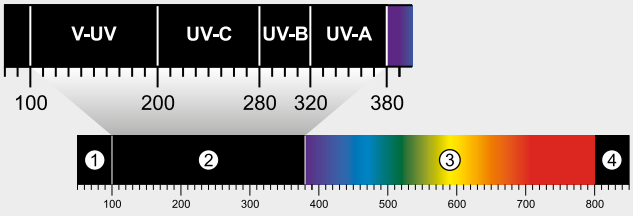
Photochemical activation

In a photochemical activation, the activation energy to enable or accelerate the reaction is applied by means of electromagnetic radiation. When the atoms or molecules absorb this radiation, they achieve a higher energy level and are activated. For an effective reaction process, the emission spectrum (wavelength range) of the light source used has to be as similar to the absorption spectra of the reacting substances as possible.



Spectrum of electromagnetic waves:

1 X-radiation, **2** ultraviolet radiation, **3** visible light, **4** infrared radiation

In industrial-scale photochemical reactions, the electromagnetic radiation leads to the formation of radicals. The most important property of radicals is that they have an unpaired valence electron instead of an electron pair. This electron gives the radical its great reactivity and enables the reaction rates necessary for the industrial process. One advantage of photochemical activation is the possibility to activate specific chemical bonds by selecting a suitable emission spectrum. Another advantage is the fact that the reaction rate can be easily influenced by switching light sources on or off.

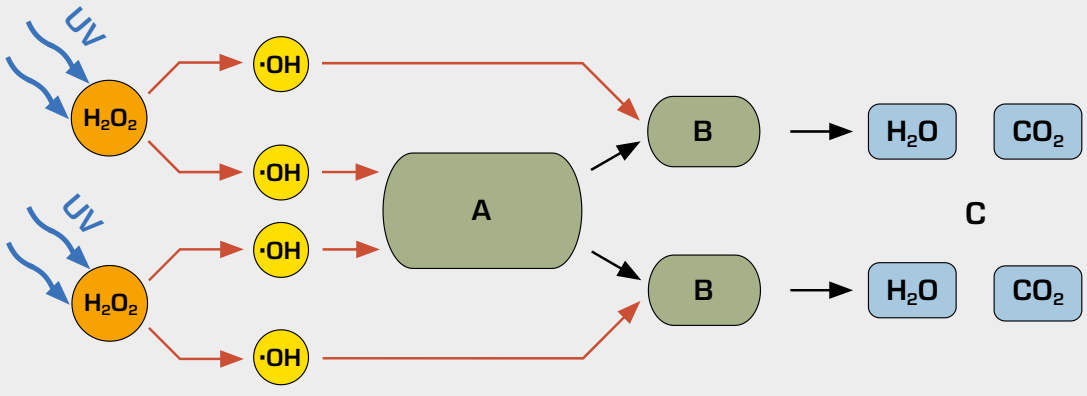
The following applications are examples of the industrial use of photochemical reactions:

- chlorination of hydrocarbons
- vitamin D production
- polyvinyl chloride (PVC) production
- treatment of wastewater contents

The electromagnetic radiation is mostly generated by means of lamps working according to the electric discharge principle. The gas used is normally mercury vapour.

The following lamp types are generally distinguished:

- **Low-pressure lamps**
  These lamps generate a nearly monochromatic light (light of a single wavelength) with a wavelength of 254nm (UV-C).
- **Medium-pressure lamps**
  These lamps emit radiation of various wavelengths in the UV range and in the visible range. The emission spectrum is in the range of 200...600nm.
- **High-pressure lamps**
  The spectrum of these lamps ranges from the short-wave UV range (V-UV) far into the visible range. It is used in many photochemical reactions.



Example of a photochemically activated reaction to decompose organic, nonbiodegradable substances:

H_2O_2 hydrogen peroxide, **·OH** hydroxyl radical, **A** organic, nonbiodegradable substance, **B** organic intermediate products, **C** inorganic end products