Advanced oxidation processes in industrial wastewater treatment (AOPI)

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Introduction

○ AOPI project aims at providing new information on the use of advanced oxidation processes in the treatment of industrial wastewaters (from food and pharmaceutical industry).
○ Sustainability assessment analysis will be used to evaluate the developed process during the whole research project and the study on the health effects of organic pollutants will also be in a central role.

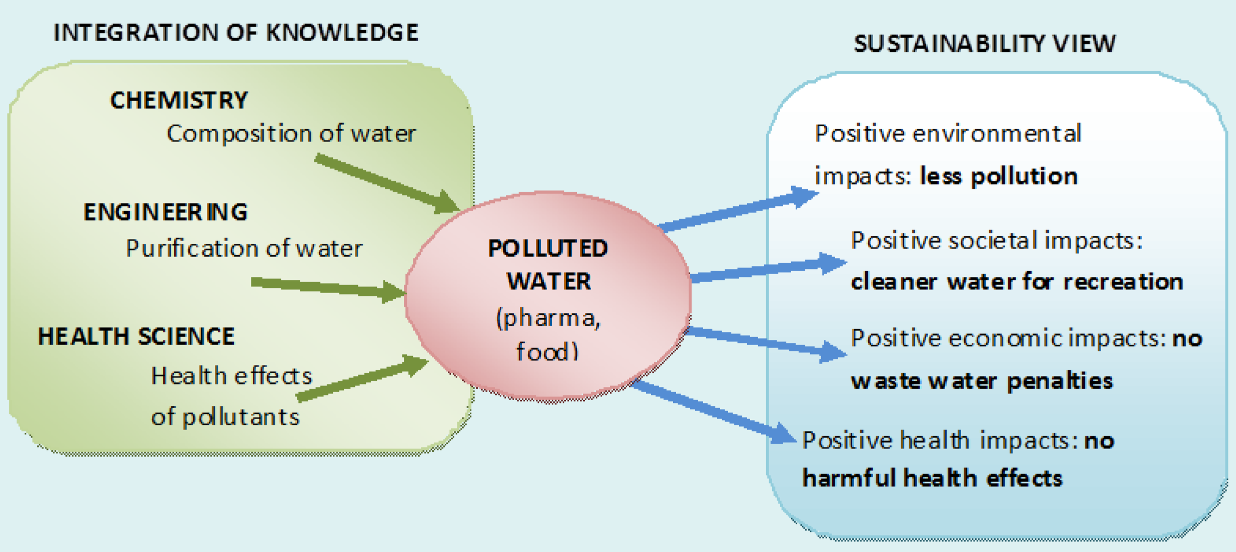

Figure 1. Integration of knowledge within AOPI project from the viewpoint of chemistry, engineering and health sciences.

Objectives of the research:

1) Determination of the compositions of wastewaters in pharmaceutical and food industry
2) Evaluation of health effects of selected industrial effluents and possible reaction by-products of the wastewater treatment process
3) Conducting a sustainability assessment analysis of the processes to be developed
4) Development of a hybrid method for the treatment of food and pharmaceutical industries' wastewaters by photocatalysis and catalytic wet air oxidation

