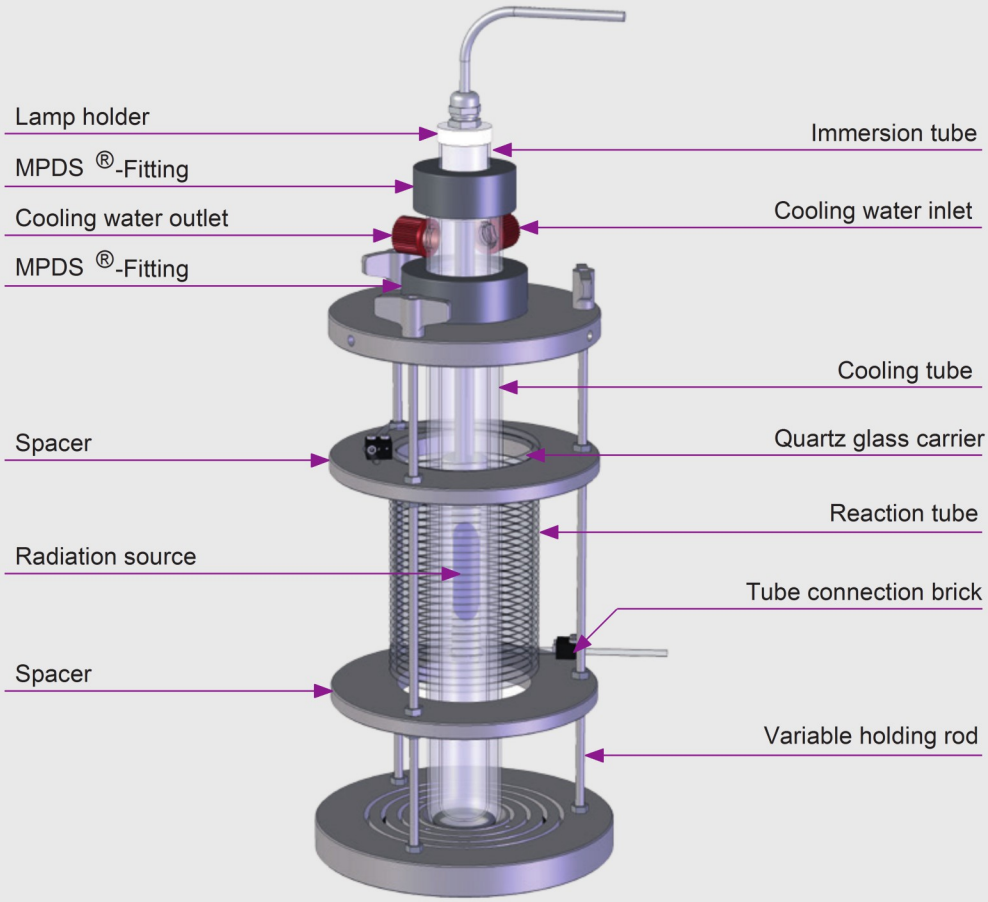

photo LAB Tubular Photoreactor

Discontinuous reactors (batch reactors) have their limitations due to the lack of precise reaction control and inexact temperature management. Moreover the depth of penetration of photons can be frequently limited by absorption, which means that no optimum photochemical reaction can take place.

The tubular reactor, also called a loop reactor, first invented by Peschl Ultraviolet in 1995 in the course of a pharmaceutical project in Basel, belongs to the group of micro photoreactors and works continuously until a reaction is concluded. This permits a simple but highly precise control of photochemical reactions.

The continuous operating mode means the reaction kinetics can be optimally adjusted and controlled and precisely analysed in conjunction with online analytics. Continuous flow operation makes the progress of reactions or optimisation of existing processes considerably easier since the reaction can be tracked precisely. For example, the possible creation of by-products through over-irradiation can be followed exactly. The collected data allows the appropriate photoreactor to be selected.

The essential advantages of this setup compared to planar micro photoreactors lie in the fact that all the emitted photons have access to the reaction medium and the flow channels can be easily cleaned or replaced by changing the tube. Likewise the selection of the tube diameter and associated adjustment of the optical section as well as of the throughput rate can be an advantage when a wide range of reactions are to be carried out (multi-purpose continuous flow).

A spiral tube of UV-permeable fluoropolymer is arranged around a support system. The tube can be of various diameters and be put on in various lengths and in multiple layers as far as this is expedient in photochemical terms. The reaction fluid is transported through the tubing by means of a pump. Located centrally in the system is the radiation source, which is operated

in thermal isolation.

Upscaling is not done primarily by an increase in scale as with classic photoreactors, but by multiplication of the reaction systems until a production volume per time unit is reached (numbering-up). Use of the tubular reactor for industrial production has considerable limitations, which is why this reactor type is suitable only for basic investigations.

This type of process development makes it possible to scale laboratory results into plants that reach target production volume relatively risk-free.

The following aspects of this photoreactor are advantageous:

- Controlled thermal conditions
- Controlled flow rate
- Controlled rate of turnover and analysis of reaction kinetics
- Long residence time
- High degree of material exchange in tube
- Transmission into UVC region
- Chemically inert and consistent
- Differing diameters of tubes
- Differing length of reaction zone