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Environmental pollution is an inevitable consequence of economic development and people's desire to improve their quality of life. With the increasing demand of textile industries in India discharge colored effluents is also increased. These colored effluents give undesirable perspective to the water streams where as some dyes and their metabolites pose toxic, carcinogenic and mutagenic effects. Out of various pollutants contained in industrial wastewaters, dye is considered to be very important from the aesthetic point of view and is stated as visible pollutant. Dyes usually have a synthetic origin and complex aromatic molecular structures, which make them more stable and more difficult to biodegrade and are widely used in textiles, paper, plastic, leather, cosmetics and food industries to color their products. The extensive use of dyes often caused pollution problems in the form of colored wastewater discharged in to environmental water bodies. The synthetic dyes are cheap and offer a very wide vast range of new colors. The synthetic dyes are used in many spheres of life and their applications are continuously growing in various industries like textile, leather, cosmetics, paper, paint and food. Approximately 10,000 different dyes and pigments are used industrially, and over 0.7 million tones of synthetic dyes are produced annually. Tons of different dyestuffs are used per year thus making this industry as a major consumer of synthetic dyes and consequently cause water pollution. The dyes may cause disruption of biogeochemical cycles and irreversible damage to the aquatic environment. Dyes cause aesthetic problems and strongly absorb sunlight thus inhibiting the photosynthetic activity of aquatic plants and severely damage the whole ecosystem. Demand and necessity of synthetic dyes are continuously growing for dye manufacturing and dye utilizing companies all over the world. However, the major consumers of dyes are textile industries.

Wastewater effluent from cloth dyeing industries of Ludhiana used various dyes is one of the major water pollutants to aquatic ecosystem the water bodies also undergo chemical and biological changes thus after the physico chemical properties of water and most of the dyes possess toxicity that is hazardous to aquatic life. Dye effluents may contain toxic organic residues with the major compounds of phenol derivatives,

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aniline derivatives, organic acid and benzene derivatives. The dyes effluents are highly variable from day to day and hour to hour depending on the type and color of dye thus it may also using in between the month & seasons.

Workers in dye industry are exposed to an increasing number of chemicals and occupational hazards. Exposure to different types of dyes causes different types of diseases like skin allergies, respiratory diseases and musculoskeletal disorders among workers. The respiratory diseases may cause dry or productive cough of chronic or non-chronic nature, asthma and other respiratory symptoms among dye workers. Occupational dermatoses in dye industry account for a large number of occupational diseases in dye industry and could even exceed all other industrial diseases put together. Other organs such as the eyes, lungs, liver and urinary bladder may also be involved after chronic exposure. The common factors that predispose to the development of contact dermatitis are existing dermatoses, pressure, friction, sweating and prolonged immersion in water. Various investigations have been done everywhere throughout the world to identify and assess the wellbeing impacts specialists working in the coloring and printing industry. Be that as it may, such investigations are pitiful for Indian urban areas. It is important to safe protect the laborers of printing and coloring enterprises.

In this backdrop, the present book titled *Impact of Textile Dyes on the Public Health and the Environment* is an essential reference source that discusses the management of different types of dyes and provides relevant theoretical frameworks about new dye management technologies for control of water and soil pollution.. This book is ideally designed for environmentalists, policy makers, professionals, researchers, scientists, industrialists and environmental agencies.

This book included 12 chapters from different researchers across the world. These chapters have discussed the world of the dyes, classification, chemistry and applications of chemical substances, impact assessment of textile industries, effect of dyes on environment, effluent generated from dyeing and textile industries, impact of synthetic dyes on human health and environment, chemical & biological treatment of dyes, advanced oxidation processes and removal of dyes by adsorption, applications, perspectives, and regulatory aspects of and use of nanotechnology in detail.

Chapter 1 argues that the textile sector is 14% of total industrial production in India and contributes to about 4% of the gross domestic product and earns about 27% of India's total foreign exchange. Worldwide, up to 10,000 dyes are available and their annual production is above 7×10^5 metric tons, which are being used not only in textile sector but also applied in paper, food and pharmaceutical industries. This chapter also presents a review of literature on the significance of bioremediation technologies over other physicochemical methods for efficient removal of textile dyes from industrial waste effluents to improve the fragile ecosystems in different regions of the world.

A detailed classification of dyes has been discussed along with their chemical class and chemistry in Chapter 2. International, regional, and national classification and labeling systems are already established and tested in practice. These hazardous chemicals can be liquid, solid, gas, aerosol, mists, vapors, semisolid etc. Hazardous chemicals have wide applications e.g. dyes which are used for coloring purpose, pesticides which are used for pest control, fertilizers are essential part of the agriculture system, plastic and plastic waste, e-waste to name a few.

Chapter 3 is mainly focused on toxicology of dyes advocates that colours play a prominent and dominant role in human life. Dominating feature of any product has been found with its colours elevating the market of colouration in different sectors. During manufacturing procedure around 50% of dye stuff gets along with the effluents of the industry leading to release of colourful water. Modification in choice of chemicals is being considered to slow down the toxic effects of existing complexes.

