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A Review on Biodegradation of Dyes by Bacterial Isolates from Effluent Sample.

[a]Chavadhri Umesh, [b]Ankitha Karvi

[a] Research Scholar, Student, [b] Teaching Assistant

Department of Microbiology, Bhagwan Mahavir College of Basic And Applied Science, BHAGWAN MAHAVIR UNIVERSITY, Surat, India -395007

ABSTRACT:

Textile industries play a major role in polluting the environment because these industries release large amounts of dye stuff, chemicals, reactive dyes, synthetic Azo dyes and other polluting waste compounds. The industrial wastewater must be treated according to the environmental regulation until the dye concentration is reduced to an acceptable level in effluent. The World Health Organization (WHO) says that 17-20% of the industrial water pollution is caused by the dying treatment of the textile industries. They also estimate that above 80% of Azo dye can be used for dying purposes in the textile industry of which approximately 10-15% of the textile dyes lost through effluent into the environment without binding to the fibers. Many dyes are carcinogenic and cause bladder cancer in humans as they are made with many chemical textile dyes that also cause allergies such as dermatitis and respiratory disease. The accumulation of dyes slowed the rate of plant growth. The presence of the dye contamination affects the coverage area of dead life and the color of the plant. The Effluent sample was obtained for screening and isolating the dye degrading bacteria , after isolation these parameters such as temperature, pH and inoculums size, FTIR analysis were conducted.

Keywords: Azo dyes, Staphylococcus arlettae, Enterobacter sp. Biodegradation, Crystal violet dye and Textile effluents.

1.Introduction

Textile industry is an economic part of India. Nowadays there are more than 100,000 different synthetic dye pigments available in the market, produced in over 700,000 tones worldwide. Azo dyes are aromatic compounds having one or more (–N-N–) groups; they are the most common and widely used synthetic dyes in commercial applications (Vandevivere et al., 2004). They are xenobiotic compounds that are extremely toxic and refractory to biodegradation processes. The textile sector uses a greater amount of water, with about 90% of it ending up as effluent Textile wastewater contains a diverse range of colours. Major pollutant that is not only obstinate, but it also gives waste a vivid colour. Textile wastewater is improperly disposed of, which leads to a variety of problems. The Major environmental and global issues that have a negative impact on aquatic organisms in aquatic Ecosystems, improper wastewater disposal reduces sunlight penetration, which in turn reduces photosynthetic activity, resulting in acute toxic effects on the aquatic flora/fauna (Muhd Julkapli, Bagheri & Hamid, 2014).

1.1 AZO DYE

Synthetic dyes are generally made by petroleum by-products and earth minerals. Different types of synthetic dyes used in the textile industry are reactive dyes, and azo dyes are the largest group of synthetic aromatic dyes used in the textile industry for dying purposes. Generally azo dye contains one, two, three or more azo linkage: linking phenyl, naphthyl ring usually substituted with some functional group like triazine amine, chloro, hydroxyl, methyl, nitro, and sulfonate. The azo dyes are most commonly used synthetic dye in the textile food lather and also used in some other industries. Synthetic dyes are mostly commonly used in textile dying, paper printing, color photography pharmaceuticals, cosmetics and other industries. This dye can affect aquatic life and also affect humans. All are affected because of insufficient treatment of the waste. Their metabolite is mutagenic or carcinogenic to humans and also causes severe environmental problems worldwide. Textile waste water leads to adverse impacts like chemical oxygen demand (COD) and high oxygen demand (BOD) in aquatic life (H.zoliner 2003).

1.2 Dye removal techniques

Textile dyestuff and wastewater is recalcitrant for the degradation so several physicochemical and biological techniques can be used to remove color from dye contaminated wastewater. Several factors, including dye type, wastewater composition, cost of required chemical, operation cost, handling cost of generated wastewater product determine the technique and economic feasibility of each single technique. In general, each technique has its own limitations.

1.3 Physicochemical method

These methods are not single steps rather a multistage treatment process with long retention time is required. Some physicochemical methods such as flocculation, coagulation are widely used in textile wastewater treatment plants to eliminate organic contamination. In comparison to soluble dye material in the water, the efficacy of coagulation treatment against the insoluble dye material was highlighted. These methods can be used either pretreatment, post treatment, or even in the main treatment system of wastewater treatment. These methods are generally efficient to remove mainly Sulphur dye and disperse dye. Filtration methods such as ultra-filtration, nanofiltration and reverse osmosis have been used for water reuse (Kim et al., 2002). We can also use this method for chemical recovery in textile industries. This method can be used for both filtration and recycling. Some other methods are used like adsorption, precipitation and irradiation. Significant ability of acid dye was showed by adsorption chitin as it comprises amino waste material contain an ample number of adsorbents which have the ability to decolorize the dye as well as colorize, colored organic material that provide color to the media even at low price that Some methods are used but they require more energy and chemicals. Although physic chemical method of wastewater treatment are easy to us but generates a significant amount of chemical sludge, this sludge waste is disposed of in a landfill because of this process cost are increased, Inefficient and sometimes produce hazardous by-product, it also effects environment during degradation process of dyes (Sharma et al., 2009).

