ISSN: 2395-7639

International Journal of Multidisciplinary Research in Science, Engineering, Technology & Management (IJMRSETM)

(A Monthly, Peer Reviewed Online Journal)

Visit: www.ijmrsetm.com

Volume 3, Issue 9, September 2016

Impact of Textile Waste on Human Health in Rajasthan: A Critical Review

Dr. Pratibha Pareek

Lecturer, Dept. of Zoology, S.P.S.B. Government College, Shahpura, Bhilwara, Rajasthan, India

ABSTRACT: Clothing is among the basic needs of human being, which derives from two sources, ancient handicrafts and modern scientific invention. In India, textile sector is one of the oldest manufacturing sectors of Indian economy, dating back to several centuries and famous for its product across the world. The textile industry is one of the key contributors to the economy of Rajasthan. After agriculture, this sector provides highest employment opportunities. The textile industry also has potential to provide large scale employment in the state, it has high percentage of entrepreneurs along with skilled, semiskilled, and unskilled workers. With a strong base of textile industry in Rajasthan, there is a vast potential for its development in the state. Rajasthan's textile industry comprises wide range of units from small-scale units of spinning, weaving, block printing, screen printing, dye houses, apparel-making enterprises to large scale processing units. Abundant availability of raw material, trained labour and a network of backward and forward linkages make Rajasthan an attractive hub for this sector. Rajasthan has a leading position in spinning of polyester, viscose yarn & synthetic suiting and processing. Textile cluster of Rajasthan are mainly present in five districts i.e., Jaipur, Bhilwara, Pali, Jodhpur and Barmer, around 2500 industries are presently operating in these clusters. Jaipur is a well-known centre for garment manufacturing, Sanganer town of district Jaipur is famous worldwide for its dyeing and printing industries. Bhilwara has specially emerged as a leading center for processing of synthetic fabric, specially suiting of mixed fiber. Pali has evolved as one of the most important production centers in the textile dyeing and finishing sector, it is also known for production and export of cotton, rubia and polyester. Jodhpur textile cluster houses the biggest block of textile dyeing and printing industries. Rajasthan is also famous for printing & dyeing of low cost, low weight fabric. Jodhpur, Pali, Sanganer, Balotra, Jasol and Bituja are the major clusters of small scale industries engaged in printing and dyeing of low cost fabric

KEYWORDS: rajasthan, textile, dyeing, printing, industries, health hazards, textile waste, processing

I. INTRODUCTION

It has been studied that in almost all production stages of the textile industry, there is a form of chemical contamination that is released into the environment; from the moment, the base materials were planted and produced, to spinning, weaving, dyeing, and finally transporting the finished products, each of these stages leaves a potentially devastating ecological footprint in our environment. Textile effluent/emission varies from day to day and even hour to hour due to the batchwise nature of the textile process. Textile industries generate all four kinds of waste i.e., Liquid effluent, air emissions, solid wastes and hazardous wastes. Effluents generated from the sector are of utmost concern because of its high volume and pollution potential. The composition, quantity [1] and nature of waste generated is determined by the processes involved, fiber type and chemicals used, operating practices etc. The strong color of textile wastes is the hardest component to treat. The important pollutants present in effluent are colour, biochemical oxygen demand (BOD), chemical oxygen demand (COD), toxic heavy metals, residual chlorine, formaldehyde (HCHO), PBDEs, phthalates, organochlorines, dissolved solids and non-biodegradable organics.

Sludge generated during treatment of effluent from textile industries is categorized as Hazardous waste as per Schedule - I Category - 35.3 of HWM Rules. The waste generated can be utilized as energy resource in Thermic Fluid Heater/Boiler as per standard operating procedure issued by CPCB regarding utilization of ETP sludge from textile industries to use as a supplementary fuel along with Coal in Thermic Fluid Heater (TFH)/Boiler. The waste can also be used in co-processing in cement kilns. When waste generated is not utilized as resource then it gets disposed in authorized TSDFs (Treatment, Storage & Disposal Facilities) in accordance with authorization conditions. Other sources of hazardous waste source in textile industry are used oil, empty containers of dyes and other harmful chemicals[2]

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Noise pollution is one of the major issues apart from air and water pollution due to textile units. Prolonged exposure to high noise causes psychological effects and physical damage includes loss in concentration which finally affects the workers and people living nearby. There are different processes in the textile chain that can produce noise pollution. The dry processes produce more noise than the wet processes. Though machinery manufacturers are taking continuous efforts to reduce the noise level but the measures are not adequate

The solid waste generated by textiles industry is further classified in three types of wastes. Pre-consumer textiles waste: It includes scraps, damaged or defective material samples, fabric selvages and leftover fabric from the cutting process. Post-consumer textile waste: These are household articles or garments that the owner does not require any more and discards. Industrial textile waste: It is generated from industrial applications and includes conveyor belts, filters, geo-textiles and wiping rags.

