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Fate, Effects and Regulatory Measures for Organochlorine Pesticides

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Abstract
Organochlorines are chlorinated hydrocarbons that have been used as pesticides over several decades. Humans and several other non target organisms are exposed to pesticides due to occupational or dietary and environmental exposure (water, soil, air). This article contains a brief review of persistence, toxicity and metabolism into non-toxic forms by microorganisms, by a process of bioremediation. In the last section of the article, the safety measures that must be taken in order to protect ourselves as well as the natural environment has been discussed. Finally other alternatives like organic farming, use of GM crops, proper regulatory measures that must be taken so that usage of these toxic compounds is limited has been discussed.

1. Introduction
After the second world war the need to increase world food production for rapidly growing population is very well recognized and it led to the concept of Green Revolution in late 1960s. Green revolution significantly increased agricultural productivity by planting hybrid crops with higher yield. On the other hand, effective pest management has also been introduced because more than 30% of annual food production is lost due to pest infestation and in India this loss of food is reported to be around 45% (Abhilash and Singh 2009). Effective pest management by the use of different groups of chemicals and increased food productivity by the application of these pesticides ensure increased food production, a safe and secure food supply but on the another hand, this leads to the use of chemical pesticides. Although a wide range of pesticides of different chemical properties is very well recognized but only a very few among them is cost effective, safe and versatile against various pests. Chlorinated hydrocarbons also known as organochlorine group of pesticides is one of them and initially BHC, DDT, endosulfan, heptachlor, aldrin, etc. have been used extensively worldwide with few guidelines or restrictions for protection of crops and prevention of vector borne disease. Due to strong lipophilicity, resistance to environmental degradation, stability and its biomagnification ability through the food chain (Fisher, 1999), most of these organochlorine pesticides have been banned in developed nations in late 1970s. But these are still in use in the developing countries.

Various non-target organisms like humans exposed to even very low dose of these pesticides through both internal and external exposure sources have been reported to be affected by chronic and acute threats. Long-term low-dose exposure to pesticides is found to cause immune suppression, hormonal disruption, diminished intelligence, reproductive abnormalities, and carcinoma (Aktar et al 2009). The accumulated residues of such pesticides deteriorate the overall quality of the soil and that of the surrounding environment and various living organisms as well. Use of such pesticides is therefore of great concern. Microbial degradation of contaminants is a cost-effective and efficient way to remediate contaminated environments (Elsaid et al., 2010). Toxicological study of pesticides and the metabolites obtained after the bioremediation by different microbial community either alone or in a consortia is also a great area of research.

2. Global Concern due to pesticides
Use of majority of old, hazardous pesticides can be found in low- and middle-income countries to meet agricultural demands by farmers. Farmers and workers in these countries lack both access to basic protective gears and equipments due to financial constraints. According to the results collected from the report of 1996, the Food and Agriculture Organization of the United Nations estimated that the total number of obsolete pesticide stocks in only African countries amounted to 15,000 to 20,000 tons. There are many programmes running in parallel at international level like the Stockholm Convention on Persistent Organic Pollutants to eradicate use of toxic pesticides. The Convention seeks to reduce or eliminate the production of the most toxic pesticides and other persistent organic pollutants. The Food and Agriculture Organization of the United Nations (FAO) has also tried to introduce modern agricultural practices with the aims of minimizing the future use of pesticides, to respond more effectively to pest outbreaks, and reduce the creation of new stocks. The Africa Stockpiles Programme is another example of multilateral effort to clean up such sites and prevent their recurrence. This program currently operates in Ethiopia, Mali, Morocco, Nigeria, South Africa, Tanzania, and Tunisia. There are
various research programmes supported by the government of different nations by the use of in-situ technologies for the characterization and treatment of soil, sediment, and ground water.

Fig: Short term and long term effects of organochlorinated pesticides exposure.