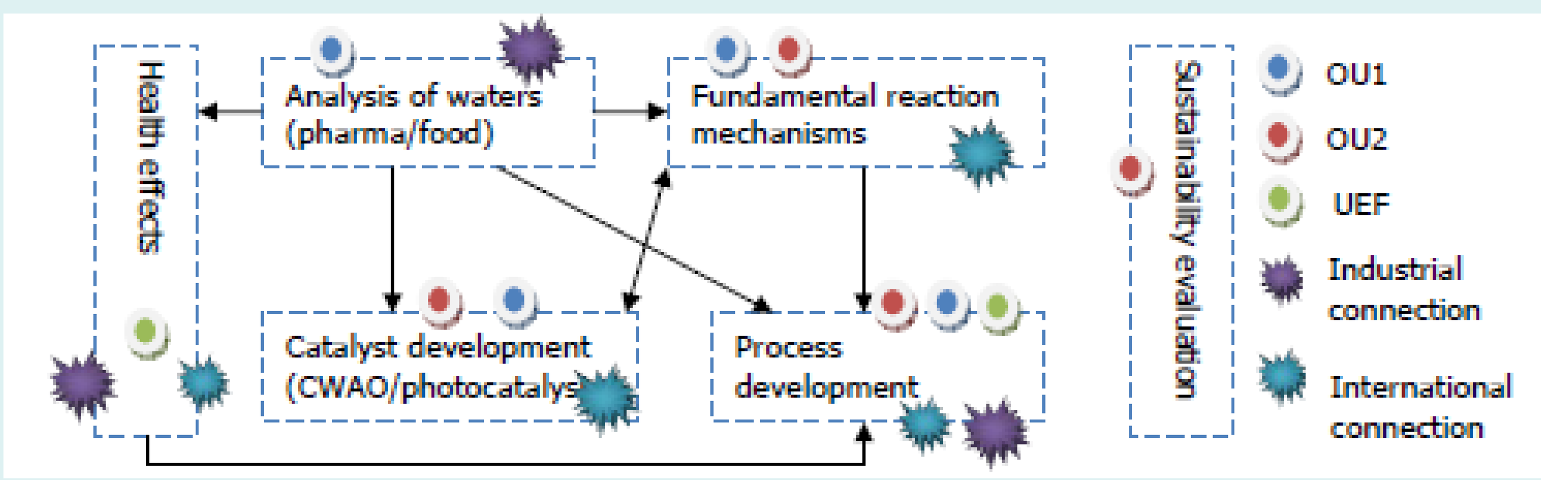

Figure 2. Project description; connections between themes, responsible groups and international connections.

Photocatalysis

Figure 3. Equipment for the liquid phase photocatalysis studies.

Photocatalysis is capable of oxidizing and mineralizing a wide range of organic compounds into harmless inorganic substances such as CO_2 and H_2O. The photocatalytic reactor (Fig. 3) will be used for the degradation studies of organic molecules from wastewaters. An annular-type batch photoreactor (~1 dm^3) is made of Teflon and a UV lamp is placed in a quartz glass tube inside the reactor. The studied photocatalytic material can be used either as a suspension or immobilized on a solid carrier.

Catalytic wet air oxidation

Figure 4. Reactor set-up for catalytic wet air oxidation.

In the wet air oxidation (WAO) process organic and oxidisable inorganic compounds of the liquid phase are oxidised to intermediates, CO_2 and water at elevated temperature and pressure using oxygen containing gas. In catalytic wet air oxidation (CWAO) due to the presence of catalysts, milder operation conditions can be used to achieve much higher oxidation rates.