Air pollution caused by the textile industry is also a major cause of concern. Boilers, thermic fluid heaters, and diesel generators are the main sources of air pollution in textile units. The pollutants generated include dust and lint, solvent mists, odour and boiler exhausts containing Suspended Particulate Matter (SPM), sulphur dioxide gas, oxides of nitrogen, etc

The waste water generated from the textile industry is required to be treated by a suitable mechanism to remove harmful pollutants present in textile effluent. Typically the conventional wastewater treatment system in textile processing industries includes screen chamber, oil & grease trap, equalization, coagulation and flocculation, followed by settling in primary treatment systems and biological treatment followed by clarifiers in secondary treatment system. Although COD/BOD reductions are achieved through this conventional treatment system but objectionable colour, high TDS levels of effluents remain and effluents are not fit to be discharged into surface water or on land. Hence, tertiary treatment systems are becoming necessary for achieving prescribed standards for disposal. Pressure Sand Filter (PSF) and Activated Carbon Filter (ACF) are typically used for polishing. Membrane based processes such as Reverse Osmosis (R.O), ultra filtration and nanofiltration are being widely used as end of the treatment for removal of organics and dissolved salts.[3] Ozonation is also one of the tertiary treatment options which is mainly used for the oxidation of organic and inorganic, deodorization, and decolorization in textile industries. Typically evaporation process is used for evaporation of high concentrated rejects of R.O, ultra-filtration, nano filtration etc, where TDS concentration is high. Similarly, Multiple Effect Evaporators, Mechanical Vapor Recompression, Direct Contact Evaporation are various methods used for evaporation of effluents or rejects generated from the membrane processes.

For benefits of Small Scale Textile units located in textile clusters of State, CETPs have been installed for treating their waste water excluding Bhilwara textile clusters. Whereas individual units located in isolated areas need to install their own effluent treatment arrangements. State Board is allowing units to have their own ETP only when the proposed treatment is ZLD based to achieve zero liquid discharge and to use 100% recycle treated waste water generated for industrial purposes. Also, they shall not discharge the effluent neither inside nor outside their premises. CETPs are also adopting zero liquid discharge status which will benefit both the industries and the environment as the water requirement of the units can be met with the recycled water.[4]

II. DISCUSSION

Under the provisions of the Water (Prevention and Control of Pollution) Act, 1974, every industry has to provide adequate treatment of its effluents before disposal. The Small Scale Industries (SSIs) which are a major contributor to the total pollution, find it uneconomical to install dedicated pollution control equipment due to their limited size and scale of operations and therefore the concept of Common Effluent Treatment Plants (CETPs) is suitable for them. CETPs help in achieving end-of-pipe treatment of combined wastewater of the SSIs at lower unit cost and also facilitate better monitoring by the State Pollution Control Board (SPCB). Number of initiatives have been taken by State Govt. and Central Govt. to provide financial assistance to SSIs to establish and upgrade the existing CETPs.

Textile industries also discharge with wastewater an array of hazardous organic and inorganic compounds/substances such as aromatic amines, heavy metals, ammonia, alkali salts, and toxic solids, as well as large amount of pigments and chlorine, a known carcinogen, which causes serious environmental and health problems. The untreated dyes cause chemical and biological changes in aquatic resources, which threaten fish

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and other aquatic species. Textile mills and industries discharge millions of gallons of colorful toxic hazardous wastes containing organic chemicals into the environment.[5]

Colorants and chemicals used in the textile coloration process are required to meet the fashion demands; however these introduced serious environmental hazards that are mainly resulted in effluent loading, containing the toxic, carcinogenic, and mutagenic substances, to natural environment. Textile dyeing process and the rinsing of dyed fabric utilize a variety of substances including dyes/ pigment, fixing agent, surfactants, leveling agent, mordant, salts etc. However, all these substances are not fully consumed in the process, and a residual content remains in the dyeing effluent. This review observes the challenges to environment posed by the dyes and chemicals present in spent dye bath, progress in possible remedies in dyeing wastewater treatment including the nanotechnology; and particularly discusses the studies based on the dyeing effluent samples collected from the local textile processing industries in Rajasthan. There are obvious case studies made in different regions, using the process wastewater from the local textile dyeing and processing industries, confirming the need for research and innovation to replace or control the hazardous dyes and chemicals in conventional dyeing process and making the resulting effluent more environment- friendly. Moreover, the cleaner production practices and environmental standards are introduced in improving the textile dyeing process. Selection of dyes and chemicals, use of best available techniques, and wastewater treatment technologies can significantly improve the textile dyeing to become an environment- friendly process. Workers and people living close to factories often bear the brunt of the pollution. Gastrointestinal problems and skin diseases are among the common ailments that he attributes directly to textile pollution.

