European Journal of Biotechnology and Bioscience
ISSN: 2321-9122; Impact Factor: RJIF 5.44
Received: 05-11-2019; Accepted: 07-12-2019; Published: 14-01-2020
www.biosciencejournals.com
Volume 8; Issue 1; 2020; Page No. 07-09

Bio-Remediation Technology For Waste-Water: An Eco-Friendly Approach

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Abstract
In the present scenario, waste is one of the widely used problems around the globe due to its enormous properties. Due to its dumping from domestic to industrial level, every year billion tons of waste gets accumulated in the environment. Waste poses a serious threat to both terrestrial and marine biota, among the various methods to tackle with the wastewater, bioremediation is considered as the most eco-friendly and cost-effective method. Bacteria from Mula-Mutha River such as Ecoli, Serratia, and Bacillus degrade the contaminants from it. This Review paper serves as the opening chapter of the present Bioremediation Technology for Wastewater treatment, and describes the basic concept of bioremediation and enlists various types of environmental waste.

Keywords: waste, wastewater, bioremediation, microorganisms

1. Introduction
"Waste" is everything unwanted; unwanted material needs to be disposed of. Water is the most precious natural source which is required for the survival of life and the economic development of every nation. Since the last few decades, environmental pollution is one of the major challenges of today's civilization. Worldwide growth and expeditious industrialization have led to the recognition and increasing understanding of the interrelationship between pollution, public health and environmental well-being (Kaushik *et al*., 2012) [3]. According to the World Water Development Report (2012) [4] predicts 47% of the world population will be living in areas of high water stress by 2030. The developing countries of the world have a major share of water pollution. According to the United Nation's World Water Assessment Programme (WWAP, 2015) [6] around 90% of the total waste in these countries is diverted to sources like rivers and lakes, without subjecting it to proper treatment which has caused gross contamination of rivers and lakes within and around urban centres with known and unknown pollutants. In developing countries like India and China, rapid urbanization is causing a burden on their natural water resources and hindering their sustainable development. It is found that in India one-third of total water pollution comes in the form of industrial effluent discharge, solid wastes and other hazardous wastes posing a potential hazard to the natural surface water systems like rivers and lakes (Kansal *et al*., 2011) [7]. Bioremediation is one of the in-vitro as well as in-vivo Biotechnological remediation treatments whereby organic wastes are biologically degraded under controlled, managed conditions. This technology invented by using microorganisms was invented by George M. Robinson. By the definition, bioremediation is the use of living micro-organisms, to degrade the environmental contaminants toxicants into less toxic forms.
This technique uses naturally occurring bacteria and fungi or plants to degrade or detoxify substances hazardous to the human being.
(https://www.avma.org/PracticeManagement/Administration/Pages/Definitions-What-is-Waste.aspx

1.2 Bioremediation
Bioremediation is a natural terminology but seldom induced to clean up the environmental contamination like water pollution and is carried out by deteriorating, applying microbes (mostly fungi and bacteria) (Korda *et al*. 1997) [8]. These microbes are regarded as a biological agent of municipality members of nature. If these microbes had not been available in nature, the present earth might have entangled with the debris, and water pollution and the important nutrients needed for the Continuation of life might have been buried in the wastes (National Research 1993) [9].

1.3 Purpose of Bioremediation
The main purpose of the bioremediation is to clean or to restore the contaminated environment at low costs and eco-friendly method using microorganisms as key players (Azubuike *et al*. 2016) [1]. These microbes target the waste to get the carbon source and other nutritional requirements needed for the continuation of life.

1.4 Types of Environmental Waste
Even after the advancement of human civilization in all the fields from domestic to industrial level, the ultimate truth is deterioration, which leads to the generation of different kinds of wastes in the environment. From all the waste-generating sources, three major kinds of environmental waste are reported, such as agricultural waste, toxic waste generated from different factories, industries and hospitals, and waste generated from households, hotels, and restaurants. Plastic waste includes municipal solid waste, and as per estimate around 1.3 billion tons of municipal solid waste is being generated around the globe annually, and it is expected to get doubled by the end of 2025 (Hoornweg and Bhada-Tata 2012) [2].