3. Bioremediation: a promising tool for detoxification of organochlorine pesticides

A number of methods such as coagulation, filtration with coagulation, precipitation, ozonation, adsorption, ion exchange, reverse osmosis and advanced oxidation processes have been used for the removal of persistent organic pollutants from the environment. These methods have been found to be limited, since they often involve high capital and operational costs.

Bioremediation is one of the most environmentally-sound and cost-effective method for the decontamination and detoxification of a pesticide-contaminated environment. Bioremediation of hazardous wastes is not a new technology. It started several decades ago but the research is still going on in a more intense level in the recent decades due to rise in contaminant levels. Various microbial pathways for biodegradation include oxidation of organic contaminants, biotransformation of persistent toxic pesticides into less toxic metabolites and reduction of highly electrophilic halo- and nitro- groups by transferring electrons from the contaminant (termed the electron donor) to an electron acceptor to gain energy (Rockne and Reddy, 2003). Group of microorganisms reported for bioremediation belong to basidiomycetes or to bacterial classes: gamma-proteobacteria (Pseudomonas, Aerobacter, Acinetobacter, Moraxella, Plesiomonas), beta-proteobacteria (Burkholderia, Neisseria), alpha-proteobacteria (Sphingomonas), actinobacteria (Micrococcus) and flavobacteria (Flavobacterium) and Paenibacillus.

4. Health impact of organochlorine pesticides

According to the data published in WHO report it has been estimated that unintentional poisonings kill an estimated 3,55,000 people globally each year (WHO Report 2003). In developing countries where two thirds of these deaths occur such poisonings are associated strongly with excessive exposure and inappropriate use of toxic chemicals.

Due to the lipophilic nature, these pesticides get accumulated in milk and other fat rich substances. These toxicants get into the human body through the food chain, and initially cause acute and later continuous exposure over a long period of time may eventually lead to a substantial body burden of these toxic chemicals. Higher dose of such toxic pesticides causes chronic health effects. Human health risk assessment was done according to the methodology described by the US EPA (1991). It has been reported that the pesticides have been linked to a wide range of human health hazards, ranging from short-term impacts such as headaches and nausea to chronic impacts like cancer, reproductive harm, and endocrine disruption.

Studies have been carried out on pesticidal contamination of food stuff from different parts of the world (Johnson and Manske, 1977; Mitra et al., 1999). Long-term exposure to environmental low dose of organochlorine pesticides in the general population has been linked to the risk of Alzheimer's disease and other neurodegenerative diseases (Richardson et al., 2014). Many studies have found that endosulfan, one of the
organochlorine pesticides having high persistence and toxicity has the potential to disrupt hormones and be reproductively and developmentally toxic, especially amongst males (Sang and Petrovic, 1999).

5. Regulatory measures
More sustainable alternative strategies for the reduction and elimination of such pesticides are also needed. Alternative method used for controlling pests is biological control. In this, natural predators of the pest are introduced to prey on or parasitize the pest. When using this method, farmers get natural predators of the pest and release them into their fields so that the predators can manage the pest population. Integrated Pest Management (IPM) and Integrated Vector Management (IVM) can be also be adopted for crop protection and disease vector control. Such strategies should be implemented and promoted through regional cooperation, in addition to development and implementation of national action plans.

As Stockholm convention is already supporting the monitoring and assessment programs, but there is still an urgent need to establish coordinated research programs for environmental and public health management regarding persistence organochlorine pesticides in low- and middle-income countries.

