BASIC KNOWLEDGE

ADSORPTION

The thermal process of adsorption is used to remove individual components from a gas or liquid mixture. The component to be removed is physically or chemically bonded to a solid surface.

The component removed from a gas or liquid mixture by adsorption can either be a product that is wanted or an impurity. In the latter case, the aim could be to clean exhaust gases.

The solid is referred to as the adsorbent and the adsorbed component as the adsorbate. Where possible, the adsorbent should only bind the adsorbate and not the other components in the mixture to be separated. Other important requirements for the adsorbent are a large specific surface (high porosity) and good regeneration properties. Activated carbon is a frequently used adsorbent.

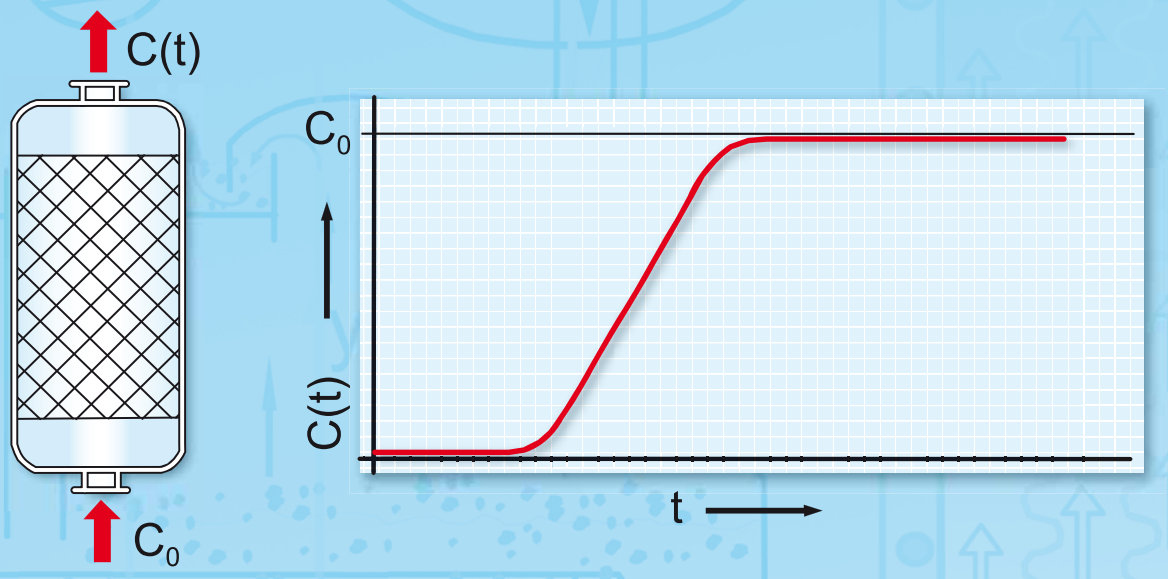
As adsorption is enhanced by low temperature and high pressure, high temperature and low pressure are used to promote regeneration, i.e. desorption. This means that water vapour or hot inert gas can be used to regenerate the adsorbent.

If a fluid with a constant concentration of a component to be removed (adsorbate) flows into a packed bed adsorber, the adsorbate is initially completely adsorbed in the lower area of the packed bed (adsorbent). The fluid leaving the adsorber therefore contains no adsorbate at this time.

As time progresses, the adsorption capacity in the lower area of the packed bed falls. The adsorbate is gradually bonded to the adsorbent in higher and higher areas. This corresponds to the migration of the mass transfer zone (MTZ) over time. When the MTZ reaches the upper area of the packed bed, breakthrough occurs.

The adsorbent cannot bond any more adsorbate over the entire height of the packed bed. The concentration of the adsorbate at the adsorber outlet then corresponds to the inlet concentration.

Breakthrough curves are used to design packed bed adsorbers. Their shape characterises the sorption behaviour.



Idealised breakthrough curve for a packed bed adsorber:
***C_0** inlet concentration of adsorbate in fluid, **C(t)** concentration of adsorbate in fluid at adsorber outlet*