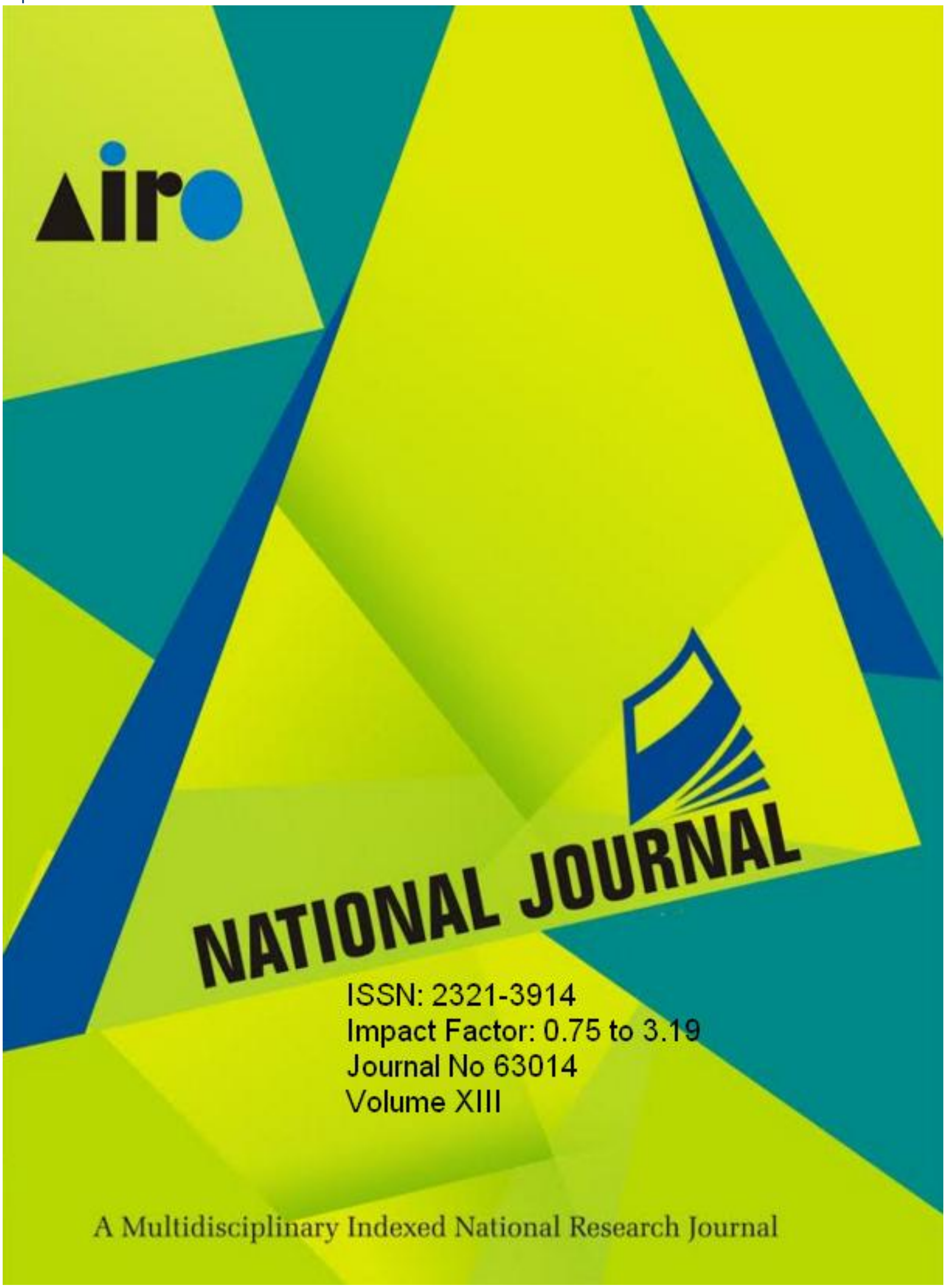
Volume XIII, ISSN: 2321-3914
February, 2018
Impact Factor 0.75 to 3.19

