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Wet Processing of Textiles: An Eco Friendly Approach

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Abstract—*The textile industry consumes large quantities of water, dyes and chemicals besides utilising significant quantities of coal, natural gas and electricity as sources of energy. Further, textile wet processes like desizing, bleaching, mercerizing, dyeing and printing are using toxic dyes and chemicals which come in contact with the skin and cause a direct damage to the health in the form of skin cancer and allergies etc. It is important to adopt waste minimisation, which basically means to avoid the formation of waste at source i.e minimise the use of resources like water and substances that are exhausting. Wherever possible, to reuse and recycle the wastes those are generated. Waste minimisation is possible by increasing the process efficiency, reducing the amount of raw material needed for production and using clean technology. Further, care has to be taken to either eliminate or optimize the use of unsafe chemicals/auxiliaries/dyestuffs during the wet processing of textiles.*

Keywords*: (Waste Minimisation, Textile Industry, Wet Processing, Ecofriendly)*

1. INTRODUCTION

The textile industry is the single largest industry in the country. It fully meets the growing needs of the increasing population for one of the basic necessities of life i.e. clothing. Being agro- base, the textile industry enjoys strong links with a vast army of farmers, rural artisans, craftsman and numerous allied trades and industry personnel. Most of the raw materials, items of capital goods, skilled workers, technicians and supervisory personnel needed by the textile industry are available within the country (Saxena et al., 1998). The textile industry offers immense scope for employment. It provides direct employment to about 35 million people and indirect employment to millions engaged in cotton growing and ginning, manufacturing man-made fibers / yarns, textile machinery, spares, dyes, chemicals, trade, transport, banking, insurance and so on. As far as exports are concerned, India commands a worldwide reputation as a reliable supplier, and the industry has a huge potential for earning foreign exchange (Ministry of Textiles, 2010).

Though the Indian textile industry has its importance in the national economy, but at the same time it is responsible for disastrous environmental impacts (Bunning et al., 1993). A textile-processing unit consumes between 10-70 m^3 of water and 350-500 kg of dyes/chemicals per ton of fabric processed. Only about 15-20% of input is utilized in making the finished product and the rest goes waste. Not only these waste streams contain toxic constitutes, but they also represent valuable resources loss (Saxena et al., 1998). The problem is, therefore, not only associated with the toxicity of metal ions released but also the toxic effluent flowing through the sewerage. Such a large quantity of effluent from a dyeing unit and its extent of pollution, it is bound to deteriorate the aquatic life (Gupta, 1998).

The human health impacts are also caused due to the release of the various pollutants. A number of diseases like cholera, typhoid, hepatitis, gastroenteritis, bladder cancer, others respiratory and skin diseases are caused among workers (ITUT, 2003). Most of the dyes remain in and on the finished products and come into direct contact with the skin of the wearer and it has been found that certain dye on absorption by the skin releases carcinogenic amines (Chakraborty et al., 2001). Therefore, it can be ascertained that textile processing does have the capacity to pollute the environment and causes harmful impacts to the human life. Thus, there is a need to use the process technologies that are energy efficient, which produces less waste, require fewer resources such as chemicals, water and lastly they should be easy to handle.

Janakiraman (1998) discussed that waste minimisation is the preventative approach, the cost of the waste treatment system may get substantially reduced since wastes are inherently reduced in this approach, and the overall resource utilisation factor improves. Wet processing is a water intensive industry. The practice of water conservation can be achieved by good housekeeping and rationalising the use of water by the reuse of the cooling water, counter current washings, recovery of heat from steam condensate, heat exchangers, recycle of waste streams for toilets etc., are examples of resource recovery and give a substantial saving in the long term. The ‘clean technology’ may be defined as the manufacturing process or technique, which helps in conserving the resources and reduces waste, energy etc.

Lal (2000) stated that clean technologies help in decreasing waste liability, waste collection, handling and treatment cost as well as it recovers value of waste. Lal (1998) reviewed that waste minimisation basically means to avoid the formation of waste at source and where possible, to reuse and recycle the wastes that are generated. Waste minimisation is possible by:

- Increase in process efficiency
- Reducing the amount of raw material needed for production
- Using clean technology

2. METHODOLOGY

Research was conducted in and around Delhi (Delhi/NCR). In total, 51 units were studied for the present research which included 27 cotton processing units (processing only cotton) and 24 cotton & manmade (processing both). An interview schedule was prepared to study the types of raw materials used in the textile wet processing units, responsible for causing pollution.

