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Treatment of Textile Dye Wastewater with Bacterial Isolates

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Abstract

The textile industry is one of the oldest and most important manufacturing sectors in the world. It employs approximately 35 million people worldwide and has contributed significantly to the expansion of numerous economies. Despite its obvious significance, the material industry is tragically one of the most deeply polluting businesses. The wet processing sector of the textile industry is responsible for desizing, scouring, bleaching, dyeing, and finishing of textiles. Surfactants, dyes, pigments, alkalis, salts, and water all play important roles in these processes. One third of the world's population does not have access to clean water, and industrial pollution is one of the main causes of this problem. Water is a necessity for human survival, but it is a scarce resource. A typical material plant consumes approximately 1.6 million liters of water per day, with the printing and coloring industries using 24% of this total. In the textile and dyeing industries, approximately 700,000 tonnes of dyes are used annually. Between 10 and 15 percent of those dyes are not fixed and end up in water bodies. Because the colors prevent light from entering through the water, when they are thrown into water bodies, the presence of water and the dependability of amphibian conditions are both affected. The aquatic animals that live there suffer as a result of the decreased oxygen levels in the environment. Untreated textile dye wastewater disposal has emerged as a major cause for concern in many nations due to the dangers it poses to aquatic and human life.

Keywords: Material plant • Textile dye wastewater • Textile effluents

Introduction

Dye removal from textile effluents has been accomplished using a variety of physicochemical, electrochemical, and biological treatment methods, such as adsorption, coagulation-flocculation, membrane technologies, fenton-oxidation, ozonation, and electrolysis. Each of these methods has its own benefits and drawbacks in terms of efficiency, cost-effectiveness, and the production of waste from by products. This may explain why a combination of these approaches is typically used to treat textile dye wastewater in the most efficient manner. In an effort to develop treatment strategies that are less harmful to the environment and more cost-effective, there has been a significant interest in the use of microbial agents for the treatment of dye effluents over the course of the past few years. This is largely due to the fact that biological wastewater treatment methods perform better than conventional methods [1].

Discussion

Algae, yeast, fungi, and bacteria are just a few of the microbial organisms that have been used to treat dye wastewater. For dye wastewater remediation, fungi, algae, and yeast have traditionally been the preferred microbial agents. Bacterial organisms, on the other hand, have attracted more attention because of their longer growth cycles and ineffectiveness at decolorizing dyes. On the other hand, bacterial organisms have the advantage of having shorter growth durations and the capacity to degrade and mineralize dyes. The optimization of bacterial organisms for wastewater treatment has been the subject of several studies. The identification of bacterial strains that can be used to degrade and decolorize dye wastewater and the investigation of their mechanism of action have been the primary goals of some of the studies. Therefore, the primary goals of this review are to: 1) Investigate the biodegradation of the three most widely used dyes in the textile and dyeing industry, azo, anthraquinone, and triphenylmethane dyes, by bacteria in pure or mixed cultures. 2) Distinguish bacterial strains that have been effectively segregated and used to debase these kinds of colors and their system of color expulsion. 3) Talk about the most recent developments in bacterial dye degradation. 4) Talk about the factors that affect how efficiently bacteria biodegrade.

The relevant literature in this article has been reviewed using scholarly scientific databases in relevant fields. A few articles were gotten to and screened bringing about a sum of 156 articles that were considered important, with dispersion by discipline of 7.7% Material Science and Designing, 43.3% Natural Science and The executives, and 43.3% Organic Sciences, and 5.8% Compound Designing and Innovation. There are different types of dyes used in the textile industry. These are most commonly classified according to their: source, chemical structure, and industrial application. The two sources of dyes are: natural and synthetic dyes. Natural textile dyes are obtained from plants, insects and minerals, while synthetic dyes are derived from organic and inorganic compounds, generally prepared from petroleum by-products or earth mineral types of synthetic resources. Synthetic dyes are the most utilised in the textile industry compared to natural textile dyes. Their popularity emanates from their solubility in water, ease of absorbance and very fast colouration compared to natural textile dyes. Natural textile dyes also have numerous other challenges like a low degree of fixation, poor colour fastness, and narrow shade range. However, natural textile dyes may still be utilised for their beneficial functional properties to textiles such as: anti-microbial, anti-bacterial, anti-inflammatory, anti-insect, UV protection and deodorising characteristics [2].

Classification of dyes by chemical structure focuses on the nature of the chromophore grouping; these classes include: triphenylmethane, phthalein, triphrnyl methyl, nitrared, athraqinone, azo, indigo, azine, xathene, nitro, oxazine, phthalocyanine and triarylenethane, azo, anthraquinone, indigo, xanthene, pthalocyanine, nitrated and nitrosated, diphenylmethane, triphenylmethane, azine, xathene, nitro, oxazine, diarylmethane and polymethic dyes. dye structures of some commonly used dyes in the textile dyeing industry. Amongst these dye classes azo, anthraquinone and triphenylmethane dyes are the most widely used. The main challenge with the structure of these dyes is their stability due to their aromatic nature, which makes them difficult to

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degrade. The textile industry is one of the global economic drivers; however, it is also one of the largest consumers of high amounts of chemicals, energy and water. The textile industry uses over 8 000 chemicals, most which are hazardous to the environment and human health [3-5].

Conclusion

The negative environmental impact of the textile industry is mostly as a result of untreated effluent discarded into the water bodies which accounts for 80% of the total industry emission. What further complicates the situation is the presence of non-biodegradable organic compounds from textile dyes in the effluent. According to Yaseen and Scholz textile wastewater consist of dyes, suspended solids, raw materials, inorganic salts and other chemicals. Without proper and effective wastewater treatment processes, the dyes and the other constituents of textile wastewater escape into the environment. The colouring in wastewater is due to incomplete exhaustion of dyes during the dyeing process leading to excess dyestuff being discharged into the environment. In addition to dyes, wastewater also contains other toxic substances such as sulphur, naphthol, nitrates, acetic acid, soaps, chromium compounds, and heavy metals like copper, nickel, arsenic, lead, cadmium, mercury and cobalt, formaldehyde based fixing agents and hydro-carbon based softeners. These pollutants, when washed-off into water bodies, are detrimental to the environment, cause deterioration of the ecological balance and are also hazardous to humans.

Acknowledgement

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Conflict of Interest

None.

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