

UNIT OPERATIONS IN WATER TREATMENT

What is water treatment?

Water is changed in its characteristics through domestic use or industrial processes. Used water (wastewater) can't be discharged directly to a watercourse. Wastewater must first be treated so that it no longer poses a hazard to the environment. If organically polluted wastewater enters a watercourse, microorganisms will degrade the organic matter, consuming large amounts of oxygen. This may reduce the oxygen level enough to kill fish.

Water treatment can also be used to make water usable for a specific purpose. Examples of this are the production of drinking water or process water in industry.

What unit operations are employed in water treatment?

There are a number of unit operations for water treatment. The choice of unit operations depends primarily on the substances needing to be removed.

The key unit operations can be classified accordingly as follows:

| Undissolved Substances (Solids) | Dissolved Substances | | |
|--|--|---|----------------------|
| | Organic Substances | | Inorganic Substances |
| | Biodegradable | Non-Biodegradable | |
| Organic Inorganic | | | |
| Mechanical Processes | Biological Processes | Physical/Chemical Processes | |
| <ul style="list-style-type: none"> Flotation Sedimentation Filtration | <ul style="list-style-type: none"> Aerobic Processes Anaerobic Processes | <ul style="list-style-type: none"> Adsorption Membrane Separation Processes Ion Exchange Precipitation / Flocculation Chemical Oxidation | |

Removal of undissolved substances (solids) is effected by mechanical processes. Dissolved substances can be removed by either biological or physical/chemical processes.

The aim of biological processes is to remove organic, biodegradable substances. Microorganisms use such substances as a source of nutrition, thereby degrading them. If this process takes place in the presence of dissolved oxygen, they are termed aerobic. They include the activated sludge process and biofilm process. Their main field of application is in the treatment of

domestic wastewater by wastewater treatment plants. By contrast, anaerobic processes exclude oxygen. Anaerobic processes are used in the treatment of heavily organically polluted wastewater e.g. from industries like food processing and paper manufacturing.

Non-biodegradable organic and inorganic substances can be removed by means of physical/chemical processes. Examples of this are water softening by ion exchange and the adsorption of chlorinated hydrocarbons on activated carbon.

| The unit operations... | | ...and the appropriate GUNT unit | |
|-----------------------------|-------------------------------|----------------------------------|---|
| Mechanical Processes | Flotation | ▶ | CE 587 <i>Dissolved Air Flotation</i> |
| | Sedimentation | ▶ | HM 142 <i>Separation in Sedimentation Tanks</i> |
| | Filtration | ▶ | CE 579 <i>Depth Filtration</i> |
| Biological Processes | Aerobic Processes | ▶ | CE 701 <i>Biofilm Process</i> ▶ CE 705 <i>Activated Sludge Process</i> |
| | Anaerobic Processes | ▶ | CE 702 <i>Anaerobic Water Treatment</i> |
| Physical/Chemical Processes | Adsorption | ▶ | CE 583 <i>Adsorption</i> |
| | Membrane Separation Processes | ▶ | CE 530 <i>Reverse Osmosis</i> |
| | Ion Exchange | ▶ | CE 300 <i>Ion Exchange</i> |
| | Precipitation / Flocculation | ▶ | CE 586 <i>Precipitation and Flocculation</i> |
| | Chemical Oxidation | ▶ | CE 584 <i>Advanced Oxidation</i> |

| Combined unit operations... | | ...and the appropriate GUNT unit | |
|--|---|---------------------------------------|--|
| Filtration Adsorption Ion Exchange | ▶ | CE 581 <i>Water Treatment Plant 1</i> | |
| Filtration Ion Exchange | ▶ | CE 582 <i>Water Treatment Plant 2</i> | |