

TD II: Pollutant Treatment and Environmental Purification

2 - Environmental Purification Techniques (Decontamination):

The results of pollutant treatment shown in Table (01) can be further developed using precise analyses and statistical indices in order to assess and measure the pollution rate of an environment and to choose the appropriate purification technique.

2-1 - Atmospheric Environment Purification Techniques:

2-1-1 - Mechanical Filtration: It consists of capturing suspended pollutants using a fan that forces air through a medium made of natural, mineral, or synthetic fibers (CO₂).



Figure 01. CO₂ Capture (Filtration by Ventilation)

2-1-2 - Adsorption: This process is carried out through adsorbing media equipped with charcoal or gel cartridges in ventilation systems, in order to attract and trap pollutant particles (VOCs).

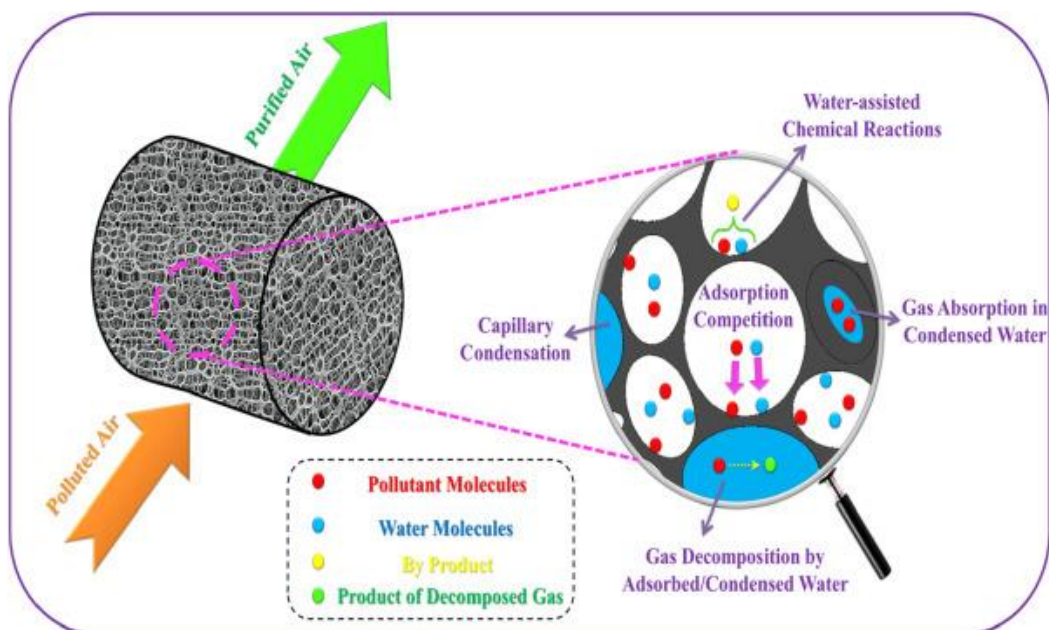


Figure 02. Charcoal Cartridge (Adsorption of VOCs)

2-1-3 - Electrostatic Capture: This technique consists of creating an electromagnetic field within a confined atmosphere in order to change the charge of pollutant particles (ionization) and cause their precipitation onto surfaces (pollens).

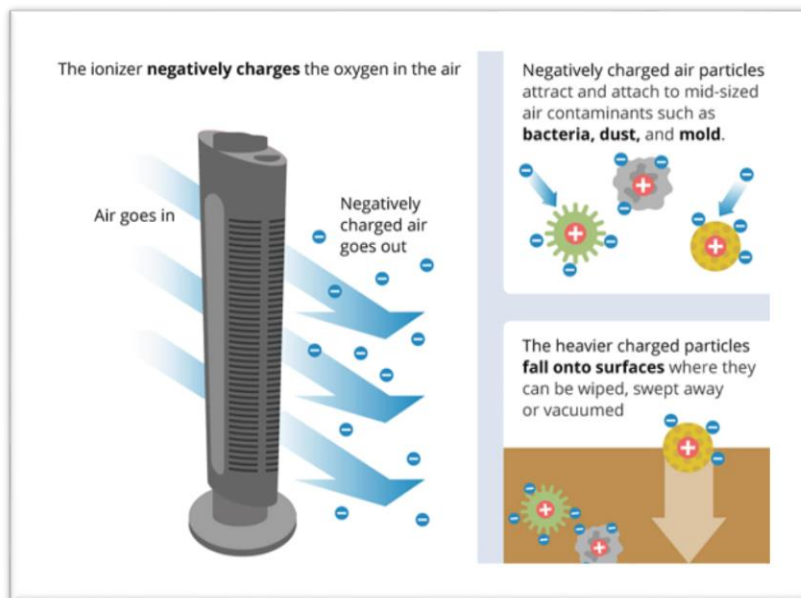


Figure 03. Ionization of Pollutants by Electromagnetic Field

2-1-4 - Ozonation: This process involves releasing ozone (O_3) molecules into the air. After dissociation into (O_2) and (O), these molecules have the ability to oxidize suspended pollutant compounds (CO_2 – VOCs) in order to decompose them.

