**Chapter 05: Detection and treatment of pollutants and**

**of waste**

Pollution is the degradation of an ecosystem by introduction, usually human, of substances or radiations which alter the product more or less significantly the functioning of this ecosystem.

1. **Air purification:**

An air purifier is a device intended to eliminate domestic and. industrial pollution, It filters the air and eliminates bad odours. Air purifiers improve air quality. They are used by industry to. filter out and remove toxic residues, in hospitals and airlines to. prevent the spread of viruses and bacteria. They are also used in. offices and homes to improve hygiene, quality of life for each individual and. reduce the risk of contagion and disease.

1. **Types of purifier:**

For the treatment of domestic and industrial pollution, we distinguish generally four types of air purifiers:

* air purifiers by filtration;
* ionising air purifiers;
* combustion air purifiers;
* air purifiers by photocatalysis.

**2.1. Air purifier by filtration:**

Filter scrubbers do not destroy domestic pollution. They filter it:

* either from high-capacity filters;
* either by using an ionizer.

To destroy air pollution and volatile residues, another type of of a purifier in addition.

The HEPA (High Efficiency Particulate Air filter) is used to filter allergens, pollens, bacteria and viruses but is not necessary for chemical pollutants. This filter of Capacity is used in hospitals or aircraft air conditioners.

In addition to its high cost, the filter replacement is subject to a strict procedure, which reduces its possibilities of domestic and individual use. This purifier has no action on chemical pollutants (household detergent, pollution atmospheric, etc.).

**2.2. Air purifier by ionizer:**

The air purification by ionizer produces a chemical reaction: it generates ions negatives (anions) that amalgamate the suspended particles. By charging them negatively, dust, pollen, animal hair and any other compound harmful volatile organic compounds (VOCs) fall to the ground or attach themselves to furniture.

The ionizer captures but does not destroy the particles, so the VOCs must be sucked in by another means.

Ionization air purifiers do not treat chemical pollution of the type industrial and domestic, nor bacteria and viruses in the air. They are supplemented by other types of purifiers, in general, HEPA filters.

**2.3. Combustion air purifier:**

Combustion air purifiers destroy particles by burning the particles harmful or by raising the air temperature. They emit purified air but increase the concentration of ozone (O3) in the air, generate an unpleasant odour and increase ambient temperature.

**Plasma:**

Plasma air purification, is a technology that propels outside the device

an oxidant. By exciting the oxygen in the air, it destroys harmful particles in the air.

This technique is generally better suited for industrial uses than for purification domestic air. This technique is used to reduce emissions of gases exhaust pipes, especially those of diesel cars.

This purification is useful for the destruction of bacteria and viruses, it comes from the space conquest, is mastered only by a very small number of companies (Air In Space, Biozone Europe). Therefore, there is no real competition for the large the public to benefit from this technology at an attractive cost.

**2.4. Air purifier by photocatalysis:**

The air purifier by photocatalysis combines filtration of volatile particles and Destruction of viruses and bacteria, solvents, detergents and nitrogen oxides.

It consists of a fan, which captures the particles, an ultraviolet lamp type UV-A (or UV-C) and a catalytic medium of titanium dioxide (Ti02). When exposed to ultraviolet light, the catalyst (for example titanium dioxide) becomes a strong oxidant that destroys odours, volatile organic compounds (VOC, allergens and pollen), the residues of chemical and atmospheric pollution such as nitrogen oxides (NOx) released from the exhaust pipes. The catalyst also destroys bacteria and viruses through this natural phenomenon.

**3. Wastewater treatment:**

Pretreatment consists of three main steps that remove water the elements that would interfere with subsequent processing phases. All stations of purification are not necessarily equipped with the three, only the fence is generalized, the others are sand-blasting and oil removal.

**3.1. Grating and sieving:**

Screening and sieving remove insoluble waste from the water such as industries, plastics, sanitary napkins, etc. Indeed, these wastes cannot be to be eliminated by biological or physico-chemical treatment, they must therefore be eliminated mechanically. To do this, the waste water passes through one or more grids are becoming increasingly tight. These are usually equipped with automatic cleaning to avoid their clogging, and also to avoid the Pump malfunction (if there is a pumping system).