ज्ञान-विज्ञान विमुक्तये

UGC Approval Number 63014



Airo National Research Journal

Volume XIII, ISSN: 2321-3914
February, 2018
Impact Factor 0.75 to 3.19

UGC Approval Number 63014

BIO-DEGRADATION OF WASTE PRODUCTS

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ABSTRACT

In recent years, it is observed that the quantity of waste products is growing at a rapid speed. Due to accumulation of these waste products, it is spreading various harmful diseases among the dwellers. Due to production of a number of insects through these waste products, most of the people are facing problems in living. These waste products are needed to be degraded so as to lower their negative impact.

One solution is to burn all these waste products. But, it would be dangerous for the environment as this process would emit a lot of harmful gases like carbon mono-oxide in the atmosphere. Another better solution is to bio-degrade these waste products. This is the aim of this paper to describe the bio-degradation of waste products.

KEYWORDS: *Bio-degradation, Waste, Product, Environment*

INTRODUCTION

Bio-degradation is the process of the conversion of organic compounds into microbial biomass with the help of micro-organisms. It is observed that water, carbon dioxide, methane are obtained after this process of biodegradation.

Through the process of bio-degradation, toxic pollutants are removed from the soil.

There are a number of factors which decides the biodegradation rate of compounds. Some of these factors are water, temperature and oxygen etc.

It is observed that compounds having high temperature are bio-degraded easily as chemical reactions are involved in the process of bio-degradation.

The measurement of biodegradability of a compound is done by quantity of methane and anaerobic microbes. The rate of bio-degradation at lower temperatures can be enhanced with the help of slurry or microbial consortium.

With the introduction of industrialization, many industries are developed and produce many products. They don't destroy the waste products yielded during the process of preparation of particular products. As a result, these waste products are accumulated at a place and harms the environment.

These waste products are needed to be degraded so as to prevent the soil to get badly affected by these products. These waste products can be in any form. It may be in the form of chemical products if there is some chemical industry nearby or it may be solid waste.

These accumulated waste products can be very harmful for the soil as well. It is observed that if these waste products are in the form of chemical then it may decrease the fertilization property of soil or that part of soil can be useless.

Bacterial strains that are able to degrade aromatic hydrocarbons have been repeatedly isolated, mainly from soil. These are usually gram negative bacteria, most of them belong to the genus Pseudomonas. The biodegradative pathways have also been reported in bacteria from the genera Mycobacterium, Corynebacterium, Aeromonas, Rhodococcus and Bacillus.

Although many bacteria are able to metabolize organic pollutants, a single bacterium does not possess the enzymatic capability to degrade all or even most of the organic compounds in a polluted soil. Mixed microbial communities have the most powerful biodegradative potential because the genetic information of more than one organism is necessary to degrade the complex mixtures of organic compounds present in contaminated areas.

RESEARCH STUDY

There are many reports on the degradation of environmental pollutants by different bacteria. Several bacteria are even known to feed exclusively on hydrocarbons. Bacteria with the ability to degrade hydrocarbons are named hydrocarbon-degrading bacteria. Biodegradation of hydrocarbons can occur under aerobic and anaerobic conditions, it is the case for the nitrate reducing bacterial strains Pseudomonas sp. and Brevibacillus sp. isolated from petroleum contaminated soil.

Both, anaerobic and aerobic bacteria are capable of biotransforming PCBs. Higher chlorinat- ed PCBs are subjected to reductive dehalogenation by anaerobic microorganisms. Lower chlorinated biphenyls are oxidized by aerobic bacteria. Research on aerobic bacteria isolated so far has mainly focused on Gram-negative strains belonging to the genera Pseudomonas, Burkholderia, Ralstonia, Achromobacter, Sphingomonas and Comamonas. Howev- er, several reports about PCB-degrading activity and characterization of the genes that are involved in PCB degradation indicated PCB-degrading potential of some Gram-positive strains as well (genera Rhodococcus, Janibacter, Bacillus, Paenibacillus and Microbacterium).