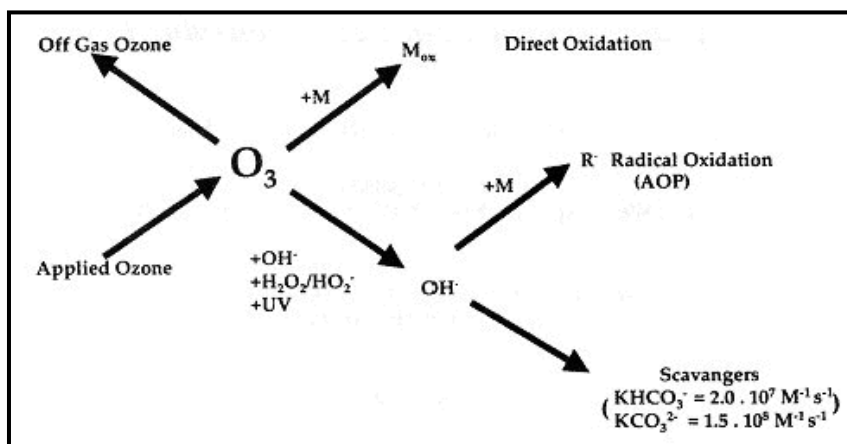


Figure 04. Oxidation Reactions by Ozone

2-1-5 - Photocatalysis: A light-radiation system equipped with a catalyst can decompose the pollutant elements it passes through by means of successive chemical reactions (organic pollutants).

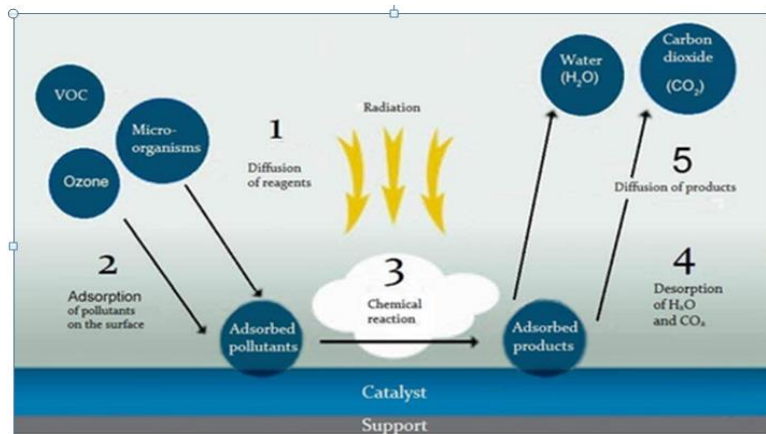


Figure 05. Principles of Photocatalysis

2-2 - Techniques for Aquatic Environment Purification:

2-2-1 - Autonomous Sanitation: It includes typical installations at the municipal level, aiming to prepare domestic wastewater for purification through siphon-shaped walls in the form of septic tanks.



Figure 06. Autonomous Sanitation

2-2-2 - Lagooning: This technique allows the separation of solid elements from wastewater by sedimentation in ponds that receive polluted water. Through physical, chemical, and biological processes, it contributes to purification.

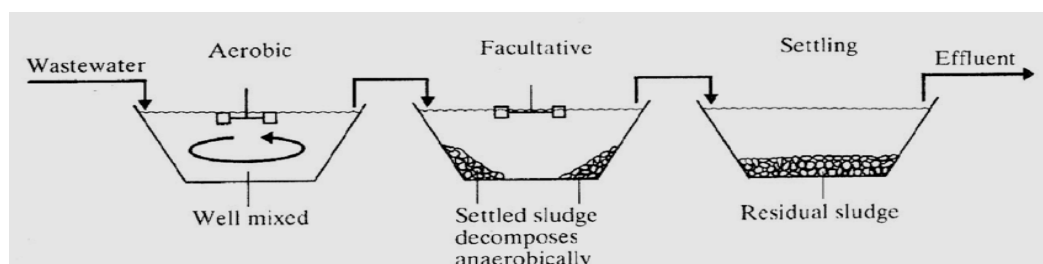


Figure 07. Principle of Lagooning

2-2-3 - Wastewater Treatment Plant: In this case, purification takes place in successive basins through several stages:

2-2-3-1 - Pretreatment: This includes:

- **Screening:** Passage of polluted water through metal bars.
- **Desanding:** Recovery of sand and mineral particles.
- **Degreasing (Oil Removal):** Recovery of oils and fats.

