# Urban Air Purification Using Semi-Active Photocatalysis

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**Introduction**. This work focusses on the semi-active use of photocatalytic surfaces in streets as an innovative method for removing anthropogenic pollutants (especially volatile organic compounds or VOC's) from urban air. The proposed method is based on lamellae, coated with a photocatalyst ($TiO_2$), lightened with UV light and arranged horizontally at the walls of street canyons to purify air upon contact.

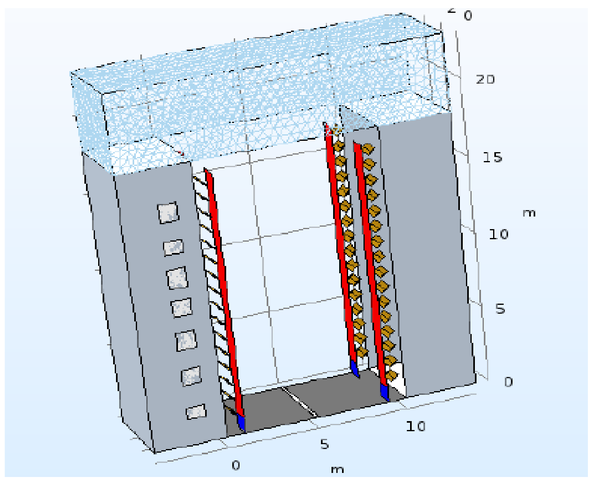


**Figure 1**. Photocatalytic lamellae in a street canyon

## Computational Methods:

- CFD and Heat transfer models using COMSOL Multiphysics®
- Adsorption defined as a flux from street to lamellae and desorption defined as a flux from lamellae to street
- Photocatalytic reaction
- Open boundary with the same concentration as the initial value
- Natural and forced convection with sources continuously emitting pollutants

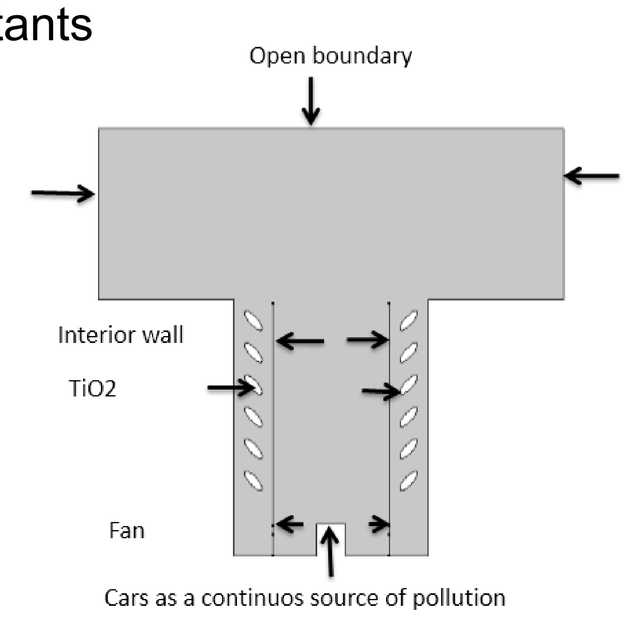


**Figure 2**.2D model of the geometry including lamellae coated with photocatalyst

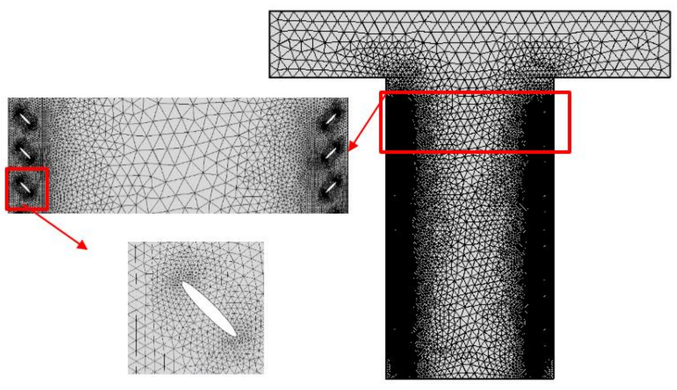

**Figure 3**. Mesh of the geometry

**Results**: Simulation results show an important purification percentage. The average concentration decreases with time until a stationary state is established.

