

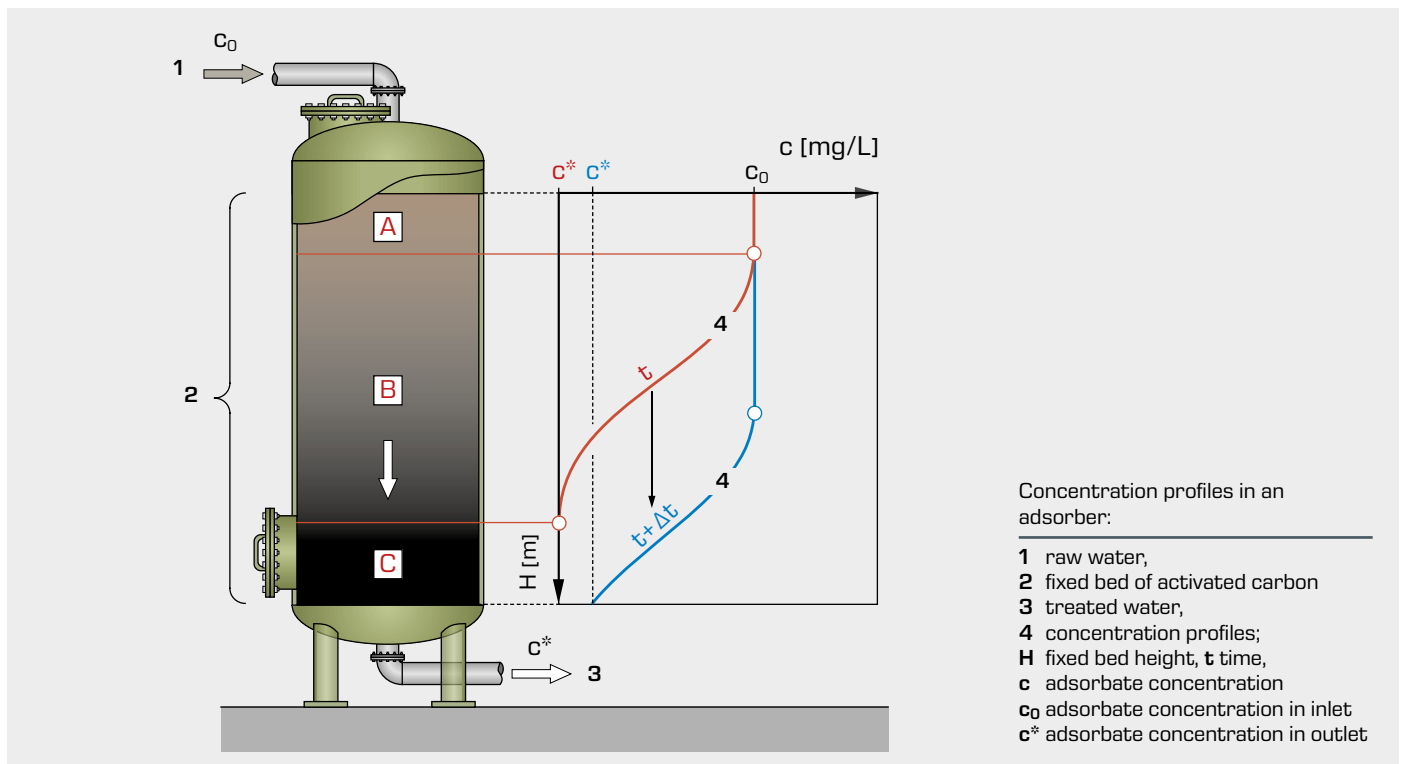
Basic knowledge

Adsorption

One method of removing dissolved substances from water is adsorption. This method is based on physical or chemical interaction between dissolved substances and a solid phase. The dissolved substances are bound to the solid phase.

The solid phase is referred to as the adsorbent, and the dissolved substance as the adsorbate. If adsorbent is brought into contact with adsorbate for long enough, an adsorption equilibrium

is established. The adsorbent is then fully charged, and can absorb no more adsorbate. The adsorbent in most widespread use is activated carbon. Activated carbon has a very distinct pore system. One gram of activated carbon has a pore surface area of approximately 1000 m².



In water treatment, adsorption is mainly implemented with continuous-flow adsorbers. In this case, the concentration profile marked in red on the illustration is established after the time t . It corresponds to the trend of the adsorbate concentration in the water along the fixed bed.

This concentration profile is divided into three zones:

■ Zone A

The adsorbent is fully charged and can absorb no more adsorbate. So the adsorption equilibrium has been reached. The adsorbate concentration in the water corresponds to the inlet concentration (c_0).

■ Zone B

The adsorption equilibrium has not yet been reached, so adsorbate is still being adsorbed. This zone is known as the **mass transfer zone**.

■ Zone C

Since the adsorbate has been fully removed from the water in zone B, the adsorbent is still non-charged here, so the adsorbate concentration is zero.

Over time, the concentration profile moves through the fixed bed in the direction of the flow. At the time $t + \Delta t$ it corresponds to the blue curve. There is no longer any non-charged adsorbent remaining in the fixed bed. The adsorbate concentration in the outlet (c^*) is greater than zero. This state is termed the breakthrough, and the trend over time of the adsorbate concentration in the outlet is termed the breakthrough curve. The shape of the concentration profile indicates how well the capacity of an adsorbent is utilised before the breakthrough is reached. The narrower the mass transfer zone, the more effectively the capacity is utilised.

Applications

Adsorption on activated carbon is suitable primarily for non-polar dissolved organic substances with low water solubility. Examples include the chlorinated hydrocarbons DDT and lindane. These toxic substances often accumulate in ground water. To prevent them from entering the food chain, they must be removed in the course of remediation processes and treatment to meet drinking water quality.