

## **Chapter 6: Environmental Preservation Part 1 (Biological Purification)**

### **Introduction**

Our environment faces the problem of pollution, represented by the significant presence of pollutants causing negative changes to the natural environment. Pollution can be in the form of matter (solid, liquid, or gas) or energy (radioactivity, heat, noise). Therefore, treatments were needed to at least reduce pollution, including biological purification.

### **1. Definition of Biological Purification**

Biological purification (or bioremediation) is a group of environmental sanitation biotechnologies that use the metabolic capacity of bacterial microorganisms, fungi, and plants (or their isolated enzymes) to eliminate contaminants in soil and water.

### **2. Contaminants Treatable Biologically**

Heavy metals, radioactive materials, toxic organic pollutants, explosives, petroleum-derived organic compounds, polluting bacteria (fecal contamination), and others...

### **3. Domains of Use**

Biological purification techniques are generally used on polluted water and soils. This process is typically not applied to polluted air, for which physical or chemical processes are generally used.

### **Forms of Biological Purification**

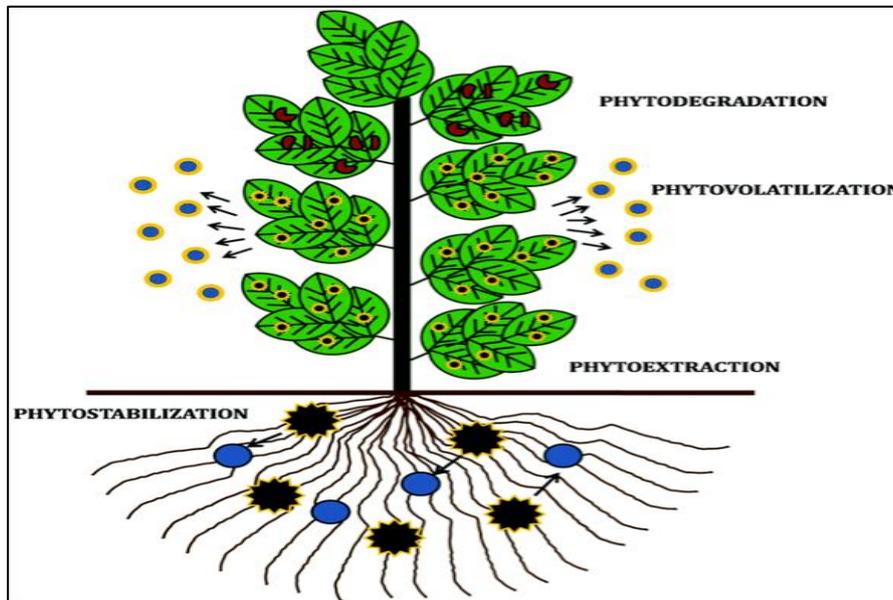
There are several forms, but we focus on two major ones:

#### **A. Phytoremediation (Purification by Plants)**

The use of plants to remove certain pollutants from soil and water. It is an important, simple, and cost-effective method that does not cause environmental damage.

- **Mechanism:** Plants vary in their ability to absorb heavy metals (like copper and tin) or organic matter.

- **Plant Types:** Fast-growing wild herbaceous plants, weeds, seasonal crops, sunflowers, and aquatic plants (especially for freshwater and river purification in industrial cities).



✓ **Types of Phytoremediation:**

- **Rhizofiltration:** Biological treatment purifying polluted water in the soil; plants absorb pollutants via roots.
- **Phyto-accumulation:** Accumulation of toxins/pollutants in upper plant parts (stems, leaves).
- **Phyto-degradation:** Breaking down pollutants (e.g., petroleum products like oil, gasoline) into less harmful byproducts.
- **Phytovolatilization:** Pollutants are absorbed by roots, transformed into gaseous components, and released into the atmosphere.
- **Phytostabilization:** Reduces pollutant movement by preventing soil erosion/cracking, then absorbing and expelling pollutants.
- **Phyto-extraction:** The plant absorbs a pollutant and oxidizes it (using oxygen, ozone, water) into less toxic products.

✓ Examples of purifying plants:



Tournesol



Peuplier



*Trypholiumcpmpestre*



Roseaux



Beta vulgarise

## B. 2 Biostimulation (Use of Microorganisms)

A biological purification technique for water and soil where pollutant decomposition by microorganisms is catalyzed by chemical or biochemical additives.

