Chapter 19

Enzymatic Treatment of Petroleum-Based Hydrocarbons

Pankaj Kumar Chaurasia
Motilal Nehru National Institute of Technology Allahabad, India

Shashi Lata Bharati
North Eastern Regional Institute of Science and Technology, India

Ashutosh Mani
Motilal Nehru National Institute of Technology Allahabad, India

ABSTRACT

Petroleum and petroleum-based products are highly beneficial for our daily life system. Functioning of several industries and machineries directly depends on different forms of petroleum. There are strong possibilities of the release of such petroleum and petroleum-based compounds like aliphatic as well as aromatic hydrocarbons during their refining process, usage, storage, transport, and other activities due to the accidents, leakages, or just a little lack of awareness. Their exposure to soils or water causes serious problems for aquatic as well as human beings. The efficient removal or detoxification of such pollutants is the demand of the present time. The use of microbial sources for the bioremediation of such petroleum wastes may be promising technique because it does not require any drastic conditions for detoxification process and by-products produced by them are also harmless unlike chemical and other techniques. In this regard, this chapter discusses the enzymatic role in detoxification or bioremediation of petroleum-based hydrocarbons.

INTRODUCTION

In the present time, our environment is being contaminated with various types of pollutants released from pharmaceutical, leather, food, paper-pulp, synthetic industries etc. The chemicals released from the different types of industries are very hazardous for human beings as well as animals. Aquatic animals are strongly and adversely affected by sewage pollutants released from industries. Water pollution is being very dangerous for all types of livings depend directly or indirectly on water. It is well known that the
water is the most important part of our life and it is the valuable living place for huge aquatic animals whose life directly depends on the water medium. Pollution of water has been found the major cause of death and diseases (Pink, 2006; West, 2006). There is not a single factor responsible for the water pollution; however, the chemical pollution is one of the most important factors behind such death and diseases. Chemical pollution may be of any types that directly or indirectly based on chemical compounds. Organic pollutants may include detergents, oxygen demanding materials, grease, fats, volatile organic compounds, insecticides, herbicides, food processing wastes, chlorinated compounds, pharmaceutically active compounds, cosmetic compounds, synthetic compounds, petroleum hydrocarbons etc (Wikipedia, 2018a). Many research works are going on to solve the problems of contamination or pollutions worldwide. In order to solve the problem of pollution, many techniques either physical or chemicals are being applied. They may also create some types of pollutions like noise pollution, by-products pollutions, chemical pollution etc. This chapter focussed the role of enzymes in bioremediation of petroleum wastes/hydrocarbons. Petroleum is a natural occurring liquid generally found in yellow to black in colour. It is found in geological formation beneath the surface of earth which undergoes refinement to various forms of fuels. This petroleum consists of different molecular weight hydrocarbons that are present in given compositions in crude oil: alkanes or paraffins (15-60%), naphthenes (30-60%), aromatics (3-30%) and asphaltics (remainder) (Wikipedia, 2018b). Petrochemicals are petroleum derived chemicals or products that can be divided in two major classes like olefins and aromatics (Wikipedia, 2018c). Olefins include ethylene, propylene and butadiene. Ethylene and propylene are the basis of industrial chemicals and plastic products while aromatics contain benzene, toluene and xylene. Benzene is used as raw material for dye and synthetic detergents and xylene is used in plastic and synthetic fibre industries (Wikipedia, 2018c). Petroleum contaminants released in soil and water are also hazardous for living organisms due to the carcinogenic properties of hydrocarbons. They become released in environment either from ruptured boats or automobiles or from oil plants, storage tanks, and from the accident of oil tankers and cause the sever effects on our systems (Wikipedia, 2018d). Bioremediation of pollutants are the highly preferable methods for the detoxification or removal of pollutants. In this method, either enzymes, microbes or other green sources are used for the bio-removal of such toxic materials. Different types of petroleum based organic compounds are shown in Figure 1 (Bahl & Bahl, 2003).

**Crude Oil**

Petroleum in its unprocessed form is called as crude oil that includes brent crude oil, heavy crude oil (HCO), light crude oil (LCO), sweet crude oil (SCO) and synthetic crude oil (Wikipedia, 2017a). Brent crude oil contains 0.37% sulphure and suitable for petrol and middle distillate productions’ productions (Wikipedia, 2017b). Petrol (British english) also called as gasoline (American english) is a petroleum derived transparent liquid (Wikipedia, 2018e). It is mostly used in the internal combustion engines for the purpose of fuel. Organic compounds obtained from the fractional distillation are the main source of the gasoline (Wikipedia, 2018e). There is approximately 19 US gallons (72 L) of gasoline (petrol) production after processing in oil refinery from 42 gallon barrel of crude oil (159 L). This can be vary with crude oil source assay (Wikipedia, 2018e). Petroleum products can be divided into four different categories like light distillates, middle distillates, heavy distillates and residuum out of which light distillates contain LPG, naphtha, gasoline; middle distillates contain kerosene, jet fuel, diesel; while heavy distillates and residuum contain heavy fuel oil, lubricating oils, wax and asphalt (Wikipedia, 2018f). Hydrogen, light hydrocarbons, re-formate and pyrolysis gasoline become produce as intermediates from
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