The textile dyeing industries produce a huge amount of effluents, dirt slurry and solid waste ingredients every day. In textile dyeing effluents, heavy metals such as iron, lead, nickel, copper, zinc, and chromium are present in trace amounts. The synthetic azo dyes are carcinogenic and toxic posturing a severe health risk to human health. These dyeing effluents are being quitted into the adjacent waterway, farming fields, irrigation channels, exterior water and these lastly arrive into the water bodies like river, sea, etc. Textile and dye industrial effluents may cause variation of the physical, chemical, and biological nature of aquatic atmosphere by the nonstop alteration in turbidity, odor, noise, temperature, pH, etc. that is injurious to community health, livestock, wildlife, fish and biodiversity. The presence of dyes in surface and subsurface water is making them not only appealingly intolerable but also sources many water-borne diseases, viz. mucous membrane, dermatitis, perforation of the nasal septum and severe irritation of respiratory tract. Adulteration to this aquatic system carries severe hazard to the inclusive epidemic and socio-economic outline inside.[6]

The textile dyeing effluent suits the source of pollution of the exterior water. Groundwater pollution deliberated to be the most significant source of drinking water. It is noted that groundwater is unpolluted still now . Mills release a huge volume of textile dyeing effluent as unsafe toxic waste, full of color and organic chemicals from dyeing and finishing salts. Presence of sulfur, naphthol, vat dyes, heavy metals, and certain auxiliary chemicals all jointly make the effluent extremely toxic. The soil is the natural body made of mineral and organic constituents. The soil is the basis for agriculture. Textile effluent pollutes the soil. When this effluent is permitted to run in the fields, it obstructs the pores of the soil causing in loss of soil yield. The consistency of soil is toughened and permeation of roots is prohibited. Now a day's effluent from textile dyeing industries is unsafe for soil

III. RESULTS

The application of dyestuffs and pigments in textile and dyeing industries may cause a number of antagonistic effects on health. Many different groups of chemical materials are used in the textiles sector, comprising optical brighteners dyes, heavy metals, crease-resistance agents, antimicrobic agents, solvents, pesticides and flame retardants .About 40 % of globally used colorants contain organically bound chlorine, a known carcinogen .The usual functioning of cells is disturbed and this, in turn, may cause an alteration in the physiology and biochemical mechanisms of animals are resulting in the injury of important function like respiration, osmoregulation, reproduction, and even mortality due to the toxic nature of the textile dyeing effluent. Textile materials can cause allergic reactions. It was found that workers acquired dermatitis, asthma, nasal problems and rhinitis after prolonged exposure to reactive dyes. The people are very much upset due to huge ingesting of contaminated wastewater [7]. Synthetic reactive dyes are health hazards and cause respiratory issues due to the inhalation of dye particles.They also affect the immune system and cause symptoms including itching, watery eyes, allergic reaction, sneezing, coughing, and wheezing, leading to illnesses such as asthma,

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dermatitis, and respiratory diseases. Some trace metals found in dyes such as Cr, As, Cu and Zn cause several health problems, including hemorrhage, skin ulceration, nausea, and severe skin irritation.Synthetic dyes are non-biodegradable and carcinogenic and pose a major threat to health and the environment. People living near rivers turning into different colors have reported health problems due to polluted water and food grown in nearby fields.

The mutogenicity of azo dyes and their potential to cause some types of cancer have been reported. Scientists have observed that painters had developed bladder cancer after long-time exposure to azo dyes. These compounds are mainly metabolized at the intestinal wall and in the liver, producing free aromatic amines that are potentially carcinogenic and mutagenic. Allergic contact dermatitis due to clothing is one of the most unfortunate dermatologic conditions. The affected individuals are often almost erythrodermic and experience a persistent intractable pruritus, which can be debilitating. Since 1926, formaldehyde-containing resins have been used in the clothing industry to make wrinkleresistant fabrics. These resins employ methylol reactive groups to crosslink cellulose fibers in cotton, linen, and rayon (cellulose-based natural polymer) garments. Formaldehyde-related contact allergy to clothing is still a concern today, despite efforts made in the textile industry in the US to switch to the resins imparting fabrics with lower amounts of free formaldehyde . The industry now claims that the average level of free formaldehyde, contained in the textiles made in the US, is approximately 100–200 ppm [8]. Allergic contact dermatitis due to formaldehyde present in textiles was commonly reported in the literature in the 1950s and 1960s. In recent years, the textile industry has attempted to lower the amount of free formaldehyde in wearing apparel and bedding fabrics, and the reports of contact allergy to textiles, caused by formaldehyde have become less common .

