

4.3 ADSORPTION

- When a gas or vapor is brought into contact with a solid, part of it is taken up by the solid.
- The molecules that disappear from the gas either enter the inside of the solid, or remain on the outside attached to the surface.
- The former phenomenon is termed absorption (or dissolution) and the latter adsorption.
- The most common industrial adsorbents are activated carbon, silica gel, and alumina, because they have enormous surface areas per unit weight.
- Activated carbon is the universal standard for purification and removal of trace organic contaminants from liquid and vapor streams
- Carbon adsorption systems are either regenerative or non-regenerative.
- Regenerative system usually contains more than one carbon bed. As one bed actively removes pollutants, another bed is being regenerated for future use.
- Non-regenerative systems have thinner beds of activated carbon.
- In a non-regenerative absorber, the spent carbon is disposed of when it becomes saturated with the pollutant.

Use of Activated carbon is determined by:

- Flow rate
- Pollutant concentration: Higher usage at higher pollutant concentrations. However, the specific load increases; in other words, one needs less activated carbon to collect a particular pollutant quantity.
- Pollutant type
- Gas temperature: Higher temperatures lead to higher usage.
- Gas humidity: Higher humidity level leads to higher usage
- Pressure: Higher pressure leads to lower usage

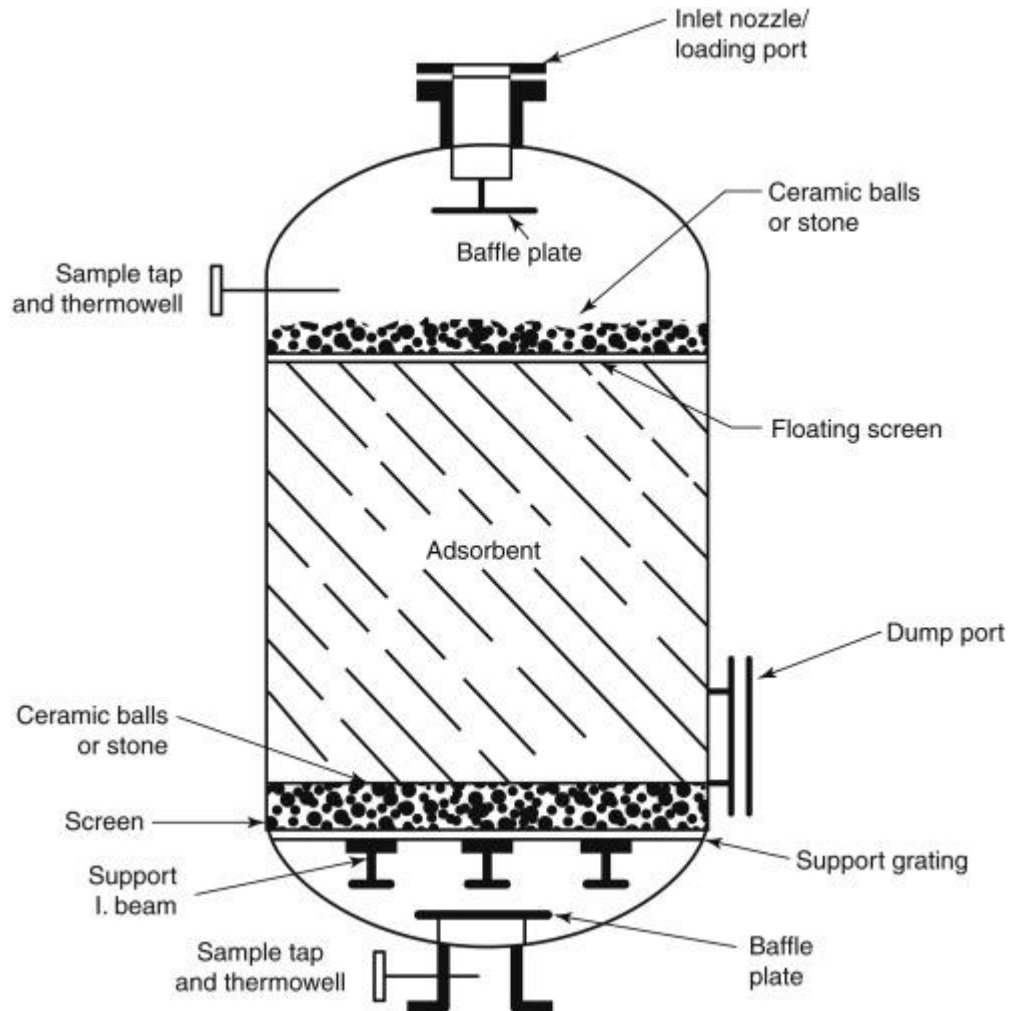


Figure 4.3.1 Adsorption

[Source: https://emis.vito.be/sites/emis/files/data_sheets/migrated/active_carbon_adsorption_2.PNG]

Advantages

- High efficiency in VOC removal
- Simple and robust technology
- Suitable for discontinuous processes
- Easy to maintain
- Easy to place

Disadvantages

- Dust can lead to blockages
- Component mixes may lead to early malfunction
- Not suitable for wet flue gases (less critical for impregnated activated carbon)
- Risk of spontaneous combustion in the bed (ketones, turpentine...)

- Polymerisation risk for unsaturated hydrocarbons on the activated carbon (exothermal and causes blockages)



