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Sanganer Textile and Dye Industries Causing Serious Environmental Pollution

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ABSTRACT

Sanganer town, district Jaipur (Rajasthan, India), is famous worldwide for its dyeing and printing industries. There are about 400 industries involved in textile printing processes, which discharge effluents into nearby ponds and drains, without any treatment. These effluents contain highly toxic dyes, bleaching agents, salts, acids, and alkalis. Heavy metals like cadmium, copper, zinc, chromium, and iron are also found in the dye effluents. Textile workers are exposed to such waters with no control over the length and frequency of exposure. Further, as the untreated effluents are discharged into the environment they can cause severe contamination of surface and underground water. Dyeing and textile printing industries of Sanganer houses about 400 small scales and one large scale industry [1]. These industries use a variety of chemicals and azo dyes (direct, reactive, rapid, mordant and premetalised etc.) during processing and finishing of raw materials. The workers in those industries are exposed to such dyes with no control over the length and frequency of exposure. Further, a huge volume of mostly untreated textile dye wastewater (10,000 - 15,000 Kl/day) is released into surface waters of Amani Shah drainage or through the drainage systems, seeps into the groundwater and adjoining water bodies flowing through Sanaganer. The untreated waste water is discharged directly into the drains that connect the industry to the main drainage network through the nullas in the town. The effluents disposed in open drains are directly used for crops cultivation which affects the nearby agricultural land also. The study deals with the collection of effluent from one of the large scale printing and dyeing industry in Sanganer town and physicochemical characterization of these samples in order to find out the physio-chemical load put in by the effluent on the wastewater stream. Environmental pollution caused by such textile effluents results in adverse effects on flora, fauna, and the general health of not only the textile workers, but also the residents of Sanganer town. Therefore, to assess the possible genotoxic health risk and environmental genotoxicity due to the textile industry effluents, this study was carried out using the Ames Salmonella/microsome mutagenicity assay. The results clearly indicate that the effluents and the surface water of Amani Shah drainage have high mutagenic activity. Further, the drainage water and the dry bed of the drainage (during summer months) are not fit for agricultural or other recreational purposes. Wastewater and groundwater samples of Sanganer were studied to find out the pollution load of wastewater generated from dyeing and printing units and its impact on the quality of domestic wastewater of the Amanishah Nallah and groundwater. The wastewater of these units was found to have high concentrations of sodium, chloride, and sulfate. It has remarkable concentrations of copper, chromium, and iron with low chemical oxygen demand and nearly 7-fold biochemical oxygen demand. The wastewater of these units, discharged on land without any treatment, comes into the Amanishah Nallah through small watercourses. The quality of the domestic wastewater of Nallah deteriorates with the mixing of wastewater from these units. Maximum concentrations of physicochemical parameters were found at the Sanganer Road bridge sampling point. Eleven groundwater samples, collected from various locations of Sanganer, were found polluted due to percolation of wastewater into the ground. Copper and chromium were recorded from some groundwater sources while iron was recorded from almost all sources. Sodium and chloride are the major cation and anion in the groundwater, which is identical to the wastewater of dyeing and printing units.[2]

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INTRODUCTION

Dye production in India is estimated to be around 64,000 tonnes, which is about 6.6% of the world production. There are around 700 varieties of dyes and dye intermediates produced in India, mainly direct dyes, acid dyes, reactive dyes and pigments. Most of these dyes have not been characterized regarding their chemical nature, purity, possible toxicity or their impact on health and the environment. Yet, they are widely used by textile, leather, paint and even the food industry. The textile industry in India alone consumes up to 80% of the total dyestuffs produced. In Rajasthan state particularly, textile mills represent an important economic sector. Sanganer is famous for dyeing and printing of colorful dresses, bed sheets, curtains, dress material and variety of other textiles. Bulk of the textile products of these industries is exported. It is located about 15 km south of Jaipur, the State capital that has a population of more than two million people. The total area of Sanganer is about 635.5 Sq. km out of which, 12.9 Sq. km comprises the urban area. Most of the textile industries of Sanganer are

concentrated in this urban area. There are estimated to be around 500 block and screen printing units in Sanganer. Of all dyes produced across the world, 11% goes out as effluents, 2% from manufacturing and as much as 9% from coloring. The effluents from dyeing and textile industries contain chemicals with intense colors and the release of these effluents to receiving streams may be objectionable for various aesthetic reasons. Besides a number of dyes used by these textile industries are not degradable. Further, these colored dye wastes contain compounds that are difficult to treat biologically due to their resistance against biodegradation. The dye effluents may contain some components or moieties that could be toxic, carcinogenic or mutagenic to aquatic life. Central Pollution Control Board has listed the dye and dye intermediates industry as one of the heavily polluting industries (CPCB, 1990). They are thus, a potent hazard to the natural sources like soil, water, flora, fauna, livestock and human population. Ecological and toxicological problems due to the discharge of wastewaters from Sanganer textile industries in local drainage (Amani Shah Ka Nallah) have been one of the most important water pollution problems in this area. Studies have clearly indicated that the industrial effluents, which are directly discharged into the Amani Shah Ka Nallah, drainage contain highly mutagenic compounds. These compounds are also contaminating the surface and even underground water, thereby, making it unfit for irrigation and drinking [1] High concentrations of heavy metals like Cu, Cd, Zn, Pb, Ni, etc. have also been reported in this area [2] Dyes and heavy metals have been considered to be the possible source of genotoxic activity in dyeing and textile effluents. Several dyes have been investigated and found to be carcinogenic [3] Since large quantities of dyes are used, such pollution due to dyes may occur on a significant scale. Assessment of genotoxicity of dyes is therefore of utmost importance. Most of the dyes, being openly sold in Sanganer markets have no information regarding their chemical nature, purity or possible mutagenicity or toxicity. This study was thus planned to investigate the mutagenic potential of the dyes available in markets of Sanganer.