One of the major causes of concern is occupational dermatoses. Most of the time it was reported by workers working in Jaipur dyeing industry those other vital organs such as the eyes, lungs, liver and urinary bladder are also involved. The reason for occupational dermatoses among the workers of cloth dyeing industry in Jaipur is the constant immersion of hands for prolonged periods in water. Pressure, friction, sweating and also plays an important role for the development of dermatoses among the workers. It was observed that the workers in this industry are also exposed to various types of respiratory symptoms like asthma, chronic bronchitis, cough and chest pain. The presence of organic dyes produced chest tightness, chest pain, angina, that kept the workers away from the work most of the time. Organic dyes exposure produces symptoms like chest tightness mostly on resuming work after an absence, altered pulmonary functions findings, etc. The process of making clothes involves many stages and the whole process is labor intensive which can be broadly divided into printing and dyeing of fabrics. The fabric is stretched along a long table and the selected design is printed using a screen which has the selected motif engraved in it during screen printing. However, this process exposes the workers to many types of ergonomic disorders that are mostly overlooked by the owners of the units and the workers who are engaged in this profession. The dye is applied on the screen at regular intervals without using any type of personnel protective equipment by the workers that aggravate the problems of the workers involved in the process. Depending upon the design requirements wax is melted on fabrics using either a block or a brush in batik printing. In the dyeing process, thick rope is used first and is dyed first and then rinsed in water and later sundried to complete the process.[9] The process of tying and dyeing is a manual procedure that directly exposes various workers of cloth dyeing industry of Jaipur to various dyes and chemicals used for bleaching, printing and finishing. The most common skin diseases, such as allergic contact dermatitis, irritant dermatitis and inflammation of mucous membranes, result from contact with dyes and chemicals, particularly acids, alkalies, oxidizing and reducing agents, detergents and solvents. In the present investigation, the prevalence of contact dermatitis in the 'tie and dye' industries of Jaipur has been reported by the workers was found to be very high as compared to other studies. It was observed that all the family members including the children participated in the 'tie and dye' work that is done manually in the courtyard of small residential houses, with poor ventilation, light and working conditions using wood as a fuel. The solution for dyeing is prepared in one corner of the house and washing and rinsing is done in another. The drainage system is very poor, open and highly unhygienic in all the units that were under investigation. The study revealed that dye workers suffered from ache in various parts of the body, especially in lower back, knees and upper extremities due to kneel, squatting and awkward working postures for longer periods of time. Severe discomforts or pain in the workers is due to heavy spinal loading and repetitive movement of the body parts over an extended period. The feeling of discomfort (pain) in different parts of the body among the workers may be due to their prolonged working hours and repetitiveness of the work without sufficient rest, which may lead to severe musculoskeletal disorders.[10]

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IV. CONCLUSIONS

Although all the workers strongly believe that there should be safe methods of to handle and dispose contaminated packaging in an ecofriendly manner, only 20% of the workers had been instructed on safe methods of handling dyes. The rest of the workers did not receive any instructions on handling of dyes, because in every unit only few people had been identified to prepare the dye solution. The different methods are utilized by the workers of cloth dyeing industry to remove the stains due to dyes on the hands and legs depend on the availability, ease of access, perception of workers for stain removal. Workers engaged in dyeing mostly used bleaching powder to remove irritants while dish washing powder and soap was used by workers engaged in screen printing, and water was used by hand printers and batik printers. This study clearly indicated that although workers had knowledge regarding the workrelated hazards irrespective of the nature of the occupation they are engaged in, their attitudinal approach toward the betterment of the work environment is positive. Making workers aware of the occupational hazards and motivating them to use PPE while at work is the need of the hour. The workers in cloth dyeing industry of Rajasthan are exposed to different types of health hazards due to poor working conditions and lack of awareness among working community. There must be established policies binding the owners of cloth dyeing industry to keep conditions favorable for weaving. Most diseases and health problems found in carpet units can be avoided with proper precautions and care. Some protective equipment must be provided, e.g., face masks and first-aid facilities, to protect workers from the adverse effects environment. The owners, with the co-operation of the government, must also provide health insurance.[11]

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