1.5 Biological Treatment of Waste Water

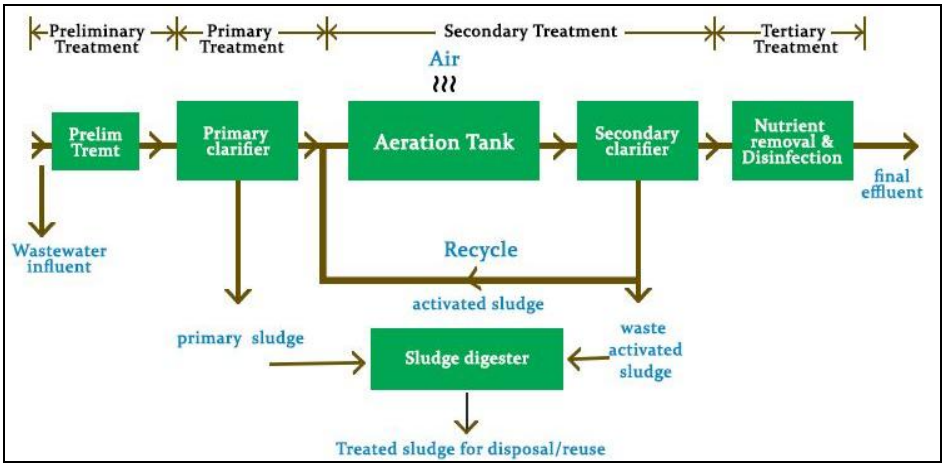

Fig 1: Biological Treatment of waste Water (http://neoakruthi.com/blog/biological-treatment-of-wastewater.html)

Biological wastewater treatment is an integral step of the wastewater treatment system and it treats wastewater coming from either from household waste and industry. It is called as Secondary Treatment process which is used to remove any toxicants, contaminants that leftover after primary treatment. Chemical treatment of wastewater makes use of chemicals to react with pollutants present in the wastewater and whereas biological treatment uses microorganisms to degrade wastewater contaminants. This treatment by using bacteria,

Nematodes, algae, fungi, protozoa, rotifers to break down organic wastes using cellular processes to stable inorganic forms. Based on the various processes, the biological treatment of wastewater methods are majorly classified into two types and are as follows:

1. Biological Aerobic Treatment (in presence of oxygen)
2. Biological Anaerobic Treatment (in absence of oxygen)

1. Biological Aerobic Treatment: Aerobic wastewater treatment is a biological process that takes place in the presence of oxygen. It is the rapid and the most efficient biological waste treatment which removes up to 98% of organic contaminants. Aerobic biological treatment involves various processes include activated sludge process, trickling filter, aerated lagoons, and oxidation ponds, etc. The activated sludge process is the most widely used process for domestic and industrial wastewater.

a. **Activated Sludge Process:** In this method, the sewage containing organic matter with the active microorganisms is aerated in an aeration tank. This process enhances waste decomposition. Aeration in an activated sludge process is based on pumping air into a tank, which promotes microbial growth in the wastewater. The effluent from the aeration tank containing the inoculants microbial mass, known as sludge, is separated in a settling tank, sometimes called a secondary settler or a clarifier.
b. **Trickling filters:** This is the second commonly using type of aerobic treatment which is also called percolating or sprinkling filters. These filters are commonly used to remove compounds such as ammonia from the water after primary treatment. The secondary effluent that settles will either enter a digest.
c. **Aerated Lagoons:** An aerated lagoon is a treatment pond that is provided with mechanical aeration that introduces oxygen into the pond to promote the biological oxidation of the wastewater.
d. **Oxidation Pond:** The ponds involve the treatment of bacteria, algae and other organisms which feed on the organic matter received from primary effluent.

2. Biological Anaerobic Treatment

This treatment process is to treat the high amount of wastewater and it records organisms that function in the absence of oxygen and it will typically treat high-strength wastewater to a level that will permit discharge to a municipal sewer system. Here, the amount of semisolid waste produced is very small when compared to aerobic treatment. Anaerobic treatment is a very slow process and it occurs in many different stages. Anaerobic digestion is a biological process that is used in wastewater treatment plants for sludge degradation and stabilization. Once the process is completed, the wastewater can undergo many additional treatments. This process is followed because it can stabilize the water with great biomass production. Biogas is produced as the bacteria feed off the biodegradable material in the anaerobic process, the process converts about 40% to 60% of the organic solids to methane (CH_4) and carbon dioxide (CO_2). (http://neoakruthi.com/blog/biological-treatment-of-wastewater.html)

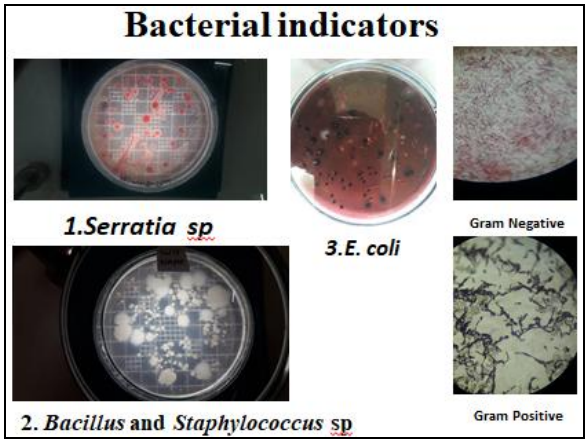

Fig 2: Seasonal bacteria used in bioremediation in Mula-Mutha River water, Pune.

1.6. Conclusion

This is output of authors M.Phil. Work, Concerns for new biotechnologies released into the wastewater treatment do exist and there is a tremendous potential for technology to contribute to the remediation and protection of the environment. The author studied and isolated three seasonal bacteria from Mula-Mutha water that effectively degrade pollutants from it. (Fig.2).

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