There are some recommendations regarding these persistent pollutants which are as follows:

1. Coordinated effort should be made among the governments of all developed and developing nations.
2. A team comprising of environmental scientists, biologists, public health specialists should work together and a team of mathematical modelers is needed to study the sources, fate and environmental and health effects of such pesticides.
3. Food items especially those containing high levels of lipid such as milk, eggs and fish should be routinely monitored time to time and the concentration of these persistent pollutants and the data observed should be published not only in national or international journals but also in local newspapers to create more awareness among the public.
4. The concentrations of these persistent organochlorine pesticides in different ecological compartments should be monitored and the toxicological study should be supported on different species at both in-situ and ex-situ levels.
5. On the another hand to fulfill the requirements of food supply, use of genetically modified (GM) crops should be supported and research towards these areas should be promoted.
6. Many other organizations have to work together with the WHO Pesticide Evaluation Scheme (WHOPES). They together can promote and coordinate the testing and evaluation of pesticides for public health.
7. At the national level, policies have to be improved. At the global level, there must be programmes implemented for global conventions on the management of highly toxic and persistent pesticides.

References


Explosives Removal from Soil and Water

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1. Introduction

Improper disposal of explosives or their transformed products, land mining, military exercises, and explosive manufacturing units are common sources of explosives contamination to soil and water. The effluents from explosive industries contain hazardous nitroaromatic and nitramine compounds. During artillery training at defence sites; explosives, granades and other munitions usage is a common practice (Doughlas et al., 2009). Major explosives include 2,4,6-trinitrophenol (TNP), 2,4,6-trinitrotoluene (TNT), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) and octahydro 1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) (Doughlas et al., 2009). Explosives are carcinogenic contaminants that may accumulate in the food chain and create serious problem.

2. Typical explosive contaminants

Common explosive compounds are categorised into picrates, nitrobenzenes, nitroglycerine, and nitrocelluloses. Major explosives as contaminants encountered at the contaminated sites (FRTR, 2015) are given in Table 1. Chemical structures of major explosive compounds are shown in Figure 2.

Table 1. Commonly used explosives

<table>
<thead>
<tr>
<th>Sl. no.</th>
<th>Explosive Compounds</th>
</tr>
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<tbody>
<tr>
<td>1.</td>
<td>RDX (Cyclo-1,3,5-trimethylene-2,4,6-trinitramine)</td>
</tr>
<tr>
<td>2.</td>
<td>Tetryl (N-Methyl-N,2,4,6-tetranitrobenezeneamine)</td>
</tr>
<tr>
<td>3.</td>
<td>2,4-DNT (2,4-Dinitrotoluene)</td>
</tr>
<tr>
<td>4.</td>
<td>2,6-DNT (2,6-Dinitrotoluene)</td>
</tr>
<tr>
<td>5.</td>
<td>HMX (1,3,5,7-Tetranitro-1,3,5,7-tetrazocyclooctane)</td>
</tr>
<tr>
<td>6.</td>
<td>Nitroaromatics including 2,4,6-trinitrophenol (TNP)</td>
</tr>
</tbody>
</table>

Fig. 1. Chemical structures of some major explosive compounds
3. Water and Soil Contamination due to explosives
The spent explosives still contain some left out toxic matter that could be adsorbed either by soil or may enter into the groundwater. These toxics may also undergo reductive transformation heading toward a long term soil contamination (Eriksson et al., 2004). Soils with high clay and total organic carbon had shown to promote TNT transformation (Myers et al., 1998). Soils with fine and mobile particles expected to adsorb explosives and facilitate their transport (Dontsova et al., 2009). The explosive may be transported from soil to the groundwater in sandy soils with little organic matter or clay content (Fuller et al., 2007). On the other hand, water samples with high clay and organic contents pose high risk of explosive compounds transformation (Eriksson et al., 2004). Common pathways of explosive compounds interaction with soil and water are summarised in Figure 2.

![Fig. 2. Contact pathways (A) and (B) of explosive compounds interaction with soil and water](image)

4. Toxicity of explosives
Being xenobiotic and carcinogenic in nature, the explosives are hazardous to human health. Nitroaromatic compounds are harmful ecotoxins (Michalowicz and Duda, 2007). They provoke mutagenesis and carcinogenesis in human beings and other living organisms. Long term exposure to nitroaromatics may result into cardiovascular disease. Ingestion of concentrated aqueous nitroaromatics may cause serious gastrointestinal damage and even death (ATSDR, 1992). They can also inhibit the central nervous system or cause damages to liver and kidney functions (Qu et al., 2013). RDX is a Class C carcinogen and may cause hyperirritability, mental confusion and amnesia.