2-2-3-2 - Primary Treatment: It allows the elimination of organic matter through decantation in a cyclone-shaped system.

2-2-3-3 - Biological Treatment: This process is carried out by microorganisms that degrade pollutant matter and transform it into sludge.

2-2-3-4 - Physico-Chemical (Complementary) Treatment: During this stage, several processes aim to eliminate nitrogen, phosphorus, and microorganisms.

2-2-3-5 - Sludge Treatment: It consists of reducing the volume of sludge and decreasing its fermentative capacity. A chemical treatment is then applied to this phase to eliminate odors.

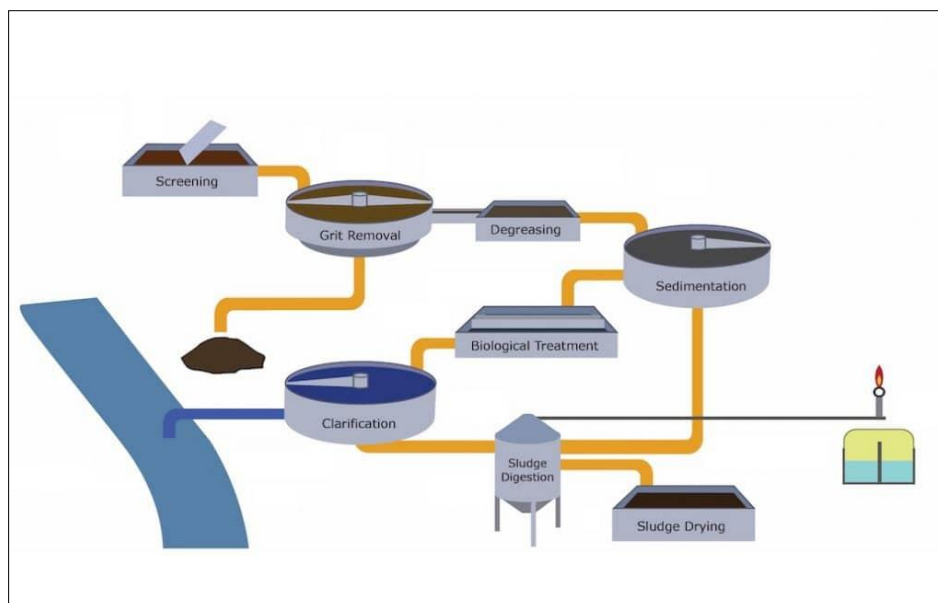


Figure 08. Main Stages of Wastewater Decontamination in Treatment Plants

2-3 - Techniques for Terrestrial Environment Purification:

2-3-1 - Thermal Treatment: This process treats polluted soils through reducing gases at very high temperatures (around 2000 °C) in order to degrade pollutant particles.

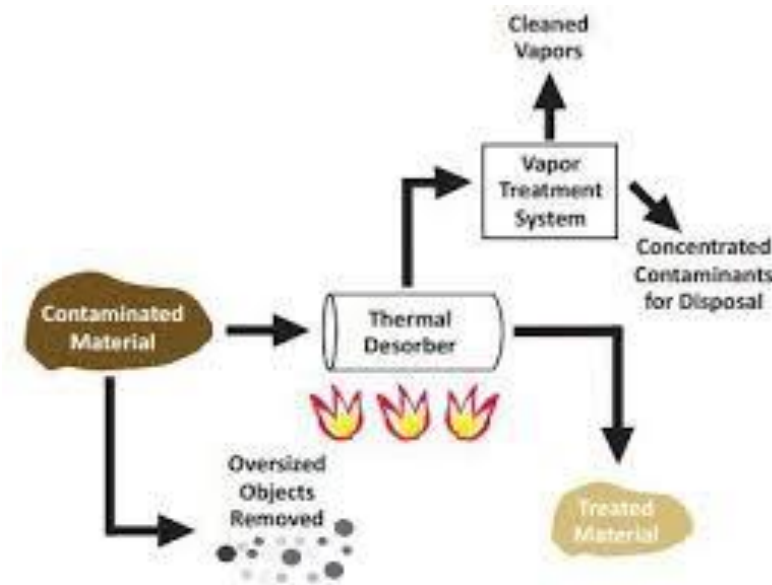


Figure 09. Soil Decontamination by Thermal Treatment

2-3-2 - Leaching: This is the removal of pollutant molecules from the soil by extraction. Flooding the soil with water containing acids or alkalis can decompose all toxic particles.