**3.2. De-sanding:**

The sand blasting allows, by decantation, to remove the sands mixed in the waters by runoff or brought by erosion of the pipes. This material, if it was not removed, would be deposited further away, interfering with the operation of the station and causing wear faster mechanical elements such as pumps. The extracted sands can be washed before landfill, to limit the percentage of organic matter, the degradation of these causing odours and mechanical instability of the matter.

**3.3. Degreasing:**

The flotation principle is generally used for the removal of oils. Its principle is based on the injection of fine air bubbles into the oil removal tank allowing the surface fats to rise quickly (the fats are hydrophobic). They are then removed by scraping the surface. It is important to limit as much grease as possible in downstream structures to avoid example a fouling of structures, especially pipes. Their disposal is also essential for limiting the problems of emissions of problems with settling or disturbances in gas exchange. Sand-blasting and oil removal are most often carried out in the same work: the sands settle at the bottom of it while the fats rise to the surface. Oil removal can also by coalescence. This process allows an extraordinary level of oil removal

Secondary treatment is most commonly done by biological means. A physico-chemical can replace it or more often add to it to promote flocculation and coagulation of sludge or allow, for example, phosphate fixation.

1. **Soil treatment:**

Four techniques are possible depending on the type of pollution:

* in situ,
* on site after excavation,
* off-site
* by confinement.

**4.1. In situ processing:**

This method of treatment allows pollutants to be extracted and treated on-site. These are either degraded or fixed in the soil by means of hydraulic binders.

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| **Nature of pollution** | **Treatment principle** | **Type of treatment** |
| volatile products | Extraction of pollutants volatile by setting depression. | Venting  (extraction under  void) |
| hydrocarbons | Degradation of pollutants by bacteria | Bio-degradation |
| Volatile hydrocarbons and semi-volatile | Combination of the two previous techniques | Bio-venting |
| Vaporisable pollutants  (chlorinated solvents) | Steam phase of dissolved pollutants | Stripping |
| All products (including organic pollutants or metals) | Driving pollutants to  water and recovery by  pumping | Leaching |

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* 1. **Treatment on site after excavation of land:**

It allows the land to be extracted and treated. The land can then be left on the site or evacuated after treatment.

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| **Nature of pollution** | **Treatment principle** | **Type of treatment** |
| Light and heavy hydrocarbons,  metals | Extraction by water or with a solvent | Wash |
| Volatile hydrocarbons not  chlorinated (gasoline, fuel oil, kerosene) | Evaporation and/or cracking  and/or incomplete combustion | Desorption  thermal |

* 1. **Off-site processing:**

It allows the excavation and evacuation of waste, polluted land and water to a suitable processing or storage.

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| **Nature of pollution** | **Type of treatment** |
| All (except constraints  of acceptance) | Landfilling in class site  I |
| Hydrocarbons | Biological treatment in collective centre |
| All (except constraints  of acceptance) | Incineration in specialized centre |

* 1. **The confinement:**

The containment allows to leave the land to be cleaned on the site by preventing the Spread of pollutants through a waterproof barrier: geo membrane, cover waterproof, moulded wall, etc. Soil erosion, water percolation to the groundwater and This prevents runoff on contaminated land.

**5. Waste treatment:**

**5.1. Thermal treatment by incineration:**

The plants are equipped with smoke treatment and cleaning systems before emissions to the atmosphere well beyond regulatory requirements, in accordance with to the objectives of the regulatory anticipation group. Releases are measured and analyzed continuously, and are controlled by accredited laboratories. They are also subject to DREAL control.

The thermal energy emitted by flue gas treatment plants is recovered and recovered as electricity and/or steam.

**5.2. Storage:**

The waste is stored in dedicated cells designed under quality assurance plan, and whose levels of tightness go beyond the regulatory requirements to long-term preservation of the environment. Traceability is guaranteed through 3D filling management that allows a topographical identification of the waste stored.

**5.3. Physico-chemical treatment:**

The treatments depend on the nature of the waste: treatment of effluents on ion-exchange resins, neutralization of extreme pH (base acids), breaking down Oil emulsions by centrifugation, biological treatment, ...