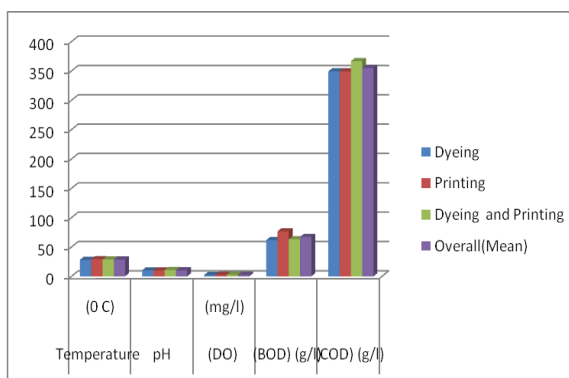


Fig. 1: Non-significant relationship between the physico-chemical characteristics of effluents

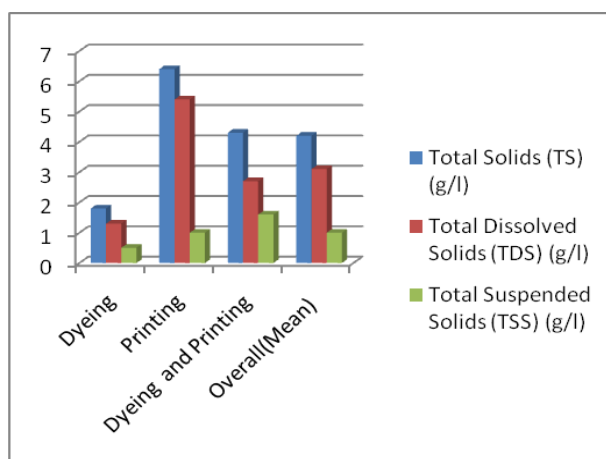


Fig. 2: Significant relationship between the physico-chemical characteristics of effluents

Figure 1 reflects the non-significant relationship between the physico-chemical characteristics of effluents collected from selected units of Jaspur area and Figure 2 reflects the significant relationship between the physico-chemical characteristics of effluent collected from selected units of Jaspur area.

One-way ANOVA was applied to the mean values of physico-chemical characteristics of the effluent samples to compare the nature of the effluents collected from three different types of units. No significant differences were found in temperature, pH, DO, BOD and COD of the effluents collected from different types of units but significant differences were found in the case of TS, TDS and TSS of the effluents collected from three different types of units.

CONCLUSION

Colour makes the textiles more beautiful and helps in making their sale more effective resulting in high revenue generation. It also shows the emotions of the person automatically through his style of wearing clothes. Dyeing and printing add colour to textile materials. The overall mean of the physico-chemical characteristics of effluents collected from different types of units were beyond the permissible limits in term of all the parameters when compared with the standards given by CPCB, indicating highly polluting nature of the dyeing and printing units located at Jaspur, Uttarakhand. The following recommendations can be helpful in making these process more productive both environmentally and economically are as follows:

➤The awareness about the practices that degrade the surroundings as well as the resources is more necessary among them than the knowledge of improving infrastructural design of units, method of colour application on textiles, adoption of

the safe equipments, the design used in making of product and its value addition.

- The efforts to optimize the process require them to have the knowledge of the resources used and their source, function/purpose and available possible alternatives. To get above information there is need to create a detailed profile on these topics.
- The extensive research is required to find out the impacts of polluting streams of the units over the health of local residents, disposal channels, water bodies and agricultural land in Jaspur and nearby areas.

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