

## The GUNT learning concepts of chemical process engineering

### What does chemical process engineering deal with?

Unlike in mechanical or thermal process engineering, the focus of chemical process engineering is not to change substance properties or the composition of a substance. The central subject of chemical process engineering is the creation of a new substance type through chemical reaction.

The knowledge which reacting agents are required for a desired product comes from chemistry. Chemistry also provides the knowledge of the conditions that enable a smooth chemical reaction process.

These conditions include the activation of the reaction, pressure and temperature adjustment and the composition of the reacting agents. The aim of chemical process engineering is to create these conditions for industrial-scale use. In addition to these conditions, the aggregate state of the reacting agents and reaction products also has a significant influence on the design of the reactors and the overall production process.

### How can the chemical processes be classified?

There are several ways of classifying chemical processes. One of them is based on activation energy. Many thermodynamically possible chemical reactions do not take place at all or are too slow for technical applications unless a certain activation energy is applied.

Chemical reactions can be activated in different ways. The activation method significantly influences the design and operation of chemical reactors. It is also possible to combine different activation methods:

#### ■ Thermal activation

The energy required to activate the chemical reaction can be applied through heat. The desired temperature range is achieved by heating or cooling. In this temperature range, the reaction conditions are optimal and undesired side reactions are avoided.

#### ■ Catalytic activation

Many reactions are too slow for technical applications at ambient temperature because the required activation energy is very high. Catalysts lower the required activation energy and accelerate the chemical reaction. There are two types of catalysis:

##### ▶ Homogeneous catalysis

The catalyst and the starting substances of the chemical reaction are in the same phase.

##### ▶ Heterogeneous catalysis

The catalyst is in the solid phase in most cases. The starting substances of the reaction are in the liquid or gaseous phase.

#### ■ Photochemical activation

The reaction is activated by atoms or molecules absorbing optical radiation. The mostly organic substances thus achieve a higher energy level and are activated.



Supply unit for chemical reactors CE 310 with continuous stirred tank reactor CE 310.01

### Our training systems for chemical process engineering

#### Thermal activation

CE 310.01	Continuous stirred tank reactor
CE 310.02	Tubular reactor
CE 310.03	Stirred tanks in series
CE 310.04	Discontinuous stirred tank reactor
CE 310.05	Plug-flow reactor
CE 310.06	Laminar flow reactor
CE 100	Tubular reactor

#### Catalytic activation

CE 380	Fixed bed catalysis
CE 650	Biodiesel plant

#### Photochemical activation

CE 584	Advanced oxidation
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### Abstract processes clearly illustrated

The diagram shows UV light (represented by wavy arrows) incident on a hydrogen peroxide molecule (H-O-O-H). This leads to the formation of two hydroxyl radicals (·OH), represented as oxygen atoms with a single bond to a hydrogen atom and a single dot representing the unpaired electron.

Below the diagram are two photographs of laboratory equipment:

- CE 380 Fixed bed catalysis:** A complex laboratory setup with multiple glass vessels, tubes, and a control panel.
- CE 584 Advanced oxidation:** A tall, vertical, cylindrical reactor vessel with a blue tint, equipped with various sensors and a control panel.

CE 380 Fixed bed catalysis

CE 584 Advanced oxidation