Chapter 18

Role of Enzymes From Microbes in the Treatment of Recalcitrant From Industries

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ABSTRACT

The limited availability of fresh water is a global crisis. The growing consumption of fresh water due to anthropogenic activities has taken its toll on available water resources. Unfortunately, water bodies are still used as sinks for waste water from domestic and industrial sources. Azo dyes account for the majority of all dye stuffs, produced because they are extensively used in the textile, paper, food, leather, cosmetics, and pharmaceutical industries. Bacterial degradation of azo dyes under certain environmental conditions has gained momentum as a method of treatment, as these are inexpensive, eco-friendly, and can be applied to wide range of such complex dyes. The enzymatic approach has attracted much interest with regard to degradation of azo dyes from wastewater. The oxido-reductive enzymes are responsible for generating highly reactive free radicals that undergo complex series of spontaneous cleavage reactions, due to the susceptibility of enzymes to inactivation in the presence of the other chemicals. The oxidoreductive enzymes, such as lignin peroxidase, laccases, tyrosinase, azoreductase, riboflavin reductive, polyphenol oxidase, and aminopyrine n-demethylase, have been mainly utilized in the bacterial degradation of azo dye. Along with the reductive enzymes, some investigators have demonstrated the involvement in some other enzymes, such as Lignin peroxides and other enzymes. This chapter reviews the importance of enzymes in dye degradation.

INTRODUCTION

Industrial wastes are the wastes produced by industrial activities which includes any material that is rendered useless without a manufacturing process such as that of factories, industries, mills, and mining operations, which has existed on the start of the Industrial Revolution (Maczulak & Elizabeth, 2010). Examples of industrial wastes includes chemical solvents, paints, sandpaper, paper products, industrial byproducts, metals, and radioactive wastes, industrial wastes are named as toxic waste, chemical waste,...

DOI: 10.4018/978-1-5225-5237-6.ch018
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industrial solid waste and municipal solid waste. These industries use raw materials to produce finished goods during the manufacturing process, these are materials which are rendered useless. They constitute the industrial wastes. Some examples of industrial wastes are metals, paints, sandpaper, slag, ash, radioactive wastes, etc.

Industrial wastes treatment deals with the mechanisms and processes used to treat wastewater that have been contaminated in some way by anthropogenic industrial or commercial activities prior to its release into the environment or its re-use. Most industries produce some wet waste although recent trends in the developed world have been to minimize such production or recycle such waste within the production process. However, many important industries remain dependent on processes that produce wastewater. Hence removal of waste has become the key issue from the industries.

Wastewater management is the key issue for many industries generating large volume of waste water in various processes. Effluent treatment plant is very important to manage wastewater treatment and achieve the norms given by government bodies. To avail the quality water, various advanced technology solutions are developed today. There is an array of technologies in industries wastewater treatment solutions to get economical yet effective results.

While devising the wastewater treatment plant for any industry, it is essential to assess the type of wastewater released from the industrial processes. This wastewater can be contaminated with heavy oil quantities, or hazardous chemicals, corrosive materials, metals or other harmful substances which make water unfit for its reuse. There are several factors to consider a right treatment processes, equipment or technologies.

The pollution of rivers and streams with chemical contaminants is one of the most crucial environmental problems. Waterborne chemical pollution entering rivers and streams causes tremendous amounts of destruction. Although some kinds of water pollution can occur through natural processes, it is mostly a result of human activities. We use water daily in our homes and industries. The water we use is taken from lakes and rivers and from underground (groundwater); and after we have used it and contaminated it most of it returns to these locations. This used water is called “wastewater”. If it is not treated before being discharged into waterways, serious pollution is the result (Metcalf & Eddy, 2015).

Industrial wastewaters vary widely from composition, strength, flow and volume, depending on the specific industry or manufacturing establishment of the community. The specific composition and volume of the industrial waste will, of course, depend on the use to which the water has been put. Typical industries which produce significant volumes of wastewaters include paper and fiber plants, steel mills, refining and petrochemical operations, chemical and fertilizer plants, meat packers and poultry processors, vegetable and fruit packing operations and many more. Industrial discharges may consist of very strong organic wastewaters with a high oxygen demand or contain undesirable chemicals that can damage sewers and other structures. They may contain compounds, which resist biological degradation, or toxic components, which interfere with satisfactory operation of the wastewater treatment plant.

Conventional wastewater treatment consists of a combination of physical, chemical, and biological processes and operations to remove solids, organic matter and, sometimes, nutrients from wastewater. The conventional treatment processes have several shortcomings such as being unsuitable for use when the effluent contains high concentrations of the target pollutants, high running cost and low efficiency of removal (Stanisavljevic & Nedic, 2004).

According to Aitken (1993) enzymes were first proposed to the treatment of industrial waste in the 1930’s but it wasn’t until recent that enzyme technology received much attention (Whiteley & Lee, 2006) for the improvement in biological remediation for industrial effluents. The heterogeneous complexity of