

# CE 705

## Activated sludge process



The illustration shows: trainer (left) and supply unit (right), screen mirroring is possible on different end devices

### Description

- aerobic biological degradation of organic substances
- nitrification and pre-denitrification
- device control using an integrated PLC
- integrated router for operation and control via an end device and for screen mirroring on additional end devices: PC, tablet, smart-phone

The activated sludge process is the most important biological process in water treatment. CE 705 enables this process to be demonstrated.

A pump delivers raw water contaminated with dissolved organic substances (organic matter) into the aeration tank. Aerobic microorganisms (activated sludge) in the aeration tank use the organic matter as a source of nutrition, biodegrading it in the process. Since aerobic microorganisms need oxygen, the raw water is aerated in the aeration tank. The activated sludge is mixed with the raw water by stirring machines. In the secondary clarifier the activated sludge is then separated from the treated water by sedimentation. A portion of the activated sludge is returned to the aeration tank (return sludge). The treated water is collected in a tank.

It is also possible to convert ammonium into nitrate (nitrification) and nitrate into nitrogen (denitrification). For denitrification a zone without aeration can be created in the aeration tank by installing a partition wall.

The control of the trainer is realised by the integrated PLC via touch screen. By means of an integrated router, the trainer can alternatively be operated and controlled via an end device. The user interface can also be displayed on additional end devices (screen mirroring). Via the PLC, the measured values can be stored internally. Access to stored measured values is possible from end devices via WLAN with integrated router/ LAN connection to the customer's own network.

Activated sludge from a wastewater treatment plant and analysis technology are required for the experiments. The following parameters must be determined in order to analyse the experiments:

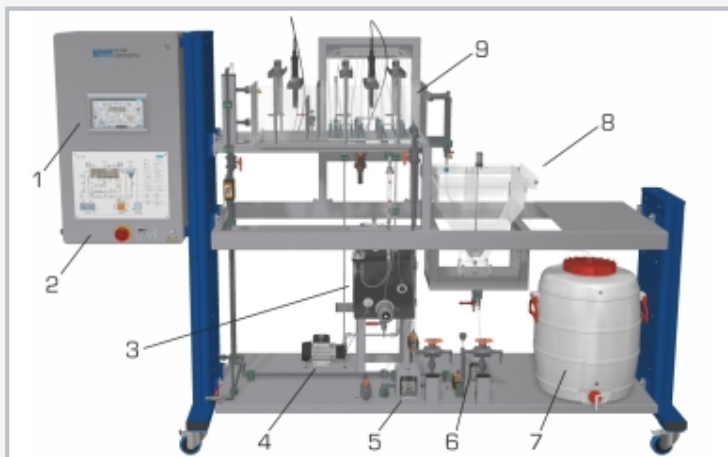
- organic matter  
BOD<sub>5</sub> or COD or TOC
- nitrogen concentrations  
ammonium, nitrite and nitrate

### Learning objectives/experiments

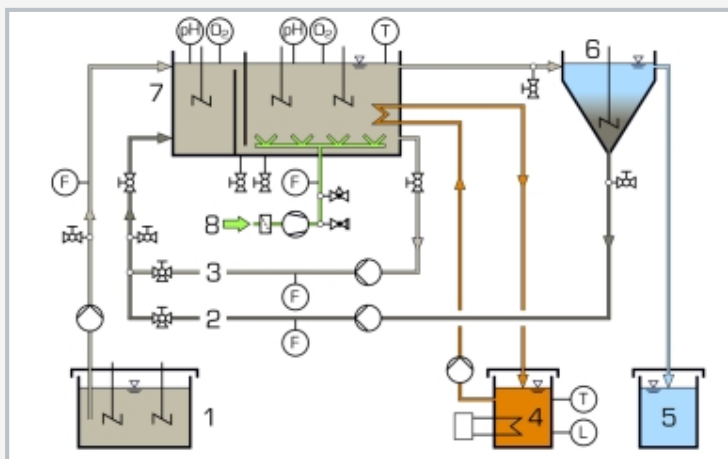
- learning the fundamental principle of the activated sludge process
- functional principle of nitrification and pre-denitrification
- creation of a stable operating state
- identification of the following influencing factors
  - ▶ return sludge ratio
  - ▶ reflux ratio of the internal recirculation
  - ▶ sludge age
  - ▶ sludge loading
  - ▶ volumetric loading
  - ▶ oxygen concentration and temperature
- efficiency of the pre-denitrification
- screen mirroring: mirroring of the user interface on end devices
  - ▶ menu navigation independent of the user interface shown on the touch screen
  - ▶ different user levels available on the end device: for observing the experiments or for operation and control

