Solar photochemical detoxification of waste water – A comparison matrix for the application of different reactor types

C. Sattler, L. de Oliveira, J. Ortner, K.-H. Funken,
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)
D-51170 Köln
Tel: +49-2203-601-2868
Fax: +49-2203-601.66900
e-mail: christian.sattler@dlr.de

Solar photocatalytic detoxification of waste water is a modern technology which is of special interest because many of its possible applications will be located in regions with good solar irradiation. But new reactor technologies could make it also useful for less sunny regions. This is of a special importance because industrialized countries at less favored solar locations are looking for ecological methods to solve water problems.

The photocatalytic technologies have been investigated very well on a scientific level, especially the system based on TiO_2 as a photocatalyst. The results of many groups working in this field have shown that it is possible to use it for a wide variety of water treatment problems like chlorinated hydrocarbons, pesticides or phenols. It is most interesting to use it for problems which are very difficult to solve by conventional water treatment processes.

The next step in R&D will be the transfer from the already existing laboratory and prototype plants to economic plants which have to work as reliable as conventional water treatment devices. Different reactor types have to be compared to find out their advantages.

In this study we tried to do this for different solar reactors from very simple non concentrating devices to concentrating parabolic trough collectors. To simulate a wide variety of applications the following parameters have been changed. Beside of the reactor type they were the radiant power, the different pollutants ranging from easily degradable hydrocarbons to very stable chlorinated organic substances and the concentration of the pollutants varying between very low concentrations (less than 1mg/l COD) to waste water with more than 20,000 mg/l COD. To get reproducible results model waste waters were used. Additionally several types of TiO_2 powder were tested.

The result of these tests is a matrix which gives an overview over several areas of photocatalytic water treatment.

So for every tested reactor type the best working conditions can be proposed.

To achieve an economic success of this technology the cost of the different plants for the different applications are decisive. Example calculation have been carried out to discuss how economical photocatalytic water treatment devices could work today. Especially the treatment costs for lowly polluted water are encouraging because the needed devices are small and cheap. But also the massive reduction of COD in industrial waste water can be an economic application because the

conventional plants for such applications are expensive too and high energy costs for conventional processes could be saved by solar photocatalytic devices.