3. RESULTS AND DISCUSSION

Changes to input materials can reduce or eliminate unwanted materials that enter the production process. Purifying or substituting input materials can avoid generating particular industrial wastes within the production processes. It is important for the industry to ensure before use that chemicals and dyes do not contain ingredients that may cause water or air pollution problems, increased risk to workers, or increased hazardous waste. Hence, units were asked about the kind of raw materials (chemicals and dyes) being used for processing and the results for the same is tabulated in Table 1. An attempt was made to know about the gray fabric used in the units, having less oil and other impurities as it reduces the COD (Chemical Oxygen Demand) load. Data revealed that (68.63%) units were ensuring that whatever gray fabric they were using for processing, was having less oil and other impurities.

Chlorine bleaching is regarded, as highly toxic and therefore, its use in processing is prohibited. Bleaching agent containing chlorine or chlorine compounds should be replaced with hydrogen peroxide bleaching (NITRA, 1996). It was found that (79.17%) cotton & manmade processing units were doing chorine bleaching, while on the other hand, it was (70.37%) in cotton processing units. Only (3.70%) of the cotton processing units and (8.33%) of the Cotton & man-made processing units were doing peroxide bleaching. Nineteen percent (19.61%) of the total units were doing chlorine as well as peroxide bleaching.

Heavy metals are also restricted as it has toxic effect to human skin and aquatic life (NITRA, 1996). A report has shown that accumulation of heavy metals in body tissues and binding to cellular enzymes disrupts the functioning of cells resulting into abnormal growth of cells leading to tumors or cancer (Pitchai, 2001). Majority of the units (92.16%) were not using the dyes and chemicals that contain heavy metals.

According to Bradbury et al. (2000), replacement of acetic acid by formic acid for neutralization of fabric after scouring, mercerising, bleaching, and reduction processes is effective, economical, and environment-friendly. Acetic acid should be replaced by formic acid as it reduces the COD load in the effluent (Saxena et al., 1998). Contrary to this, it was observed that in the present study (92.59%) of the cotton processing units and (95.83%) of the cotton & man-made processing units were using acetic acid in dyeing.

Formaldehyde is a skin irritant and sensitiser. The presence of formaldehyde in fabrics and garments above the tolerance limit is considered as highly objectionable and it is restricted by law in some countries and by voluntary specifications of textile producers in other countries (NITRA, 1996). Only thirty percent (30%) of the cotton processing units and (41.67%) cotton & man made processing units were ensuring that chemicals used by them, were free from formaldehyde**.**

Data also revealed that (86.27%) of the total units were doing final washing with chlorine free water while (13.73%) did it with chlorine water. As discussed before chlorine is prohibited.

4. CONCLUSIONS

Above discussion highlighted that substituting input materials can avoid generating particular industrial wastes within the production processes. It is important for the industry to ensure before use that chemicals and dyes do not contain ingredients that may cause water or air pollution problems, increased risk to workers, or increased hazardous waste. Therefore, it is important of textile wet processing units to adopt ecofriendly pollution preventive approach for their sustainability.

Table 1: Input Materials used by the processing units

S.NO	INPUT MATERIAL USED	COTTON UNITS (C) N = 27	COTTON & MANMADE UNITS (CM) N = 24	TOTAL UNITS N = 51
1.	**Grey fabric used having less oil & other impurities** Yes No	20 (74.07) 7 (25.93)	15 (62.50) 9 (37.50)	35 (68.63) 16 (31.37)
3.	**Type of bleaching used** Chlorine Bleaching Peroxide bleaching Both	19 (70.37) 1 (3.70) 7 (25.93)	19 (79.17) 2 (8.33) 3 (12.50)	38 (74.51) 3 (5.88) 10 (19.61)
4.	**Use of heavy metal containing dyes and chemicals** Yes No	2 (7.41) 25 (92.59)	2 (8.33) 22 (91.67)	4 (7.84) 47 (92.16)

S.NO	INPUT MATERIAL USED	COTTON UNITS (C) N = 27	COTTON & MANMADE UNITS (CM) N = 24	TOTAL UNITS N = 51
5.	**Acid used in dyeing**			
	Acetic acid	25 (92.59)	23 (95.83)	48 (94.12)
	Formic Acid	2 (7.41)	1 (4.17)	3 (5.88)
6.	**Ensuring that chemicals used free from formaldehyde**			
	Yes	8 (29.63)	10 (41.67)	18 (35.29)
	No	19 (70.37)	14 (58.33)	33 (64.71)
7.	**Final washing done with**			
	Chlorine water	4 (14.81)	3 (12.50)	7 (13.73)
	Chlorine free water	23 (85.19)	21 (87.50)	44 (86.27)

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