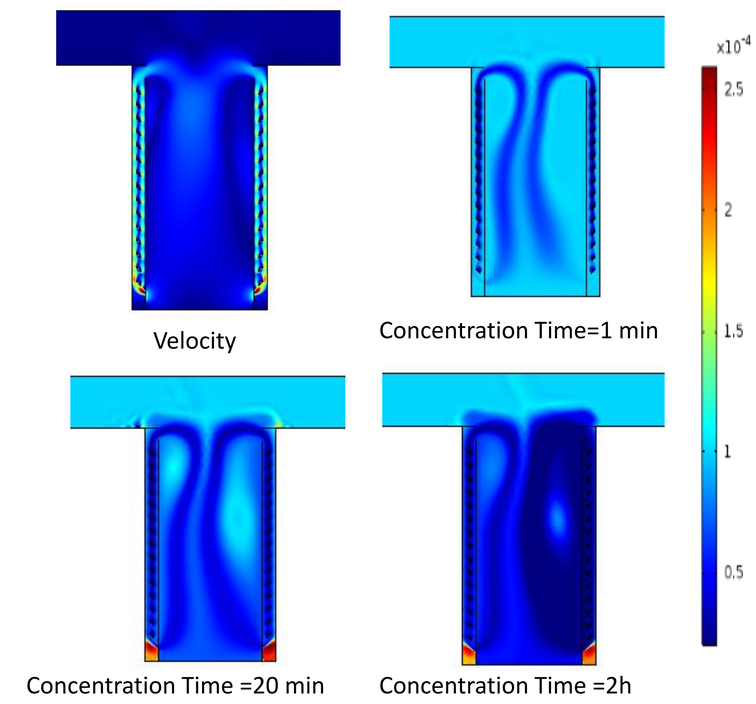


**Figure 3**. Concentration and velocity distribution

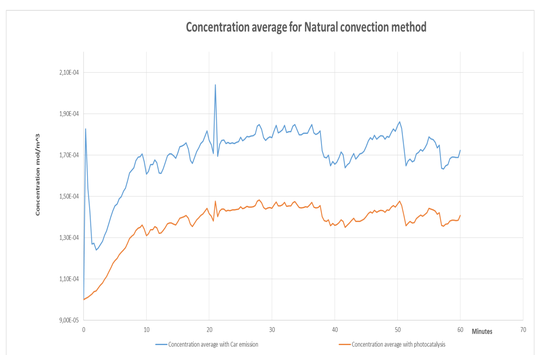


**Figure 4**. Concentration average

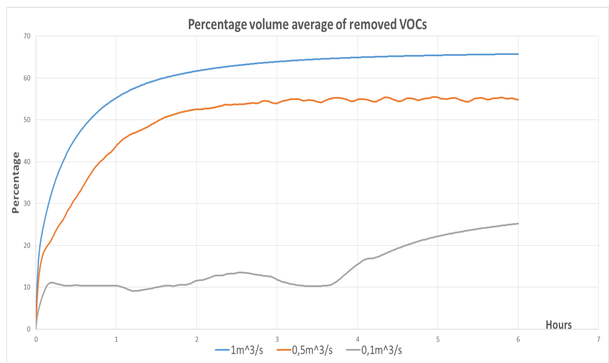


**Figure 5**.Forced convection Aspect Ratio: 1,8 with different flow rate

| Method | Fan 0,1m^3/s | Fan 0,5m^3/s | Fan 1m^3/s | Natural convection 325,15K |
|---|---|---|---|---|
| Percentage | 42% | 50% - 56% | 62% - 65% | 12%- 15% |
| Energy cost | 250w/h | 370w/h | 750w/h | 200w/h |

**Table 1**. Purification percentage vs energy cost

**Conclusions**: These techniques show up to 65% purification of urban air.
As future work we would like to link COMSOL to a weather forecast model, such as WRF-Chem, in order to provide COMSOL scenarios with up-to-date environmental and VOC's data, which should improve air purification with semi-active photocatalysis.

## References:

van Walsem, Jeroen, et al. "CFD investigation of a multi-tube photocatalytic reactor in non-steady-state conditions." Chemical Engineering Journal 304 (2016): 808-816.

## Acknowledgement

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