5. Fate and transport of explosive compounds
Explosives may have very high to moderate mobility in soil. The HMX degrade anaerobically and yield mono-, di-, tri- and tetra- intermediate compounds. TNT is readily degraded in soils. TNT reduces to nitroso, hydroxylamino and amino groups which further dimerize and resist metabolizing further (Spain, 1995).

6. Common methods used for explosives removal
Common methods available to remove explosive compounds from water and soil include adsorption (Tomaszewski et al., 2015; Zhang et al., 2011, Dontsova et al., 2009; Haderlein et al., 1996), sequential biodegradation (Moshe et al., 2009), phytoremediation (Panz and Miksch, 2012), degradation (Liou and Lu, 2008; Fuller et al., 2007), zerovalent iron assistance (Hundal et al., 1997), Ultraviolet oxidation (FRTR, 2015). Table 2 describes different methods available to explosive compounds remediation from soil, sludge, leachate, and water.

7. Conclusions
Highly toxic explosive compounds if exposed to soil and water, may badly degrade their chemical properties. Therefore, removal of these explosive compounds and their transformed products from soil and water is necessary prior using the contaminated land soil for agricultural purpose or using the water for domestic, industrial or agricultural means. Various methods available for the remediation of explosive compounds from water have been discussed. Thus, removal of these toxics is highly recommended from soil and water to safeguard the social community.
Fig. 3. Remediation of explosive contaminated soil and water

Table 2. Methods available for explosives remediation from soil, sludge, leachate and water (modified after FRTR, 2015)

<table>
<thead>
<tr>
<th>Soil, Sediment and Sludge</th>
<th>Groundwater, surface water and leachate</th>
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</thead>
<tbody>
<tr>
<td><strong>In situ biological treatment</strong></td>
<td>Biodegradation</td>
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<tr>
<td></td>
<td>Phyto remediation</td>
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<tr>
<td>Ex situ biological treatment</td>
<td>Biopiles</td>
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<td></td>
<td>Composting</td>
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<td>Landfarming</td>
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<td></td>
<td>Slurry phase biological treatment</td>
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<td>Physicochemical treatment</td>
<td>Chemical extraction</td>
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<td></td>
<td>Soil washing</td>
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<td>Thermal treatment</td>
<td>Hot gas decontamination</td>
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<td>Incineration</td>
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<tr>
<td></td>
<td>Thermal desorption</td>
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<tr>
<td><strong>Groundwater, surface water and leachate</strong></td>
<td>Biodegradation</td>
</tr>
<tr>
<td>In situ biological treatment</td>
<td>Phyto remediation</td>
</tr>
<tr>
<td>Ex situ biological treatment</td>
<td>Bioreactors</td>
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<td></td>
<td>Constructed wetlands</td>
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<tr>
<td>Containment</td>
<td>Deep well injection</td>
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<tr>
<td>Physicochemical treatment</td>
<td>Passive treatment walls</td>
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<td></td>
<td>Oxidation</td>
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<tr>
<td></td>
<td>Adsorption</td>
</tr>
</tbody>
</table>

References


Panz, K., Miksch, K., 2012. Phytoremediation of explosives (TNT, RDX, HMX) by wild-type and transgenic plants. Journal of Environmental Management, 113, 85-92

Qu, G., Liang, D., Qu, D., Huang, Y., Liu, T., Mao, H., Ji, P., Huang, D., 2013. Simultaneous removal of cadmium ions and phenol from water solution by pulsed corona discharge plasma combined with activated carbon. Chemical Engineering Journal, 228, 28-35