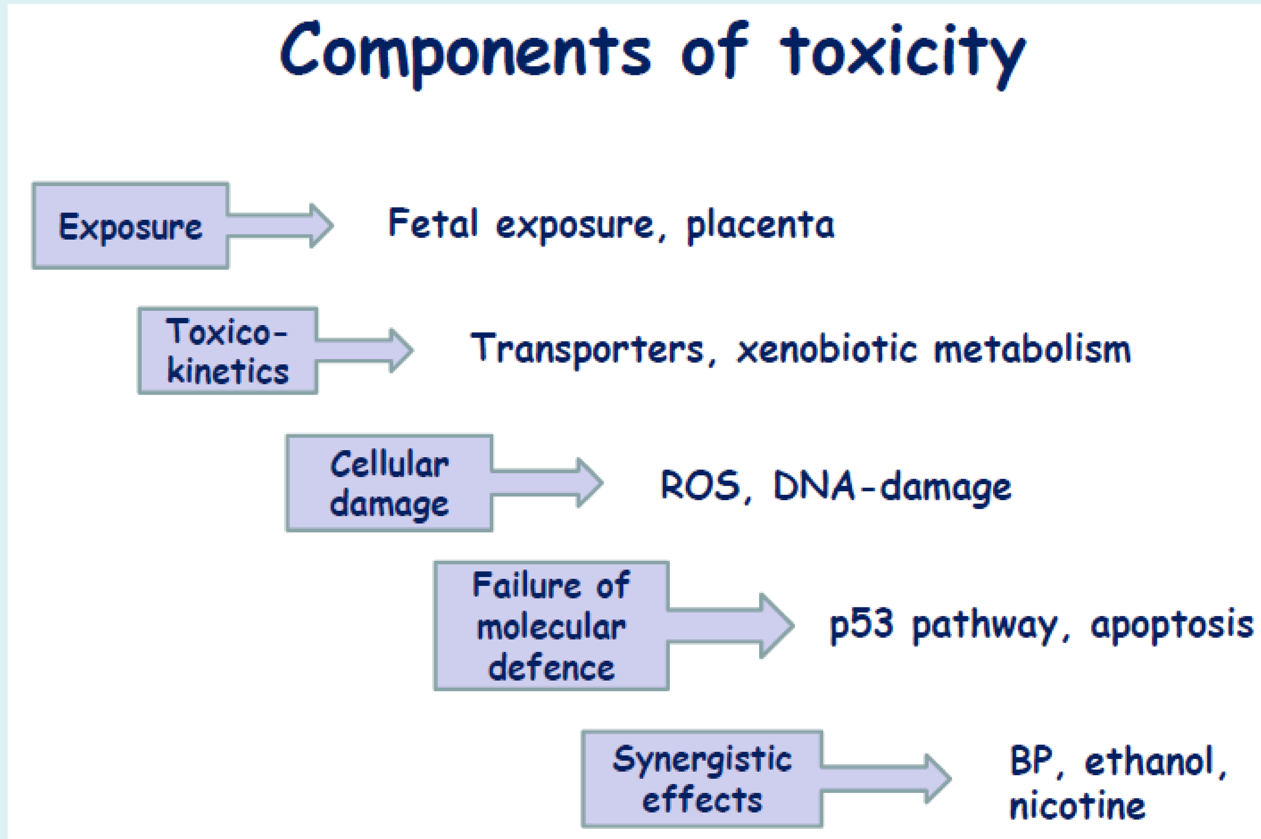

Figure 5. Various stages leading to cellular toxicity.

Toxicity requires internal exposure in the organism, transfer to target site and in some cases metabolism to the ultimate toxic metabolite(s) as well as failure of molecular defence systems. These are the prerequisites for persistent cellular damage. Synergistic effects between chemicals may occur.

Human placental perfusion

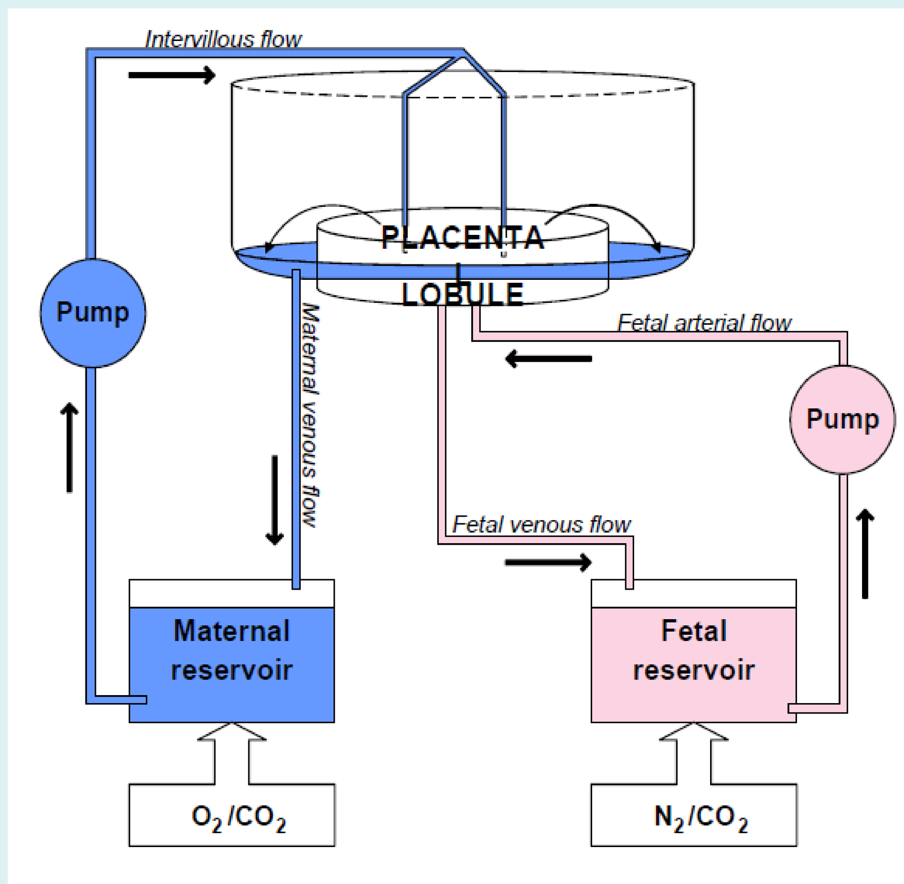

Figure 6. Placental perfusion equipment.

Human placental perfusion can be used to study: 1) Transfer of drugs and environmental chemicals through the placenta, 2) Possible metabolism in placenta, 3) Formation of possible DNA adducts and other markers of molecular toxicity, 4) Mechanisms involved in transplacental transfer (passive diffusion and role of transporters).

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