**ROLE OF BIOREMEDIATION TO COMBAT POLLUTION HAZARD**

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**ABSTRACT**

Green technology is the application of the environmental science to conserve the natural environment and resources and to curb the negative impacts of human involvement. It can be applied to either the sub-surface or surface layer depending on its location. There is above ground system that treats the soil outside the affected area. The goals informing development in this rapidly growing field include: sustainability, cradle to cradle design, source reduction, innovation and viability. Bioremediation is a green technology that uses genetically engineered living organisms to return the natural environment altered by contaminants to its original condition. It can be an effective bio-weapon on the pollution front. However, it has relatively less potential to reduce heavy metal contamination.

Keywords: Green technology, Bioremediation, Genetic engineering, Bio-weapon, Pollution

**I. INTRODUCTION**

The term technology refers to the application of knowledge for practical purposes. Green technology is the application of the environmental science to conserve the natural environment and resources and to curb the negative impacts of human involvement. The field of green technology encompasses a continuously evolving group of methods and materials from techniques for generating energy to non-toxic cleaning products. The goals informing development in this rapidly growing field include:

1. ***Sustainability:*** meeting the needs of society without damaging or depleting natural resources.
2. ***Cradle to cradle design:*** ending the cradle to grave cycle of manufactured products by creating products that can be fully reused.
3. ***Source reduction***: Lowering waste and pollution by way of changing patterns of manufacturing and intake.
4. ***Innovation:*** developing alternatives to technologies that have been demonstrated to damage health and the environment.
5. ***Viability:*** creating a centre for ecological pastime around technologies and merchandise that benefit the environment and speeding their implementation.

**II. METHODOLOGY**

Various biological processes can be utilized to minimize contamination. Green technology can be applied to either the sub-surface or surface layer depending on its location. The sub-surface layer can be removed while the surface layer can be treated with contaminated soil that is twelve inches down the ground level. Besides tilling, nutrients and water are also added to the soil in order to improve the bacterial growth rate and initiate the process of biological development. Unlike technologies that are directly used to deal with surface and sub-surface contamination, above ground systems treat the soil outside the affected area. Above ground systems are commonly used for treating contaminated soil. They can be divided into two phases: solid-phase and slurry-phase. The former involves the application of a bio-reactor to decontaminate the soil, while the latter involves the use of water and nutrients combined with the contaminated soil. The outcome of both the treatments is the same.

**III. BASIC CONCEPTS OF GREEN TECHNOLOGY**

1. ***Recycling***
2. ***Water purification***
3. ***Air purification***
4. ***Sewage treatment***
5. ***Environmental remediation***
6. ***Solid waste management***
7. ***Renewable energy***
8. ***eGain forecasting***
9. ***Energy conservation etc.***

**IV. ENVIRONMENNTAL REMEDIATION OR BIOREMEDIATION**

Microbes and microbial processes have served the need of mankind since time immemorial and now occupy an enviable position in the core of the new biotechnology revolution. Out of many branches of this biotechnology revolution, “Bioremediation” is one of the most important area of global concern that has emerged in the last decade.

The term bioremediation can be defined as any process that uses living organisms to return the natural environment altered by contaminants to its original condition. Indeed, bioremediation is not a magic to control pollution, but all the available evidences suggest that it can be an effective additional bio-weapon on the pollution front. Various meetings and workshops of scientists and government representatives from USA, Canada, Japan and West European countries are being sponsored by OECD (Organization for Economic Co-operation and Development) since 1991. All have recognised bioremediation as an effective measure to combat the pollution hazard.

Some examples of bioremediation technology are:

