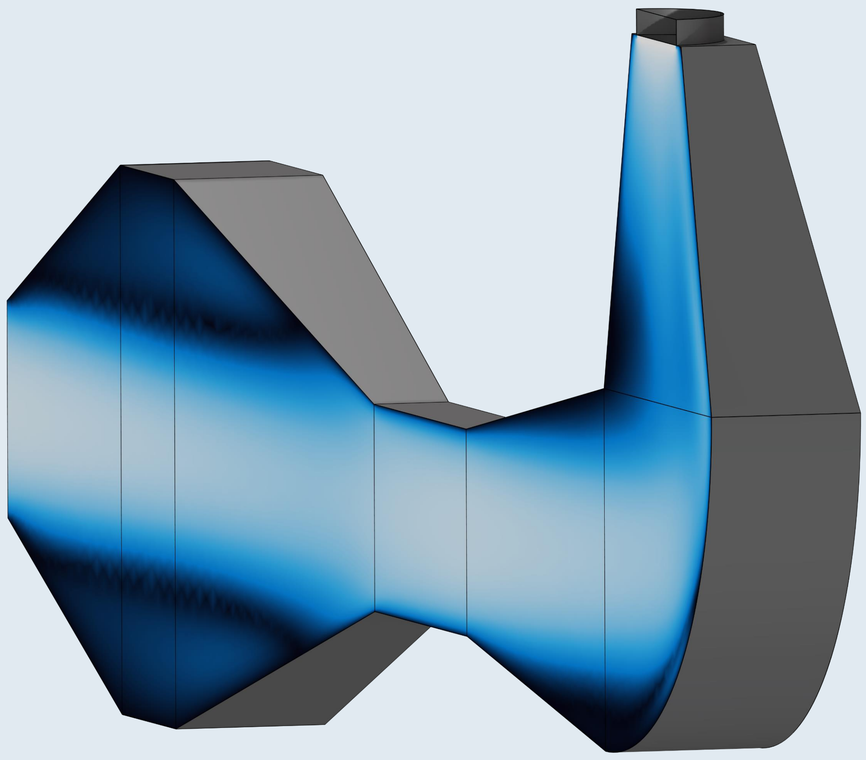

Photocatalytic Wind Tunnel for Air Purification

CFD simulation of photocatalytic degradation of gas-phase pollutants in a custom made photocatalytic wind tunnel (PWT) and it's validation for future applications.

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Introduction & Goals

Heterogeneous photocatalysis is an advanced oxidation process (AOP) that is highly effective and sustainable for air and water purification [1]. Photocatalytic degradation of air pollutants occurs on the surface of rubber tiles which are immobilized with titanium dioxide (TiO2) as a photocatalyst [2]. They are placed in a reaction chamber inside of a custom made photocatalytic wind tunnel (PWT). By using various COMSOL® modules, it is possible to visualize and simulate fluid flow and concentration distribution inside of the reactor. The main goal is to build 3D geometry and set up certain physics in COMSOL in order to validate CFD simulations with experimental results. Such model would reduce number of laboratory experiments, contribute to the optimization of process parameters and would serve as a model to determine degradation of various pollutants.