DISCUSSION

Textile finishing processes (Yarns, fabrics, nonwovens, knits and rugs) such as dyeing and printing. These dyes are reactive, direct, dispersed, indigo, sulphur and vats. Such that their presence in the liquid effluents resulting from the textile washing constitutes a serious risk, in the absence of their purification, for the quality of receiving aquatic environments.[4] Indeed, the presence of these dyes and pigments can cause a significant alteration in the ecological conditions of the aquatic fauna and flora, because of the lack of their biodegradability. This has a negative impact on the equilibrium of the aquatic environment by causing serious dangers, namely the obvious dangers (Eutrophication, under-oxygenation, color, turbidity and odor), the long-term dangers (Persistence, bioaccumulation of carcinogenic aromatic products and formation of by-products of chlorination), mutagenicity and carcinogenicity. The textile finishing dyes are organic compounds capable of absorbing the light radiation in the visible range of the spectrum and of reflecting or diffusing complementary radiation on the one hand, and dyeing a substance in a sustainable manner on the other hand [5]. They consist of chromophoric groups, auxochromes and conjugated aromatic structures. These groups have specific independent properties, i.e., the color and the ability to be fixed on such a textile support, during dyeing and/or printing [6]. Chromophoric groups are unsaturated groups consisting of atoms or groups of atoms, in which the arrangement of successive single and double bonds resonates with the unstable mesomeric form thus allowing the absorption of light rays gathers the mainchromophoric and auxochromic groups classified by the increasing intensity.

These dye waste waters can produce several dangerous problems, namely aesthetic and health problems such as changes in the quality (color and odor) of water and make it toxic, as they can cause allergies, dermatitis, skin irritations, cancers and mutations in humans [7]. Furthermore, between 60 and 70% of azo dyes are toxic, carcinogenic and are refractory to conventional treatment processes because of their resistance to conventional physicochemical destruction and the absence of their biodegradability [8]. This interrupted the phenomenon of photosynthesis in marine plants by triggering the phenomenon of eutrophication, under the effect of the release of mineral elements such as nitrates, nitrites and phosphates in an uncontrolled manner, and produced the long-term hazards of persistence, bioaccumulation, by products of chlorination, mutagenicity and carcinogenicity [9]. In terms of toxicity, the most toxic synthetic organic dyes are azo dyes and more particularly diazo and cationic dyes [9]. These types of dyes have carcinogenic effects on humans and animals primarily, as the electron-withdrawing character of azo groups generates electronic deficiencies. This makes azo compounds uncomfortable with oxidative catabolism under aerobic environmental conditions.

RESULTS

In the light of this review, we can conclude that synthetic dyes and pigments applied to textile finishing processes are numerous and diverse in terms of chromophore groups (Azo groups, anthraquinone groups, indigoids, xanthenes, phthalocyanines, nitroseds, triphenylmethanes and polymethines) and application techniques (Water-soluble dyes (Acidic, basic, metalliferous, reactive and direct dyes) and water-insoluble dyes (Vat dyes, sulfur dyes and dispersible)). The majority of these dyes are azo (60–70 %) characterized by high chemical stability with respect to chemicals and products due to the combination of azo groups with aromatic rings. The presence of these dyes and its residues in the effluents discharged into aquatic environments, as well as their relative biodegradability, have a negative impact on the environment and more particularly on aquatic ecosystems because of their toxic and carcinogenic effects as they occur. Accumulate throughout the food chain of aquatic fauna, on the one hand and dysfunctional physiological processes of aquatic flora (Plants, diatoms and algae) by disrupting their photosynthesis mechanisms by the lack of circulation of the oxygen and absorption of light in aquatic environments, on the other hand. Besides, these textile dyes must eliminate according to processes, which will be the interest of a future review, of biological, chemical, physical and physicochemical treatment before their evacuation in aquatic environments.[10]

CONCLUSION

Among the textile industries, one of the most extensively used as dyes are synthetic chemicals. Approximately 10,000 different dyes and pigments are used industrially and 0.7 million tonnes of synthetic dyes produced annually, worldwide [11] India's dye industry produces different type

of dyes and pigments. Nearly 7,00,000 tonnes of dyes are produced annually Worldwide [12] Production of dye stuffs and pigments in India is close to 80,000 tonnes. India is the second large exporter of dye stuffs and intermediates after China [13] Azo dyes being the large group of synthetic dyes constitute up to 70% of all known commercial dyes produced [14] Synthetic dyes generally classified in to reactive, acidic, vat, dispersing, direct and sulphur etc. During the dyeing process, approximately 10-15% of the dyes are released in to the wastewaters, causing serious environmental and health hazards [15] Disposal of these dyes into the environment causes serious threat, since they may significantly affect the photosynthetic activity of hydrophtes by reducing light penetration and also toxic to aquatic organisms due to their breakdown products [16] Dyes may also be toxic to some aquatic life due to the presence of aromatics and metals, chlorides etc [16] The textile finishing generates a large amount of waste water containing dyes and represents one of the largest causes of water pollution .Considerable attention has been given in evaluating the capability of microorganisms in decolourizing and degrading the azo dyes. Many studies on the decolourizing capability of microorganisms especially fungi and bacteria have been reported. Various physical and chemical methods have been used for the removal of dyes from wastewater effluent. However, implementation of physical and chemical methods have inherent drawbacks of being economically unfeasible, unable to completely remove the recalcitrant azo dyes and organic metabolites may cause pollution problems and involving complicated procedures .

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