1. ***Bio-venting***: It is the in-situ remediation technology that makes use of microbes to biodegrade organic matters absorbed in soil in the unsaturated zone. It involves the induction of air to provide oxygen to promote biodegradation of the organic matter. It is used in the cleaning of petroleum products- gasoline, jet fuels, kerosene and diesel.
2. ***Land-farming***: It is the process that is performed in the upper soil zone or in bio-treatment cells. Contaminated soils, sediments or sledges are incorporated into the soil surface and periodically turned over to aerate the mixture. It is used in the cleaning of oil sledge, petroleum.
3. ***Bio-reactor:*** It is a tool that supports a biologically active environment meant to grow cells or tissues in the context of cell culture designed to treat sewage and wastewater.
4. ***Composting:*** It involves the aerobic decomposition of organic matters- plant and animal matters. The method requires carbon, oxygen, nitrogen, water which can destroy pathogen or unwanted seeds. Microbial pesticide in compost destroy pathogens.
5. ***Bio-augmentation:*** It involves the addition of matched microbial strains to the medium to enhance the resident microbe population’s ability in order to degrade contaminants.
6. ***Rhizo-filtration:*** It is a technique which employs mycelia to filter toxic waste and micro-organisms from water in soil. The mycelium secrets extracellular enzymes and acids that breakdown lignin and cellulose, the two main building blocks of plant fibre. These are organic compounds composed of long chains of carbon and hydrogen, similar to many organic pollutants.
7. ***Bio-stimulation:*** Fertilizers are added in order to increase the bioavailability within the medium.
8. ***Phyto-remediation:*** In this technology, plants play their role. Natural plants or transgenic plants are capable of bio-accumulating toxins (heavy metals like cadmium, lead, mercury etc.) which are not easily absorbed by organisms. They are then harvested for removal. The heavy metals in the harvested biomass may be incinerated or even recycled for industrial use.

**V. GENETIC ENGINEERING APPROACH**

Using genetic engineering to create organisms specifically designed for bioremediation has great potential. The bacteria involved are gluttonous microbes placed within the contaminated site immediately start breaking down the organic constituents. These break up the carbon chains until the contamination is eliminated. It results in the release of carbon dioxide and water with little fatty acid. pH for bacterial growth is 7. Bacteria requires carbon source (carbon dioxide from air) for growth and nitrogen and phosphorus as energy source to sustain their metabolic process.

In early 1980s, little knowledge was available about how toxic wastes interact with the hydrosphere. But with the changing time the researchers acquired the maximum possible utility of these tiny organisms to degrade a wide range of pollutants. Microbes that can grow under extreme environmental conditions are yet to be discovered.

Researchers have also been using genetic engineering to develop new microbial strains with novel bio-degradable capabilities. Microbes are induced with genes that code for enzymes, that breakdown toxic chemicals. They are prepared to be able to survive and grow in much disturbed and harsh environments. This would greatly extend the range of compounds that might be treated with bioremediation.

Many examples in this concern are available out of which the most striking research work is of Japanese research team. They isolated a species of *Pseudomonas* that could grow in solvent containing more than 50% tolune, a condition that kills most organism through cell lysis.

Similarly, many instances of oil tanker leakages in oceans had caused massive devastation of flora and fauna in the past. No doubt, there were methods to neutralise these oil spills, but the most effective and safe measure is the use of biological treatment. The microbes once sprayed on the oil surface, emulsify it and disperse it throughout the water body so thinly that it no longer remain precarious. Professor Anand Chakraborty, a hydrocarbon biotechnologist, working at the University of Llinois Medical Centre, Chicago, USA has developed very efficient oil-eating bacterium “SUPERBUG” using species of *Pseudomonas* through recombination DNA technology.

With the first emerging trends for bioremediation, it is difficult to cite many examples, but broadly three different foci of research and development for bioremediation research are emerging worldwide and these are:

1. ***European upgrading of traditional waste and water treatment systems:*** Using this technology, European countries particularly Germany, Netherland, Belgium Austria and Italy are producing biogas from solid wastes, removing inorganic compounds of water aerobically to reduce BOD, removing toxic chemicals from industrial wastewater, developing biological gas treatment systems to treat air pollutants, etc.
2. ***American focus on on-site specific clean up:*** In the United States, the Environmental Protection Agency includes more than 1200 locations, where this method of bioremediation is extensively used to combat the menace of pollution. This technology is being used to treat sites contaminated with complex organic pollutants including petroleum products in oil spills and sites contaminated with heavy metals or radio-nuclides.
3. ***Japanese Global Application of bioremediation technology:*** This formula of Japanese bioremediation is also working on replacement of petrochemicals, reducing global warming, biodegradable plastics etc.

From the ongoing account it is clear that bioremediation has promising future. It has great potential to clean-up the polluted environment and treat wastes. It can therefore be used as a “Bio-weapon.”

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