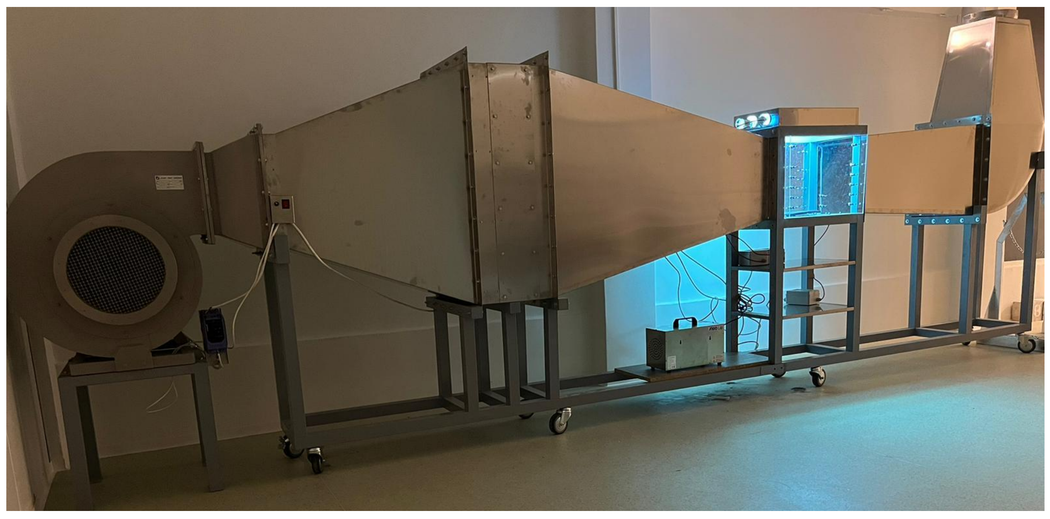

FIGURE 1. Custom made PWT with reaction chamber

Methodology

The 3D model geometry of PWT was made. To improve computational efficiency, symmetry was applied. To simulate photocatalytic degradation several modules are used. Ray Optics Module to visualize ray propagation through the reaction chamber, Chemical Reaction Engineering Module to model chemical reaction kinetics on the surface of rubber tiles and CFD Module for fluid flow simulation to determine pollutants distribution. To describe photocatalytic gas phase reactions, the Langmuir-Hinshelwood rate equations are used.

Results

The results of CFD simulation (Figure 2) show gas flow through all of PWT components. In addition, it shows the distribution of pollutant on a photocatalytic active surface (rubber tiles). For a better view of pollutant distribution, only the reaction chamber is visible on the plot. The CFD simulation shows that experimental data and model data are in considerable agreement.

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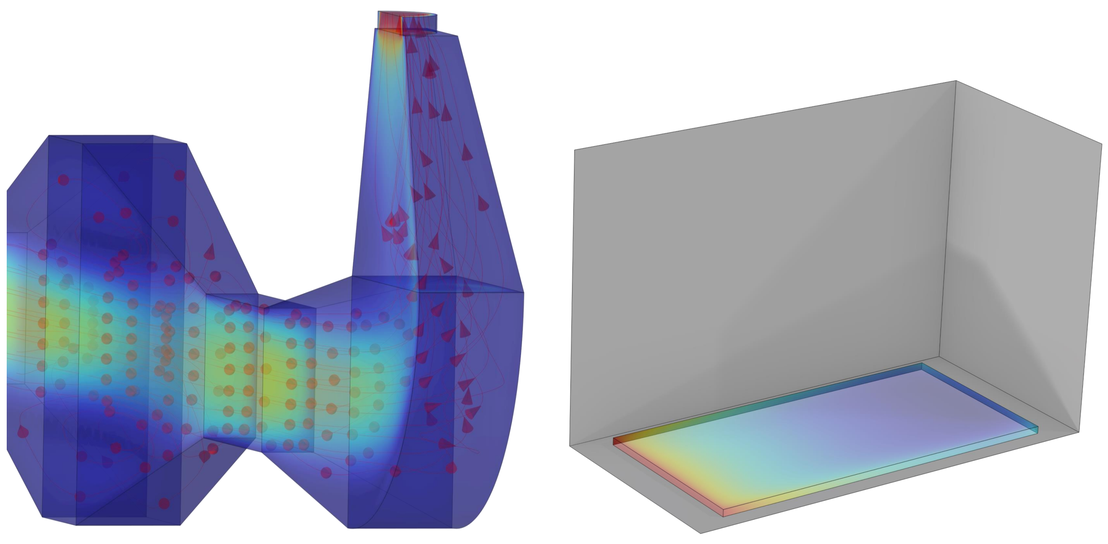

FIGURE 2. Fluid flow through the PWT (left) and pollutants concentration on rubber tiles in reaction chamber (right)

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RECYCLING RUBBER & SOLAR PHOTOCATALYSIS
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