

Masters -

Research Topic proposal (MSc Thesis)

CFD modeling and simulation of indoor air pollution

Institution host :

IMT Lille Douai represents the largest engineering school in the north of Paris graduating future engineers and scientific experts. In a partnership with the University of Lille, each year the IMT Lille Douai, an engineering school of the IMT (Institut Mines-Télécom), graduates more than 500 talented engineers, trained to overcome the engineering, economic and social challenges.

This Masters research proposal will be hosted by the Energy Engineering Department (DEI) of IMT Lille Douai situated in the research center in Douai city (around 40 km to Lille). The successful candidate will work, for about 4 to 5 months, on a research topic entitled « CFD modeling and simulation of indoor air pollution in a room with adsorptive walls/materials ». This Masters research topic will be co-supervised by two researchers from DEI of Douai (Dr. Talib DBOUK and Dr. Rémi GAUTIER) and by three researchers from the technical university of Wien in Austria (Prof. Michael HARASEK, Dr. Bahram HADDADI and Dr. Christian JORDAN).

Objectives :

Indoor air quality is becoming a major topic of interest nowadays due to the fact that humans spend most of their time at the interiors of buildings' envelopes. Thus, reducing pollutants in air by adsorptive materials/surfaces is an interesting topic for research and development. The major objective is to characterize and quantify the potential of adsorptive materials in reducing air pollution and thus improving the indoor overall air quality (i.e. as air purifier tools). Rare numerical techniques have been developed in the literature for the modeling and simulation of air pollution using CFD tools [1-4]. Due to the complexity of the physical phenomena involved, the existing CFD techniques are dispersed in the literature introducing many simplifications into the modeling of the real physical phenomena behind adsorption.

In this MSc thesis Masters research, **first**, it is required to conduct an intense bibliography study in order to identify the potential of CFD tools in reducing the indoor air pollution by applying adsorptive materials/walls.

Second, in this purpose, a CFD methodology/protocol will be developed and adopted (i.e. models choice and initial and boundary conditions strategy). Then, the successful candidate may implement some new models (in OpenFOAM® or Star-CCM+®) and then conduct CFD simulations on an air purifier case (i.e. a test case in 3D (to be defined) for predicting indoor air pollution evolution in a room in the presence of adsorptive materials/walls).

At the end, a detailed scientific report of the developed methodology and the CFD results will be analysed, discussed and presented.

Profile:

The successful candidate should have good physical and numerical backgrounds in chemical engineering science and adsorption phenomena with good experience in numerical Fluid Dynamics, and CFD simulation tools/techniques. She/He should have a good appetite for some numerical developments. Good knowledge of C++ and java (or python) and the use of OpenFOAM® and/or Star-CCM+® will be very appreciated. The candidate should be highly motivated for research, and keen to work as part of a team and in a multidisciplinary environment.

Information :

The successful candidate will benefit from a net salary around 450 euros per month during the Masters research 4 to 5 months period in Douai city.

The starting date can be anytime between April and May 2018 depending on the availability of the selected candidate.

Contact:

All candidates should send their (CV) Curriculum Vitae and a Motivation Letter **before the end of April 2018** to the following two email addresses:

Dr. Remi GAUTIER, email : remi-gautier@imt-lille-douai.fr

Dr. Talib DBOUK, email: talib.dbouk@imt-lille-douai.fr

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References :

1- R. GAUTIER, T. DBOUK, M.A. CAMPESI, L. HAMON, J.-L. HARION and P. PRÉ, Pressure-swing-adsorption of gaseous mixture in isotropic porous medium: Transient 3D modeling and validation, Chemical Engineering Journal, accepted, May 2017.

DOI: <https://doi.org/10.1016/j.cej.2017.05.145>

2- R. GAUTIER, T. DBOUK, J.-L. HARION, L. HAMON and P. PRÉ, Pressure-swing-adsorption of gaseous mixture in isotropic porous medium: Numerical sensitivity analysis in CFD, Journal of Chemical Engineering Research and Design, in press, Nov. 2017.

3- A. Queffeuilou, L. Geron, E. Schaer, Prediction of photocatalytic air purifier apparatus performances with a CFD approach using experimentally determined kinetic parameters. Chemical Engineering Science, 65, (2010).

4- T. Kim, S. Kato, S. Murakami, S. Kim, CFD analysis of pollutant distribution in a room with adsorptive walls. J. of Asian Architecture and Building Engineering, 53, (2003).