Spain, J.C., 1995. Annual Review of Microbiology, 49, 523


Report on

Tropical Ecology Congress (TEC2014), December 10-12, 2014
International Conference Organized by Dr. S C Garkoti
School of Environmental Sciences, Jawaharlal Nehru University, New Delhi-110067, India

The Tropical Ecology Congress 2014 aims to bring together the researchers actively engaged in the field of Tropical Ecology from world over and provide an interdisciplinary platform for discussion to suggest future directions of research for the benefit of humanity. Human society is currently facing enormous problems related to climate change, biodiversity loss, increased population growth, and resource use patterns that threaten earth's life supporting systems. Resolution of these multifaceted problems requires integrating knowledge from various interdisciplinary fields. Present crisis has challenged ecologists globally to provide a scientific basis for addressing these problems and develop a road map of ecosystem stewardship to the benefit of mankind. It is important to synthesize and exchange existing ecological knowledge and to identify critical gaps that demand immediate attention. Ongoing global change poses tremendous challenges on ecosystem structure and functions which in turn affect various ecosystem services crucial for humanity. It is important to develop in depth understanding of the drivers of global change to predict, evaluate and mitigate adverse effects of forthcoming changes on tropical ecosystems.

Tropical Ecology Congress 2014 was hosted by School of Environmental Sciences, Jawaharlal Nehru University (JNU) New Delhi in collaboration with International Society for Tropical Ecology (ISTE) from 10th-12th December 2014 for three days.
The tropical regions harbouring most of the developing countries – encompass varied environment, and support high biological diversity, but often fragile ecosystems. The need for the Society exclusively devoted to tropical ecology was widely felt during late 1950s. The idea was discussed among leading ecologists (e.g., 4th World Forestry 1954, UNESCO Symposium at Kandy 1956, Bogor 1958, and Pacific Science Congress 1958). International Society for Tropical Ecology (ISTE) was formally inaugurated in 1960 at the 47th Sessions of the Indian Science Congress Association at Bombay, with the aim of promoting and fostering Ecology in its widest sense in tropics and subtropics. Initially the Society started workings from Allahabad and in the year 1962 headquarter was shifted to the department of Botany, Banaras Hindu University. Since 1960 till 2014 tropical ecology science has emerged to invigorate the other disciplines associated with ecology. The International Society for Tropical Ecology is Asia's oldest and perhaps the largest scientific association in the field of tropical ecology. It aims to enhance the understanding of the biodiversity and function of tropical ecosystems, and to drive decision making and management at all levels. The society also aims to promote the conservation and rehabilitation of tropical biodiversity and ecosystems through research and its application.

Fig. Inauguration session: Release of the abstract book of the Congress by President International Society for Tropical Ecology (ISTE), from right Prof. I.S.Thakur Dean SES, JNU. Dr. Skip Van Bloem President ISTE, Prof. S.P. Singh, Dr. S.C. Garkoti SES, JNU (Convener TEC 2014).

Major activities of the Society include:
Publishing the Journal Tropical Ecology, Proceedings and such other publications as found desirable, organizing meetings, excursions, symposia and seminars at national and international level, training courses in ecology. Securing and managing funds and endowments for promotion of ecology. Collecting and maintaining a library of ecological literature.
The broad themes of the congress is Tropics and Climate change: impacts, mitigation and adaptations, Tropical Biodiversity and ecosystem services, Hill and mountain ecosystems in tropics, Forest and Grassland Ecosystems, Limnology, Coastal and marine ecosystems, Biotic interactions and biological Invasion, Traditional socio-ecological systems, indigenous knowledge and adaptive management, Socio-ecological issues in north-eastern region of India Tropical soils, agricultural systems and forest–agriculture linkages, Food security and bio-prospecting, Hydrology in terrestrial ecosystem and climate change, Biogeochemistry Landscape approach to ecosystem management, Management of degraded ecosystems.
The congress was held at Convention centre at Jawaharlal Nehru University, there were four parallel sessions. Total of 450 national and international delegates from 17 countries around the globe participated in the congress. There were seven plenary lectures, six technical sessions which include the oral presentations. There were total of 183 oral presentations and 170 posters presentations under 21 themes. There were 15 invited talks. There were also panel discussions by the panellist and expert on major global issues. A general body meeting of International Society of Tropical Ecology was also held. The last day was closed with valedictory session followed by farewell dinner.
A two day national seminar on “Advances in mobile phone and cell tower radiation on environmental health” (NAME-2014) was organized by Dr. Paulraj R, SES, JNU on 5th and 6th of December, 2014. It was under the auspices of Microwave Application Society of India (MASI). It was sponsored by Department of Science and Technology (DST), Indian Council of Medical Research (ICMR) and JNU.