Chapter 4 highlights water quality parameters of Rajasthan State using satellite remote sensing and GIS technology. Water and soil quality indices has been applied to identify and assess the magnitude of contamination due to textile effluents in the surroundings of textile industries. In the resultant indices variability caused due to presence of textile effluents is prominently visible and interpreted with geo-statistical representations. Visible Change in soil and water quality has been observed in surroundings of textile industries all over the Rajasthan state. Significant variations have been observed in Pali, Sanganer, Bhilwara regions due to presence of textile industries. Remote sensing and GIS technologies along with natural resource parameters as utilized in above study can be performed for generating assessment reports for extended area at regional as well as national level and providing backgrounds in formulation of government policies for sustainable development and management of textile industries.

Chapter 5 advocates that the degradation of azo dyes is difficult by using the conventional processes. These complex azo dyes containing $N=N$ bond have found to show carcinogenic evidences on reductive cleavage. Azo dyes have capability to alter physical and chemical properties of soil, causing harm to the water bodies. Dyes are toxic in nature which is lethal for microorganisms present in soil affecting agricultural productivity. The presence of azo dyes in water decreases its water transparency and water gas solubility. This reduces light penetration as water decreases its photosynthesis activity, causing oxygen deficiency and de-regulating the biological cycles of aquatic system.

Chapter 6 emphasis that different kinds of hazardous pollutants generated from the dyeing industries has environmental impact. The implementation of the different technologies has been developed to reduce the pollutant and its effect to sustainable environment. Hence more focus has to be given for manufacturing and application of dyes from renewable natural resources.

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Chapter 7 outlines the background of dye chemistry, the application areas and the impact of dyeing effluents in the environment and on living beings. So it is essential to remove such pollutants from the waste water before its final disposal into water bodies. Photocatalysis is one of the advanced oxidation processes, mainly carried out in the presence of light and suitable photocatalytic materials for the degradation of dyes.

Chapter 8 gives an overview on the health and environmental impact of dyes. The textile industry is one of the important industries which generates a large amount of industrial effluents. Color is the main attraction of any fabric. Manufacture and use of synthetic dyes for fabric dyeing has therefore become a massive industry today. Synthetic dyes have provided a wide range of colorfast, bright hues. However, their toxic nature has become a cause of grave concern to environmentalists. Use of synthetic dyes has an adverse effect on all forms of life. Presence of sulphur, naphthol, vat dyes, nitrates, acetic acid, soaps, enzymes, chromium compounds and heavy metals like copper, arsenic, lead, cadmium, mercury, nickel, and cobalt and certain auxiliary chemicals all collectively make the textile effluent highly toxic.

Chapter 9 discusses about existing processes as well as promising new technologies for textile waste water decolorisation. The waste of dye is predominant amongst all the complex industrial wastewater. This water is dark in color and highly toxic, blocking the sunlight and affecting the ecosystem. Among all the dyes, azo dyes contribute maximum to commercial dyes used widely in textile, plastic, leather, and paper industries as additives. The removal and degradation of azo dyes in an aquatic environment is important because they are highly toxic to aquatic organisms.

Chapter 10 discusses the fundamentals and chemistry and efficiencies of the Fenton process, ozonation, electrochemical oxidation and photocatalysis processes for complete dye removal from wastewater. The reaction mechanisms, performance, and factors affecting efficiency are discussed. Advanced oxidation processes (AOPs) namely the Fenton oxidation, ozonation, electrochemical oxidation and photocatalysis are potential alternative techniques for dye removal from textile effluents. Advanced oxidation involves the generation and subsequent reaction of various radicals and reacting species with the target compounds.

Chapter 11 describes an up-to-date critique of the use of adsorption as a wastewater treatment technique for the removal of dyes. The topics range from the classification of dyes, their occurrence in water and toxicity, various treatment methods, and dye adsorption dynamics onto agricultural wastes and inorganic adsorbents such as clay and metal oxides and adsorption onto microbial biomass under varying operational conditions. The relative performance of the adsorbents under different environmental parameters for dye removal has also been presented. The deductions made and alluded to from various kinetic and adsorption isotherm models are also discussed. The chapter presents the past, present, and suggestions for future considerations in search of non-conventional adsorbents for dye sequestration from aqueous solution.

Chapter 12 provides an overview of the various aspects of nanotechnology to remediate industrial textile dye effluents. Textile industrial effluent often contains the significant amount of synthetic and toxic dyes. Some dyes are water-soluble, dyes such as azo dyes, sulfonated azo dyes, etc. Hazardous effect of dyes result in the formation of tumor, cancer, liver or kidney damage, insomnia, diarrhea, nausea, vomiting, dermatitis, chronic asthma, coughing, headaches and allergies in human and also inhibit growth of bacteria, protozoan, plants, and different animals. A range of wastewater treatment technologies have been proposed which can efficiently reduce toxic dyes to less toxic form such as nanotechnology.

We firmly believe that this book will be quite helpful to all those who are directly and indirectly related with the world of dyes.

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