



## Waste Gas; Types and Treatments

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## Outline

- Waste gas treatments
- Biofilters



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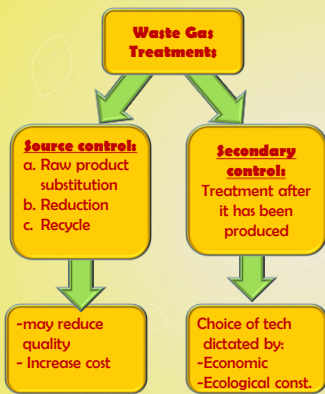
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## Waste gas treatments



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## Types of waste gas treatments

- a. Condensation
- b. Incineration
- c. Adsorption
- d. Absorption
- e. Membrane systems
- f. Biological Treatments




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## 1. Condensations

- Applicable for waste contaminant that are:
  - > concentrated and have a high boiling point
  - > have recycle or recovery value
  - > recovery is impossible for mixed pollutant stream
- Mechanism:
  - > waste gas are treated by simultaneous cooling and compressing




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## 2. Incineration

- Widely used, suitable for moderate flow rate waste
- Mechanism:
  - > thermal incineration involves combustion at tempt of 700-1400 °C
  - > catalytic incineration (used platinum, palladium, rubidium) at 300-700°C
- Drawbacks:
  - > high cost esp for low conc. Waste
  - > need a large amount of fuel
  - > produce another pollutant (Nox, dioxins)




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### 3. Adsorption

- **Most efficient for:**
  - > low concentration vapour
  - > low vapour pressure
  - > high molecular weight waste gas
- **Common methods:**
  - > fixed or fluidized bed of material such as activated carbon or zeolite
- **Function of effectiveness:**
  - > air flow rate
  - > total VOC loading




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### 3. Adsorption

- **Limitations:**
  - > misjudgment of bed saturation often encountered, bed maybe renewed before it is necessary
  - > the saturated bed materials are often treated as hazardous material
  - > increasing operational cost for its treatment
  - > generally it is treated by:
    - a. Desorption with steam or hot air
    - b. Disposal
    - c. incineration




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### 4. Absorption

- **Process:**
  - > removes contaminant with a scrubbing solutions (water mostly used)
  - > gas enters a large contactor
  - > gas are transferred to a liquid phase
  - > silicon oil maybe used for hydrophobic pollutant
  - > after gas are transferred to liquid, additional treatment need to be applied.
- **Drawbacks:**
  - > need additional treatment for liquid phase (incineration. Additional wwtp)




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## Vertical Venturi Scrubber




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## Packed Bed Scrubber




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## 5. Membrane Systems

- The subsequent process of condensation
- Process:
  - > gas stream are compressed to 310-1400 kPa
  - > the pressure differential drives the membrane separation process
  - > the membrane pores remain filled with water
  - > the organic vapour transferred through the membrane
  - > the process than requires treatment of liquid permeate for final VOC disposal




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## 6. Biological treatments

- Utilize microbial metabolic reactions
- Effective and economical for low concentrations of contaminant in large quantities of air.
- The contaminant maybe used as energy or carbon source for microbial growth
- Most succesfull for low molecular weight and highly soluble organic compound with simple bond structure (H<sub>2</sub>S or Ammonia)




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## 6. Biological treatments

### • The appropriate industries:

- Animal husbandary (slaughterhouse)
- Composting
- Crematorium
- Food Processing
- Fragrance
- Furniture
- Landfill gas extraction
- Pulp and paper
- Petroleum industries




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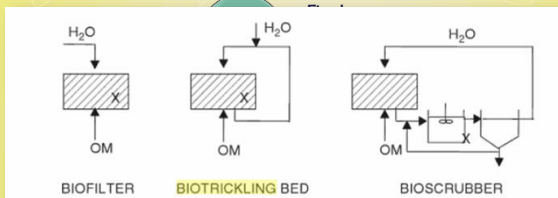
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## 6. Biological treatments



- Suspended Microorganism
- Flowing water phase




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## Operational Concerning Factors

- Characteristics of supporting medium (porosity, degree of compaction, water retention capability, ability to host microbial populations)
- Microbial inoculum
- Medium pH
- Temperature
- Medium moisture
- Nutrient content




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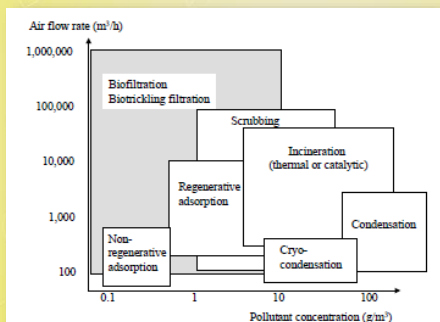
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## Applicability of various air pollution control




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## Case Studies

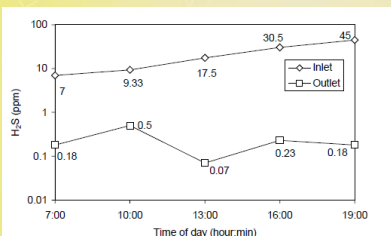


Figure 6. Picture of the UCR biotrickling filter installed at Hygiene Wastewater Treatment Plant in Los Angeles.

- 98% H<sub>2</sub>S RE
- 50-70% (toluene, benzene, xylene)




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**Thank You**



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