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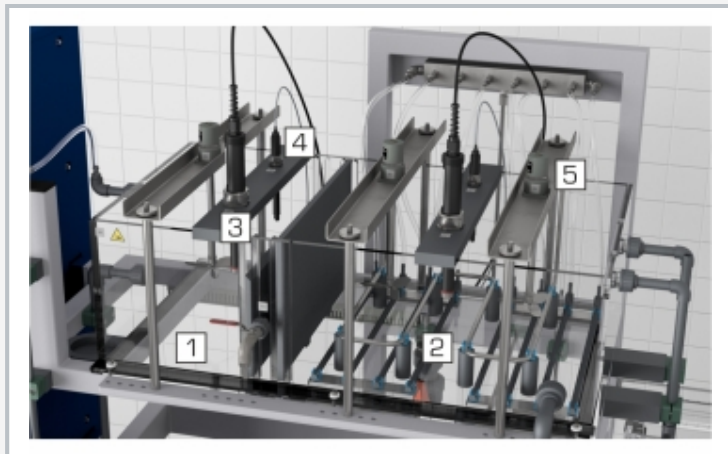
## Activated sludge process



1 PLC with touch screen, 2 switch cabinet, 3 heating water tank, 4 heating water pump, 5 circulation pump, 6 return sludge pump, 7 treated water tank, 8 secondary clarifier, 9 aeration tank



1 raw water, 2 return sludge, 3 internal recirculation for pre-denitrification, 4 heating water, 5 treated water, 6 secondary clarifier, 7 aeration tank, 8 air; F flow rate, L level, O<sub>2</sub> oxygen concentration, T temperature



Aeration tank:  
1 denitrification zone (non-aerated), 2 nitrification zone (aerated), 3 oxygen sensor, 4 pH value sensor, 5 stirring machine

### Specification

- [1] aeration tank divided into two areas
- [2] secondary clarifier with sludge scraper
- [3] nitrification and pre-denitrification
- [4] separate supply unit with 2 stirring machines
- [5] control and measurement of temperature, oxygen concentration and flow rate
- [6] measurement of pH value in the aeration tank
- [7] electromagnetic flow rate sensors
- [8] device control with PLC via touch screen
- [9] integrated router for operation and control via an end device and for screen mirroring: mirroring of the user interface on up to 5 end devices
- [10] data acquisition via PLC on internal memory, access to stored measured values via WLAN/LAN with integrated router/LAN connection to customer's own network or direct LAN connection without customer network

### Technical data

PLC: Eaton XV-303

Tanks

- aeration tank (nitrification zone): approx. 34L
- aeration tank (denitrification zone): approx. 17L
- secondary clarifier: 30L
- raw water tank: 200L, treated water tank: 80L

Flow rates

- raw water pump: max. 34L/h
- return sludge pump: max. 34L/h
- circulation pump: max. 34L/h

Speeds (stirring machines)

- raw water tank: each max. 600min<sup>-1</sup>
- aeration tank: each max. 330min<sup>-1</sup>
- secondary clarifier: max. 45min<sup>-1</sup>

Measuring ranges

- flow rate:
  - ▶ 0,6...30L/h (raw water and return sludge)
  - ▶ 3...60L/h (internal recirculation)
  - ▶ 50...550L/h (compressed air)
- temperature: 0...50°C
- pH value: 0...14
- oxygen concentration: 0...20mg/L

230V, 50Hz, 1 phase

230V, 60Hz, 1 phase; 120V, 60Hz, 1 phase

UL/CSA optional

LxWxH: 1550x790x1150mm (supply unit)

LxWxH: 2830x790x1900mm (trainer)

Total weight: approx. 450kg

### Required for operation

water connection, drain, activated sludge, analysis technology

### Scope of delivery

trainer, supply unit, pH calibration solutions, potassium chloride solution, dipotassium hydrogen phosphate, ammonium hydrogen carbonate, instructional material