

BASIC KNOWLEDGE

CHEMICAL OXIDATION

Industrial wastewaters or contaminated ground waters often contain non-biodegradable organic substances. These include, for example, chlorinated hydrocarbons. These substances can be chemically oxidised and so removed from the water. There are always two components involved in oxidation: the substance being oxidised and the oxidant. The oxidant absorbs electrons and is reduced. The substance being oxidised gives off electrons in return.

Organic substances are oxidised in stages, with intermediate products being formed along the way. Where organic substances are fully oxidised, they are converted into the inorganic end products water and carbon dioxide.

Advanced oxidation processes

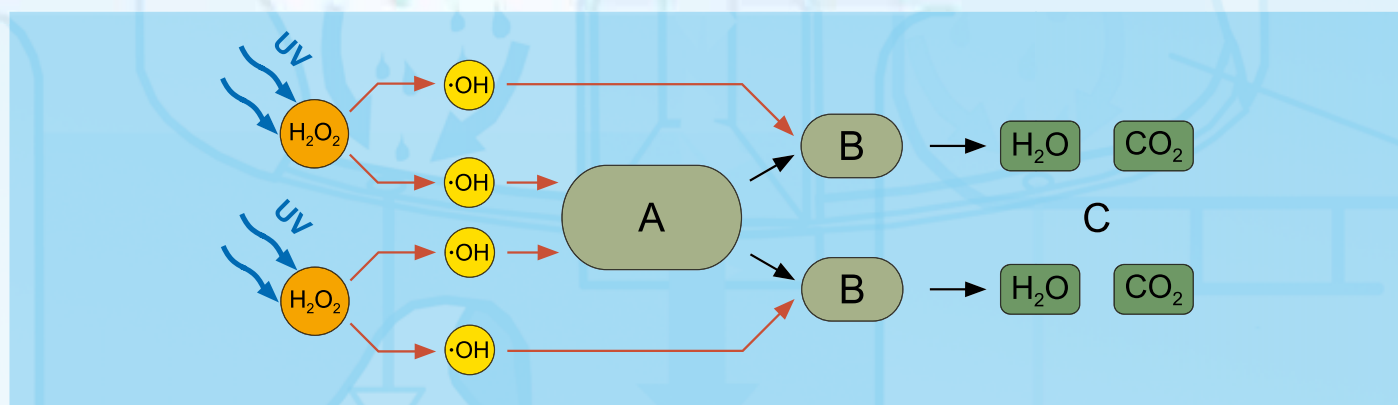
Oxidation processes are termed advanced when hydroxyl radicals (OH radicals) are used as the oxidants. The basic feature of radicals is the presence of a single free electron in place of an electron pair. This is indicated in the formula by a dot ($\cdot\text{OH}$). This electron provides the OH radical with a very high reactivity. OH radicals are very strong oxidants, and are capable of oxidising virtually any organic substance.

One method of producing OH radicals is to irradiate hydrogen peroxide (H_2O_2) with UV light. Hydrogen peroxide absorbs the UV radiation, splitting into two OH radicals (photolysis). In this way, two OH radicals can be obtained from one hydrogen peroxide molecule.

Application in water treatment

This process is applied in practice by adding hydrogen peroxide to the water being treated and then irradiating the water with UV lamps. The efficacy of this process depends to a large degree on the quantity of OH radicals produced. Their number rises with the quantity of source material and the intensity of the UV radiation. However, the high energy consumption of UV lamps means that increasing the radiation intensity at will is not economically viable.

Advanced oxidation can also be combined with biological processes. Then, organic substances are first chemically oxidised until biodegradable intermediate products are created.



Fundamental principle of advanced oxidation with hydrogen peroxide and UV radiation:
 H_2O_2 hydrogen peroxide, $\cdot\text{OH}$ hydroxyl radical
 A non-biodegradable organic substance, B organic intermediate products, C inorganic end products