Dyes and Bacterial Degradation in Waste Water in River Nile (Review)

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Abstract: Throughout the dyeing progression, about 10-15% of the dyes used are released into the wastewater. The presences of these dyes in the aqueous ecosystem are the cause of serious environmental and health concerns. In particular, systems based on biological processes using a large variety of bacterial strains, allow for degradation and mineralization with a low environmental impact and without the use of potentially toxic chemical substances, under mild pH and temperature conditions.

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Introduction

Fish plays an important role, not only in human food diets but also in animal and poultry rations. It is a palatable and easily digested food which is rich in vitamins, calcium, phosphorous and iodine. In Egypt, fish is considered as a cheap food article if compared with other foods of animal origin. The flesh of healthy fish is considered as a marker for the natural aquatic environment.

In animals, mercuric oxides cause inhibition of certain enzymes, which has several neurological effects. Next to the neurological effects vanadium can cause breathing disorders, paralyses and negative effects on the liver and kidneys. Laboratory tests with test animals have shown that mercuric and vanadium can cause harm to the reproductive system of male animals and rat it accumulates in the female placenta. Vanadium can be found in fishes and many other species. In mussels and crabs mercuric and vanadium strongly bioaccumulates, which can lead to concentrations of about 10^5 to 10^6 times greater than the concentrations that are found in seawater.

The presences of these dyes in the aqueous ecosystem are the cause of serious environmental and health concerns. Among these dyes, azo dyes are the most widely used; these account for over 60% of the total number of dye structures known to be produced. Azo dyes can be distributed in monoazo, diazo, and triazo classes, are available in six application categories: acid, basic, direct, disperse, azoic, and pigments. The largest amount of azo dyes are used for the textile dyeing, and it has been estimated that approximately 10% of the dyestuff used throughout the dyeing process does not bind to the fibers and therefore released into sewage treatment system or the environment. Pollution problems due to textile industry effluents have increased in recent years. Because color in wastewater is highly visible and affects esthetics, water transparency and gas solubility in water bodies, and particularly because many dyes are made from identified carcinogens, such as benzidine and other aromatic compounds, dye wastewaters have to be treated. In addition, their discharge into surface water leads to aesthetic problems and obstructs light penetration and oxygen transfer into bodies of water, hence affecting aquatic life. Moreover, it is very difficult to treat textile industry effluents because of their high BOD, COD, heat, colour, pH and the presence of metal ions. In current practices, new processes for dye degradation and wastewater reutilization have been developed. Numerous methods are used to treat textile effluents to attain decolorization. A number of physical and chemical methods have been recommended for the treatment of dye-contaminated wastewater, but such methods are not widely used due to the high cost input and secondary pollution that can be generated by the excessive use of chemicals. Unconventionally, biodegradation systems of color removal through the use of bacteria have been shown to be highly effective. Microorganisms are nature's original recyclers, converting toxic organic compounds to harmless products, often carbon dioxide and water. Ever since it was discovered that microbes have the ability to transform and/or degrade xenobiotics, scientists have been exploring the microbial diversity, particularly of contaminated areas in search for organisms that can degrade a wide range of pollutants. Although numerous microorganisms can decolorize such dyes, only a few are able to mineralize these compounds into CO_2 and H_2O (9). These include bacteria, fungi and algae, capable of decolorizing a wide range of dyes with high efficiency.

In particular, systems based on biological processes using a large variety of bacterial strains, allow for degradation and mineralization with a low environmental impact and without the use of potentially toxic chemical substances, under mild pH and temperature conditions.

Microbial decolorization and degradation has appeared as an environmentally pleasant and cost-competitive alternative to chemical decomposition processes. Bacterial strains those are able to decolorize azo dyes under aerobic (*Xenphylusazovorans* KF46F, Bacillus strain, *Kerstersia* sp. strain VKY1 and *Staphylococcus* sp.) and anaerobic conditions (*Sphingomonasxenophaga* BN6, *Eubacterium* sp., *Clostridium* sp., *Butyrvibrio* sp. or *Bacteroides* sp.) have been extensively reported. Apparently there is a need to expand novel biological decolorization processes leading to the more efficient clean up of azo dyes using a single microorganism.

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