The main aim of the seminar was to address the ongoing issues in environmental science “electromagnetic pollution” and to understand the effect of electromagnetic field (EMF) on biological systems. The seminar was divided into eight sessions and the main topics covered were: Radiofrequency measurement techniques, Electromagnetic fields and environment, Radiofrequency fields and dosimetry, Mobile phone and biological effect, Radiation hazards and safety standards, Shields from electromagnetic fields and Electromagnetic fields-Bio-Interaction.

The seminar was inaugurated by Prof. Sudha Pai (Rector-1, JNU) and she released the abstract book of the seminar. Prof. T.P. Singh (AIIMS, New Delhi) delivered the inaugural address and Prof. J. Behari, (Emeritus Professor, Amity University) talked about the seminar. Prof. S. Mukherjee (Acting Dean, SES) gave welcome address. Prof. V.P. Sandlas (President, MASI) gave future directions and vote of thanks was given by Dr. Paulraj R, the organizing secretary of the seminar. The seminar was well attended by scholars working on electromagnetic radiations from across India and presented their recent research work on electromagnetic radiations and its effects on environment.

There were two plenary talks. The plenary talk-1 was given by Prof. Girish Kumar, IIT, Mumbai on the topic “The effect of cell tower radiation on environment”. He gave a clear picture about the cell tower radiations and its effect on the residents residing in the vicinity of cell towers (base station). Plenary talk -2 was delivered by Prof. J. Behari on “Biological correlates of mobile phone frequency exposure”. He narrated the biological effects caused by mobile phone radiations. In addition, current scenario of cell phone and cell tower radiation in India was discussed by distinguished expertise, Prof. V.P. Sandlas, Prof. J. Behari, Prof. Girish Kumar and Prof. Tanu Jindal. There were relevant invited talks, contributory papers and poster sessions. The seminar ended with valedictory sessions on “electromagnetic research in India: Future directions” by Prof. D.C. Dube (Emeritus Professor, IIT, Delhi), Prof. V.P. Sandlas and Dr. Paulraj R. In the end, 3 best poster awards were presented to 3 deserving students who presented their research work in the area of electromagnetic radiations on biological system.
Toxic compounds in landfill leachate: The landfills at Ghazipur, Bhalswa and Okhla are responsible for toxic leachate contamination of air and groundwater. The Najafgarh drain basin, which includes Wazirpur, Naraina, Anand Parbat and Okhla industrial areas, is the largest surface drain joining Yamuna and contributes to over 50% of the wastewater discharged into the river. Wazirpur is one of the worst managed areas with 1,200 small units, a majority of which are involved in steel pickling. The report also highlights the need to address toxic smoke and dust from open dumping, burning and spilling of chemicals. "In 2011, MCD was supposed to close down around 22,000 units, but not much seems to have been done.