1.4 Biological method

Due to cost effectiveness, biological removal methods are widely applicable for the treatment purpose. They are easy to employ with high effectiveness and less sludge production. This is also compatible with the environment (Zodi et al., 2013). Different groups of microorganisms such as bacteria, fungi, yeast, algae are capable of degrading dyes in aerobic conditions. Due to the great number of microorganisms they are appropriate for dye removing activity. Also, compatibility and a short growth cycle are good for the dye removal process. These parameters directly influence the bacterial degradation performance of dye effluents for enhancement of natural biodegradation rate biostimulation and bioaugmentation are used to enhance biodegradation rate by optimization of limited environmental conditions (pears et al., 2003).

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1.5 Fungal biodegradation of dyes

Different fungal species are reported and have been tried for treatment of the waste water discharge from dying industries. The Combination of the aerobic and anaerobic treatment by different microbes has shown promising results for biological degradation of textile dye. Biodegradation coupled with ozonation has been investigated recently for elimination along with dye to minimize pollution load in effluent. Cultures of Various Fungi include penicillium sp. And aspergillus sp. Water extract and various synthetic dyes have been extensively studied for biodegradation (Kanagaraj et al. 2012).

1.6 Bacterial biodegradation of dyes

The main advantage of working with bacteria was that they were essay to culture and grow more quickly as compared to other microbes .The degrading ability of bacteria can essay be enhanced by the molecular genetic manipulation. bacteria are able to catabolize chlorinated and aromatic hydrocarbon based organic pollutants, which can be decomposed by using them as an energy source and have the ability to oxidize the sulfur base textile dyes (Mendes et al., 2015). Different bacterial groups under traditional aerobic anaerobic and under extreme oxygen deficiency conditions cause an azo dye reduction for decolorization. The chemical reaction during the reduction of the azo dyes starts with the breaking of azo bond under anaerobic environment by azoreductase enzyme which resets in a colorless solution of aromatic amines. Gram positive bacterial strain including Bacillus subtilis, Clostridium perfringens, Pseudomonas aeruginosa, Pseudomonas putida were found to decolorize various structurally different textile azo dyes effectively. Similarly gram negative bacterial strain, including Klebsiella pneumonia, Enterococcus sp., and Echerichia coli also exhibit promising decolorizing efficiency on various dyes (Sudha et al., 2014).

1.7 Bioremediation

Bioremediation is microbial clean approach, microbes can assimilate themselves to toxic waste and new resistant strains develop naturally, which can transform various toxic chemical to less harmful forms (Meyer et al., 1981; Zollinger et al., 1987; Bannat et al., 1996; Weber and Adam, 1995; Clake and Anlinker, 1980; Chundgar, 1985; Verma and Mandawar, 2003). The process of bioremediation can be measured by monitoring any of two factors, by measuring the redox potential, together with ph and temperature, oxygen content and concentration of electron acceptor/donor as well as breakdown of the product such as carbon dioxide etc. Biological oxygen demand represents only the organism matter which is capable of degradation/oxidization by microorganism whereas cod represents all the oxidizable matter including organic matter in any particular effluent. In case of color effluents, bioremediation is measured by estimating the decrease in color intensity. Degradation of azo dyes by bacterial strain is usually triggered by azoreductase which involves aerobic reduction or cleavage of the azo bond (Zimmermann et al., 1982). Reduction cleavage of azo bond leading to formation of aromatic amines is the initial reaction during the bacterial metabolism of azo dyes .The resulting metabolites could further be degraded under aerobic or anaerobic condition by a mixed bacterial community (Seshadri et al., 1994), therefore an aerobic anaerobic sequential environment was propose for bacterial degradation or mineralization of azo dyes (Banat et al., 1996).

1.8 CONCLUSION:

The present study concluded that the effluent samples were a good source of dye degrading bacteria. The isolated bacteria had the capacity to degrade textile dyes. Out of them some isolates showed good degradation effects on some textile dyes. At 37ºC some dyes were well decolorized. Also from above observation it was shown that maximum degradation was observed at pH 7 in dyes. From the above result it can be concluded that microbial consortium is very effective in the dye degradation process. The complete degradation of dye could be achieved during study which can be confirmed by FT-IR analysis.

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