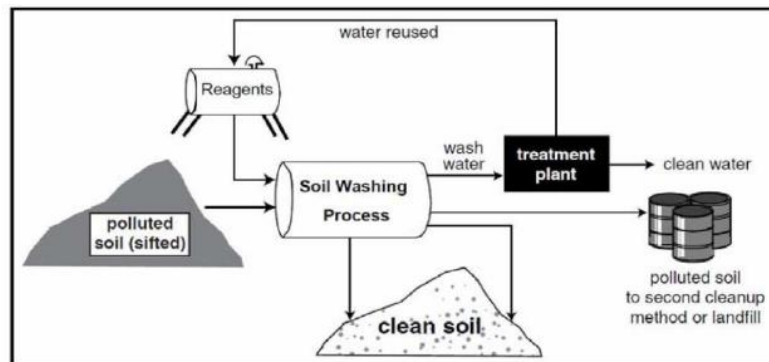


Figure 10. Soil Decontamination by Leaching

2-3-3 - Solidification: This technique transforms soil waste from its initial form into a solid form, reducing its mobility and allowing its later elimination through wind or flooding.

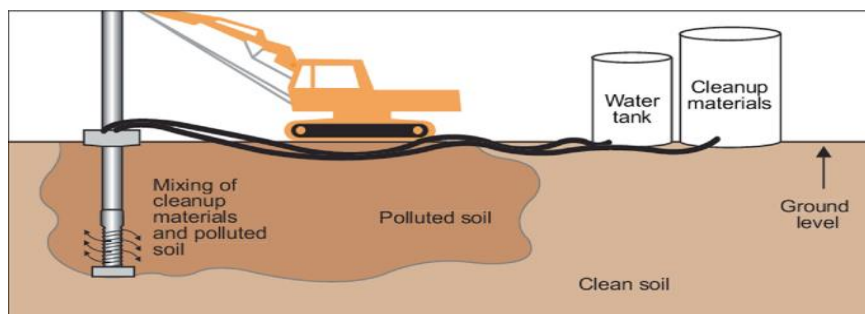


Figure 11. Soil Decontamination by Solidification

2-3-4 - Biological Treatment: Plants that accumulate heavy metals can contribute to soil decontamination. Certain microorganisms can also be used to clean soils and decompose toxic elements.

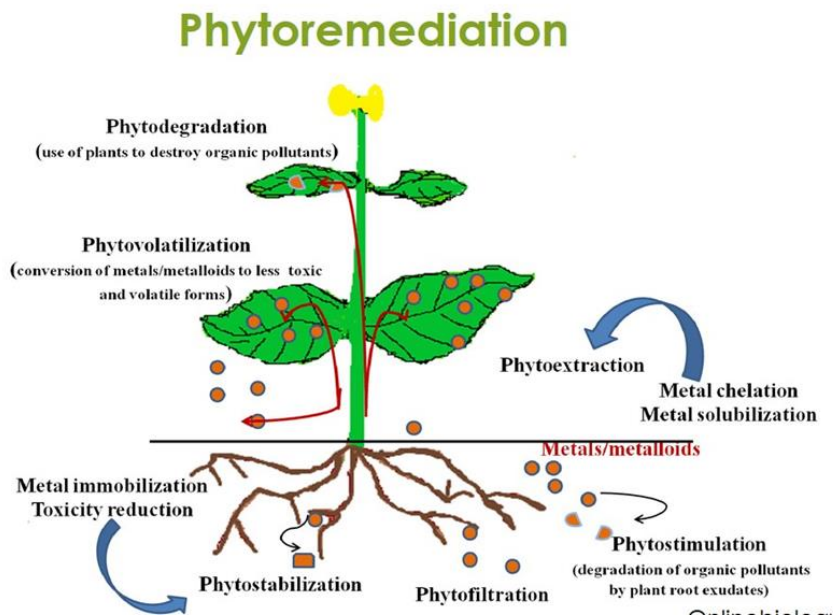


Figure 12. phytoremediation strategies