- **Aerobic Bacteria:** Require oxygen (supplied to treatment tanks) to convert organic matter into biological mass and minerals into oxides.
- **Anaerobic Bacteria:** Function without oxygen, converting organic matter into gases like methane, hydrogen, and sulfur.

✓ examples of purifying microorganisms (bacteria)



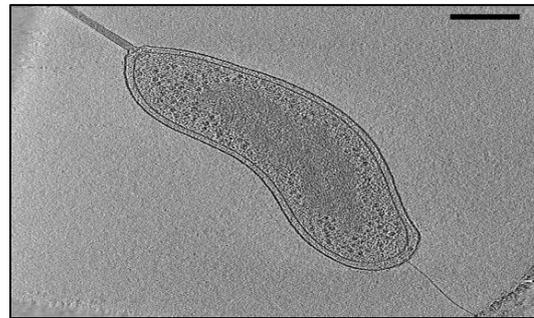
*Marinobacter*



*Pseudomonas*



*Clostridium*

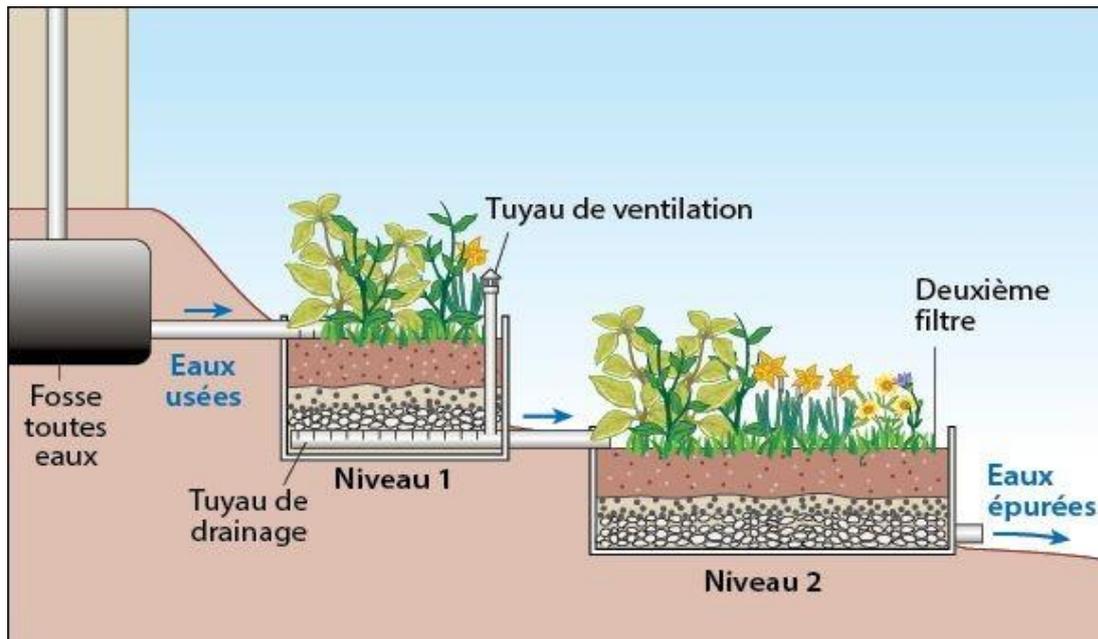


*Bdellovibrio bacteriovorus*

### Use of Trickling Filters (Lit Bactérien):

This technique supports purifying microorganisms on porous materials. Water is dispersed at the reactor top and flows through the packing (biofilter).

- **Support Media:** Inert porous materials with ~50% void space (minerals like pozzolana, coke, plastics, volcanic rocks, pebbles).
- **Process:** Effluent is filtered through the media where the active microbial mass is fixed.



Lit bactéries

## 6. Conclusion

While biological purification is effective, easy, harmless, and less expensive, it cannot be applied alone. It is generally accompanied by other techniques:

- **Chemical Treatment:** Decomposes hazardous waste into non-toxic gases or modifies chemical properties (reducing solubility, neutralizing acidity/alkalinity).
- **Physical Treatment:** Requires external mechanical, electrical, or thermal energy input.

**Example:** A **Wastewater Treatment Plant** uses physical treatment (pre-treatment), followed by chemical and biological treatments using microorganisms.