Successful removal of pesticides by the addition of bacteria had been reported earlier for many compounds, including atrazine. Recent findings concerning pesticide degrading bacteria include the chlorpyrifos degrading bacterium Providencia stuartii isolated from agricultural soil and isolates Bacillus, Staphylococcus and Stenotrophomonas from cultivated and uncultivated soil able to degrade dichlorodiphenyltrichloroethane.

Researches on bacterial strains that are able to degrade azo dyes under aerobic and anaerobic conditions have been extensively reported.

Based on the available literature, it can be concluded that the microbial decolourization of azo dyes is more effective under anaerobic conditions. On the other hand, these conditions lead to aromatic amine formation, and these are mutagenic and toxic to humans requiring a subsequent oxidative (aerobic) stage for their degradation.

In contrast to mixed cultures, the use of a pure culture has several advantages. These include predictable performance and detailed knowledge on the degradation pathways with improved assurance that catabolism of the dyes will lead to nontoxic end products under a given set of environmental conditions. Another advantage is that the bacterial strains and their activity can be monitored using culture-based or molecular methods to quantify population densities of the bacteria over time. Knowledge of the population density can be extrapolated to quantitative analysis of the kinetics of azo dye decoloration and mineralization.

Heavy metals cannot be destroyed biologically (no“degradation”, change in the nuclear structure of the element, occurs) but are only transformed from one oxidation state or organic complex to another. Besides, bacteria are also efficient in heavy metals bioremediation. Microorganisms have developed the capabilities to protect themselves from heavy metal toxicity by various mechanisms, such as adsorption, uptake, methylation, oxidation and reduction.

DISCUSSION

Reduction of metals can occur through dissimilatory metal reduction where bacteria utilize metals as terminal electron acceptors for anaerobic respiration. In addition, bacteria may possess reduction mechanisms that are not coupled to respiration, but instead are thought to impart metal resistance.

Most works on pollutants bioremediation uses pure microbial cultures. However, the use of mixed microbial cultures is undoubtedly advantageous. Some of the best examples of enrich- ment cultures comprising several specific consortia involve the bioremediation. In the case of heavy metals removal, an environmental bacterial consortium was used to remove Cd, Cr, Cu, Ni and Pb from a synthetic wastewater effluent.

For Cr (VI) removal we reported that the survival and stability of bacteria are better when they are present as a mixed culture, especially, in highly contaminated areas and in the presence of more than one type of metal.

Plant associated bacteria, such as endophytic bacteria (non-pathogenic bacteria that occur naturally in plants) and rhizospheric bacteria (bacteria that live on and near the roots of plants), have been shown to contribute to biodegradation of toxic organic compounds in contaminated soil and could have potential for improving phytoremediation.

Plant growth promoting rhizobacteria (PGPR) are naturally occurring soil bacteria that aggressively colonize plant roots and benefit plants by providing growth promotion. Some plants can release structural analogs of PAHs such as phenols, to promote the growth of hydrocarbon degrading microbes and their degradation on PAHs.

For such plant/microbe systems, an important class of bacteria is Pseudomonas spp., have PGPR activity and hydrocarbon degrading capacity. Further- more, the rhizosphere of vegetation in contaminated field contains higher diversity of population of PAH-degrading bacteria, among which two Lysini bacillus strains were isolated.

Also, the free living nitrogen fixer Azospirillum lipoferum generally found in the rhizoplane of the crop plants was used for Malathion degradation which is one of the largest organo phosphorus insecticides in the world.