Pollution hotspots in Delhi: Industrial pollution is not restricted to the peripheries but is silently causing damage inside the city. On the Edge, a study by an NGO, has identified 18 potential pollution hotspots in the capital. Unsafe, and often unorganized, methods of e-waste dismantling, dyeing, lead acid battery recycling, cathode-ray tube (CRT) dismantling and other processes have given rise to health and environmental concerns, says the Toxics Link study. Delhi has more than 1.2 lakh industries and 29 industrial estates, necessitating a watch over acid and lead fumes, as well as groundwater and air pollution. The researchers assessed 51 industrial areas on five parameters—industrial processes, chemicals used, emissions, disposal technique and occupational health hazard. They found that 18 of them were flouting the norms.

Polyhydroxy hydrocarbon and bioremediation: Okhla landfill site, one of the polluted regions of Delhi, receives 1600 tonnes of waste every day from both commercial and domestic areas. The GC-MS analysis of the soil sample collected from the nearby sites of the heap of waste showed the presence of various poly aromatic hydrocarbons, pharmaceutical compounds, steroidal compounds, personal care products and their derivatives. Bacillus sp. ISTPY1, a pyrene degrading bacterium isolated from contaminated-soil was used to treat the Okhla landfill soil. Organic extract of the landfill soil was extracted with dichloromethane/acetone (1:1 v/v) and was used for the degradation and detoxification studies. GC–MS analysis performed after biodegradation with Bacillus sp. ISTPY1 showed the elimination of various polyaromatic hydrocarbons and other persistent aromatic compounds. For toxicity evaluation, MTT assay was used to check cytotoxicity, alkaline comet assay for genotoxicity and EROD assay was used to monitor the CYP1 A1 induction, a major xenobiotic metabolising enzyme. Toxicity study was done on human hepatocarcinoma cell line HepG2 before and after treatment. The bacterium treated sample initially showed reduction in toxicity till 48hrs. This was increased after 120hrs due to formation of quinones intermediate and further decreased after 360hrs. The LC50 value also showed the same pattern. The reduction in Olive Tail Moment was observed after 360 h treatment. EROD assay results were in positive correlation with MTT assay and Comet assay results. Result of the study indicated biodegradation and detoxification of major contaminants of Okhla landfill by Bacillus sp. ISTPY1.

Emerging contaminants in sewage sludge: Wastewater was collected from Inlet, Aeration Tank, Final Settling Tank, Outlet and sewage sludge from Sludge bed of Vasant Kunj Sewage Treatment Plant (VK STP) in the post-monsoon season. The treatment plant works on Extended Aeration Activated Sludge (EAAS) process. GC–MS analysis of the organic extract of the wastewater and sludge samples showed the presence of PAHs, certain pharmaceuticals, pesticides, and industrial compounds in even after treatment. Although, there was effective removal of phenols and PAHs such as Naphthalene after treatment, yet alkyl benzenes were observed to be present in effluent and sludge samples. There was the detection of 4,4’-((p-Phenylene)diisopropylidene)diphenol in influent and effluent samples indicating its persistence. Also, detection of haloalkanes such as 1-Chlorohexadecane, 1-Bromodocosane and Pentadec-7-ene, 7-bromomethyl- and chloroacetates such as Dichloroacetic acid, 4-hexadecyl ester in effluent was indicative of their recalcitrant nature and persistence even after treatment. Presence of sterols, phthalic acid ester, terpenes and aromatic compounds such as benzene derivatives in sewage sludge could possibly be due to the sorption of hydrophobic substances over the sewage solids which tend to accumulate in sewage sludge during treatment. The results indicate the need for further treatments before their discharge into the environment.

