

## CE 583

### Adsorption



#### Learning objectives/experiments

- recording of concentration profiles
- recording of breakthrough curves
- relationship between concentration profiles and breakthrough curves
- determining the mass transfer zone
- an adsorber's mass balance
- an adsorber's efficiency
- predicting breakthrough curves
- scale-up of the results to industrial scale
- detection of the following influencing factors
  - ▶ contact time
  - ▶ temperature
  - ▶ mode of operation

#### Description

- adsorption of dissolved substances on activated carbon
- concentration profiles and breakthrough curves
- determination of the mass transfer zone
- influence of the temperature and the contact time on adsorption
- practical experiments in laboratory scale

CE 583 demonstrates the removal of dissolved substances by adsorption. During adsorption the substances dissolved in the raw water are called adsorbate.

A pump transports the water from a tank in a circuit with two adsorbers filled with activated carbon. The pump transports treated water to the first adsorber. A concentrated adsorbate solution is added to the treated water flow using a metering pump.

The raw water produced in this way enters the adsorber and flows through the activated carbon fixed bed. Here the adsorbate adsorbs on the activated carbon. To remove any quantities of adsorbate still present from the water, the water then flows through a second adsorber (safety adsorber). The treated water is returned to the feed line of the first adsorber where concentrated adsorbate solution is added once again. This creates a closed water circuit.

The flow rates of both pumps can be adjusted. Thereby the following parameters can be varied:

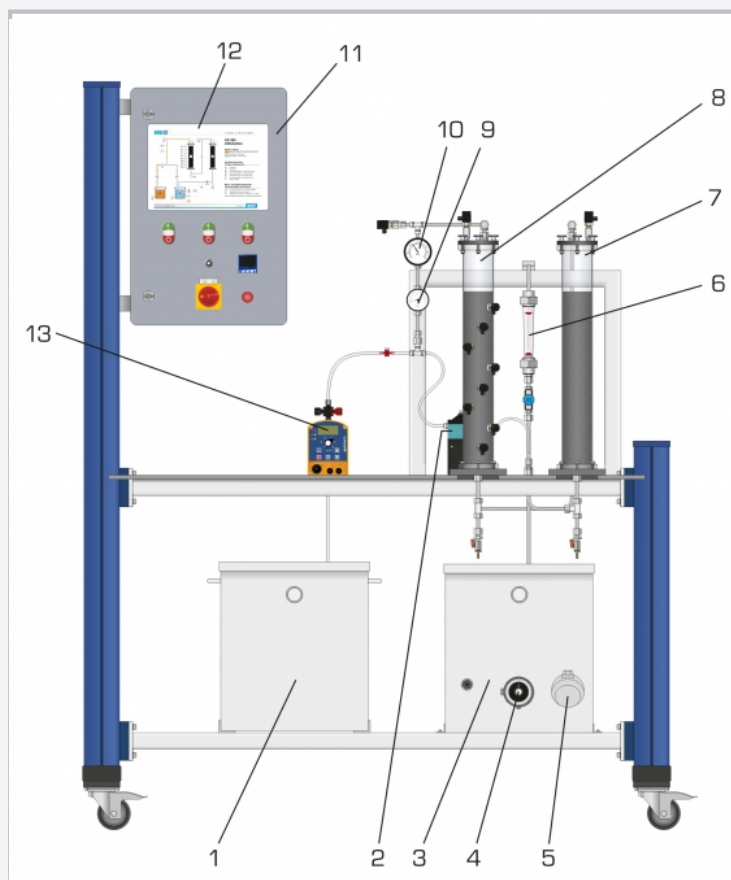
- concentration of the adsorbate in the raw water
- contact time of the raw water with the activated carbon

The water temperature can be controlled. This allows for the temperature effect of the adsorption to be investigated. Flow rate, temperature and pressure are continuously measured. Sampling points are arranged in such a way that breakthrough curves and concentration profiles can be plotted.

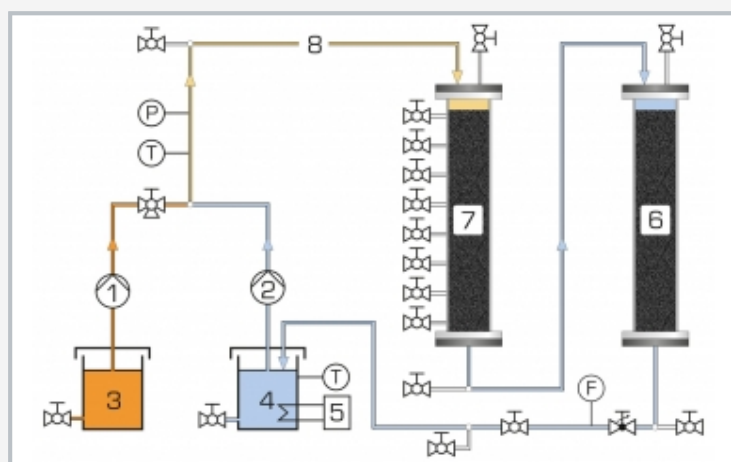
Analysis technology is required to evaluate the experiments. The choice of analysis technology depends on the adsorbate used. Methylene blue can e.g. be used as adsorbate. The concentration of methylene blue can be determined using a photometer.

# CE 583

## Adsorption



1 adsorbate solution tank, 2 circulation pump, 3 treated water tank, 4 heater, 5 temperature sensor, 6 flow meter, 7 safety adsorber, 8 adsorber, 9 thermometer, 10 manometer, 11 switch cabinet, 12 process schematic, 13 metering pump



1 metering pump, 2 circulation pump, 3 concentrated adsorbate solution, 4 treated water, 5 heater, 6 safety adsorber, 7 adsorber, 8 raw water; F flow rate, P pressure, T temperature

### Specification

- [1] 2 adsorbers with activated carbon filling
- [2] adsorber with 8 sampling points
- [3] safety adsorber for closed water circuit
- [4] continuous process
- [5] metering pump for concentrated adsorbate solution
- [6] pump for recirculating the treated water
- [7] water temperature control
- [8] digital temperature indication
- [9] flow rate adjustable
- [10] change of adsorbate concentration and contact time

### Technical data

- Adsorber and safety adsorber
- inside diameter: each 60mm
  - height: each 600mm
  - capacity: each 1700cm<sup>3</sup>

#### Tanks

- treated water: 45L
- adsorbate solution: 45L

#### Circulation pump

- max. flow rate: 180L/h
- max. head: 10m

#### Metering pump

- max. flow rate: 2,1L/h
- max. head: 160m

#### Heater

- max. power: 500W

#### Measuring ranges

- flow rate: 0...60L/h
- temperature: 0...60°C
- pressure: 0...2,5bar

230V, 50Hz, 1 phase  
 230V, 60Hz, 1 phase  
 120V, 60Hz, 1 phase  
 UL/CSA optional  
 LxWxH: 1500x790x1900mm  
 Weight: approx. 180kg

### Required for operation

Water connection, drainage,  
 methylene blue [recommendation]

### Scope of delivery

- 1 trainer
- 1 packing unit of activated carbon
- 1 set of test tubes
- 1 set of tools
- 1 set of instructional material