The use of soil bacteria (often plant growth promoting bacteria (PGPB)) as adjuncts in metal phytoremedia- tion can significantly facilitate the growth of plants in the presence of high (and otherwise inhibitory) levels of metals. To increase the efficiency of contaminants extraction, it is interesting to apply plants combined to some microorganisms; such technique is called rhizoremediation.

Fungi are an important part of degrading microbiota because, like bacteria, they metabolize dissolved organic matter; they are principal organisms responsible for the decomposition of carbon in the biosphere. But, fungi, unlike bacteria, can grow in low moisture areas and in low pH solutions, which aids them in the breakdown of organic matter.

SIGNIFICANCE OF THE STUDY

Mycorrhiza is a symbiotic association between a fungus and the roots of a vascular plant. In a mycorrhizal association, the fungus colonizes the host plant's roots, either intracellularly as in arbuscular mycorrhizal fungi (AMF), or extracellularly as in ectomycor- rhizal fungi. They are also an important component of soil life and soil chemistry. Bioremediation using mycorrhiza is named mycorrhizoremediation.

Furthermore, biodegradation of aliphatic hydrocarbons occurring in crude oil and petroleum products has been investigated well, especially for yeasts. The n-alkanes are the most widely and readily utilized hydrocarbons, with those between C_{10} and C_{20} being most suitable as substrates for microfungi.

CONCLUSION

In addition to aromatic and aliphatic hydrocarbons compounds, microfungi may transform numerous of other aromatic organopollutants cometabolically, including polycyclic aromatic hydrocarbons (PAHs) and biphenyls, dibenzofurans, nitro aromatics, various pesticides, and plasticizers.

There have also been studies of PCB metabolism by yeasts C. boidinii and C. lipolytica and Saccharomyces cerevisiae. Insecticides and fungicides can also be adsorbed by S. cerevisiae during aerobic fermentation.

REFERENCES

[1] Alexander M. Biodegradation and Bioremediation, San Diego CA 2014. Academic Press.

[2] Marinescu M, Dumitru M and Lacatusu A. Biodegradation of Petroleum Hydrocar- bons in an Artificial Polluted Soil. Research Journal of Agricultural Science 2012; 41(2).

[3] Bennet JW, Wunch KG and Faison B D. Use of fungi biodegradation. Manual of envi- ronmental microbiology 2012, 2nd ed., ASM Press: Washington, D.C., 960-971.

[4] Fritsche W and Hofrichter M. Aerobic Degradation by Microorganisms 2010 in Bio- technology Set, Second Edition (eds H.-J. Rehm and G. Reed), Wiley-VCH Verlag GmbH, Weinheim, Germany. doi: 10.1002/9783527620999.ch6m

[5] Das N and Chandran P. Microbial Degradation of Petroleum Hydrocarbon Contami- nants: An Overview SAGE-Hindawi Access to Research Biotechnology. Research In- ternational. Volume 2011, Article ID 941810, 13 pages. Doi:10.4061/2011/941810.

[6] Pramila R., Padmavathy K, Ramesh KV and Mahalakshmi K. Brevibacillus parabrevis, Acinetobacter baumannii and Pseudomonas citronellolis - Potential candidates for biode- gradation of low

density polyethylene (LDPE). Journal of Bacteriology Research 2012; 4(1) 9-14.

[7] Mrozik A, Piotrowska-Seget Z and Labuzek S. Bacterial degradation and bioremedia- tion of Polycyclic Aromatic Hydrocarbons. Polish Journal of Environmental Studies 2013; 12 (1) 15-25.

[8] Leitão AL. Potential of Penicillium Species in the Bioremediation Field. International Journal of Environmental Research. Public Health 2009; 6 1393-1417; doi: 10.3390/ ijerph6041393.

[9] Diez MC. Biological Aspects involved in the degradation of organic pollutants. Jour- nal of Soil Science and Plant Nutrition. [online] 2010; 10 (3) 244-267. ISSN 0718-9516.