Emerging contaminants bioremediation and detoxification: Leachate from landfills are loaded with toxic organic compounds and heavy metals, posing a serious threat to ground water and surface water bodies, and human health even at trace levels because of their synergistic and additive action. Bioremediation is a promising tool for clean-up of contaminated sites in a cost-effective manner. However, coupling bioremediation studies with toxicological studies is of utmost importance as removal of contaminants not always corresponds to
reduction in toxicity but production of value added products. In the present study, the ability of Pseudomonas sp. ISTDF1 to treat landfill leachate collected from Okhla landfill site, New Delhi, an unlined landfill, was investigated. Response surface methodology (RSM) involving Box-Behnken design was employed to optimize the carbon source, nitrogen source and pH based on removal efficiencies of chemical oxygen demand (COD) and color. Further, the toxic-chemical analysis of the leachate treated under optimized conditions was carried out. GC-MS analysis of the untreated leachate revealed the presence of halogenated aliphatic and aromatic compounds, polycyclic aromatic hydrocarbons (PAH’s), phthalate esters and other emerging contaminants like Lindane and Bisphenol A. Heavy metals like Zn, Cd, Cr and Fe were also found to be present beyond the permissible limit of discharge. GC-MS analysis after 240 hrs of bacterial treatment showed removal of the persistent organics and formation of simpler compounds like Phthalic acid, 2-Propene, 3-Pentanone and 3-Hexen-2-one. ICP-AES analysis also revealed reduction in the concentration of heavy metals bringing them within the limit of discharge. Further, toxicological evaluation using MTT assay for cytotoxicity, alkaline comet assay for genotoxicity and EROD assay for dioxin-like behavior carried out on hepato carcinoma cell line HepG2 before and after bacterial treatment showed significant reduction in toxicity indicating the potency of the strain for bioremediation and detoxification of landfill leachate.

**Bioremediation of dioxin-like compounds:** Chlorinated dibenzo-p-dioxin and dibenzofuran (DF) are most toxic group of persistent organic pollutants (POPs) having carcinogenic, immunosuppressive, endocrine disruptive and teratogenic properties. An alkalotolerant bacterial community developed by continuous enrichment in the chemostat in presence of dibenzofuran (DF) as sole carbon source contained six different types of bacterial isolates cultured on nutrient broth agar plates together with six operational taxonomic units (OTUs) at pH 7.0 and pH 8.0 detected by 16S rDNA-Denaturing Gradient Gel Electrophoresis (DGGE) method. However, isolates of microbial community was declined from pH 9.0 (three OTUs) and ultimately culminated to two strains at pH 10.0 after enrichment in alkaline condition. Among the six isolates tested for degradation of DF, Pseudomonas aeruginosa and Bacillus safensis, the members of alkalotolerant bacterial community had better potency to degrade dibenzofuran. *Pseudomonas aeruginosa* degraded DF through an oxidative route as indicated by 2,2′3-trihydroxybiphenyl, 2-hydroxy-6-(2-hydroxyphenyl)-6-oxo-2,4-hexadienoic acid, salicylic acid and catechol which was identified by GC-MS, however, dioxygenase and a novel anthranilate dioxygenase component enzyme was isolated by ion exchange chromatography, gel filtration, SDS-polyacrylamide gel electrophoresis and MALDI-TOF/MS/MS. Alkalotolerant bacterial community introduced in soil microcosm for evaluation of most suitable isolates for degradation of dioxin-like compound indicated more than 90% degradation of dibenzofuran after 45 days by the bacterial community enriched for 180 days in the chemostat at pH 10, however, microbial community was not competent enough to utilize even 50% DF after day 30 and more than 70% after day 90 which was not enriched in the chemostat. The survival of competent bacteria monitored by DGGE method in soil microcosm indicated presence of two major alkalotolerant isolates for utilization of dibenzofuran, substantiated the results and significance of alkalotolerant bacteria. The detoxification study carried our by animal cell culture based method reduced 80% toxicity after treatment of contaminated sites by bacterium. Results of the study indicated *in situ* bioremediation and detoxification of dioxin-like compounds by bacterium.
NAME2014 Event Photos
Our ENVIS Team at SES, JNU

- Prof. I. S. Thakur, Coordinator
- Dr. N. Janardhana Raju, Co-coordinator

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