**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 use of information for a practical purpose. Green technology is the application of environmental science to protect the natural environment and resources and limit the negative effects of human activities. The field of green technology includes many methods and materials, from energy-saving technologies to non-toxic materials. The development goals of this rapid growth include:

1. ***Sustainability****:* Meeting the needs of society without damaging or consuming natural resources.
2. ***Cradle-to-cradle design*:** Completely recycled by design.
3. **Source reduction**: Reduce waste and pollution by changing production and consumption patterns.
4. ***Innovation:*** Creating alternatives to technologies that have been proven to be harmful to health and the environment.
5. ***Compliance:*** Create ecological parks around environmentally beneficial technologies and products and make them successful.

**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. ENVIRONMENTAL 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:*** This is a home purification device that uses bacteria to biodegrade organic matter absorbed in water. It involves introducing air to provide oxygen to promote the biodegradation of organic matter. It is used to clean petroleum products-gasoline, jet fuel, kerosene and diesel.
2. ***Land-farming:*** It is a process carried out above ground or in a biological treatment room. Contaminated soil, sediment or slides are placed on the soil surface and rotated periodically to aerate the mixture. It is used to clean mud and oil.
3. ***Bio-reactor:*** It is a device that supports a biological environment designed to grow cells or tissues within the scope of cell culture designed to purify sewage and wastewater.
4. ***Composting:*** Involves the aerobic decomposition of organic matter (plants and animals). This method requires carbon, oxygen, nitrogen and water to destroy bacteria or unwanted seeds. Microbial compounds in compost destroy bacteria.
5. ***Bio-augmentation:*** It involves adding bacteria to the culture medium to improve the ability of the microbial population to degrade bacteria.
6. ***Rhizo-filtration****:* It is a system that uses mycelium to filter wastes and bacteria in the soil. Mycelium secretes extracellular enzymes and acids that break down lignin and cellulose, the two main components of plant fibers. These are organic compounds composed of long chains of carbon and hydrogen, similar to many organic pollutants.
7. ***Bio-stimulation:*** Fertilizer is added to increase bioavailability in the environment.
8. ***Phyto-remediation:*** Plants play their part in this technology. Natural herbs or modified herbs can accumulate toxins (heavy metals such as cadmium, lead, and mercury) that are not easily absorbed by the body. They were then collected and deleted. Heavy metals in harvested biomass can be burned or even recycled for industrial use.

**V. GENETIC ENGINEERING APPROACH**

The use of genetic engineering to create specific organisms for bioremediation has great potential. The relevant bacteria are voracious bacteria that settle in the infected area and immediately begin to digest organic components. They disrupt the supply chain until the pollution is eliminated. It causes the release of carbon dioxide and water, as well as small amounts of fatty acids. The pH value for bacteria to multiply is 7. Bacteria need carbon dioxide (carbon dioxide in the air) to multiply, and nitrogen and phosphorus as energy to maintain their metabolic processes.

In early 1980s, little was known about how organic waste interacts with the hydrosphere. But over time, scientists have achieved the best results in increasing the amount of pollution from these tiny organisms. Bacteria that can grow in this environment have not yet been discovered.

Scientists have also used genetic engineering to create new strains of bacteria with new biodegradation abilities. These bacteria are stimulated by genes that code for enzymes that digest toxins. They are prepared to survive and thrive in an environment full of distractions and extreme pain. This will expand the range of compounds that can be treated with bioremediation.

There are many examples of this and the best research is done by the Japanese research group. They isolate strains of Pseudomonas that can grow in a solvent containing more than 50% toluene, which kills most bacteria through cell lysis.

Similarly, many tanker oil spills into the oceans in the past have caused great damage to animals and plants. 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. He has a great ability to clean dirty places and handle garbage.

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