Title: Study of Self-cleaning adsorbent textile for indoor air treatment under real conditions
Titre : Etude du textile adsorbant autonettoyant pour le traitement de l'air intérieur dans des conditions réelles

Keywords: Heterogeneous photocatalysis, Adsorption and regeneration, chemical oxidation, modelling, mass transfer limitation

Contextual elements

This thesis will be carried out within the framework of the ANR TEXAD project, which is an interdisciplinary and collaborative project between CIP-ENSCR, IRCELYON and Brochier Technologies (industrial) and IGGCM - Rennes 1. The project TEXAD aims to develop an innovative and sustainable technology of remediation that will be integrated into a stand-alone mobile module. This module placed in the room (office, meeting rooms, classroom…) will allow to treat indoor air. The concept consists in using adsorption as trapping technique coupled with AOP (pollutant degradation technique) allowing to have no more consumable and to develop a sustainable purifier. This coupling will allow from one hand to avoid the propagation of potentials intermediate pollutants from AOP and from other hand it will allow to avoid a potential release of pollutants from adsorbent before its saturation. The module will be validated firstly in $1m^3$ chamber according to standard and secondly in $30m^3$ climatic chamber simulating the actual operating conditions

Objectives and specific thesis program

The thesis subject concerns a research work on the kinetics of VOCs degradation using combined photocatalysis and adsorption in continuous reactor in order to investigate the efficiency of the best new catalysts under different configurations of reactor:

The first stage aims to (i) qualify the laboratory reactor performances, (ii) determine the influence of the parameters related to the gas flow (residence time, temperature, relative humidity...), mode of treatment (adsorption, regeneration and photocatalytic oxidation), (iii) identify if presence of by-products due to the various characteristics of the gas and (iv) optimize of residence time to avoid formation of by-products.

The second stage is based on the study the influence of operating parameters on the reaction kinetics of photocatalytic degradation made it possible to test the feasibility of the oxidation of the target pollutants. It also made it possible to highlight many phenomena concerning in particular the differences between the air treatment devices with tangential flow and those with crossing flow: correlation between regeneration capacity and air flow within the catalysts.

The third stage will be about the adsorption in continuous operation (UV off) and regeneration with recycling mode. Inf act, after the evaluation of the support regarding to its photocatalytic activity alone then as an adsorbent (without UV LED). Several photocatalysis regeneration studies of the AC* will be carried out in detail on an open and a closed loop. It depends on the optimized reactor configuration.

Finally, all the results obtained during this work with a modeling of the phenomena involved should make it possible to validate the function of module in $1m^3$ chamber according to standard and secondly in $30m^3$ climatic chamber simulating the actual operating conditions

Thus, it is a multidisciplinary investigation crossing experimental and theoretical aspects within the Chemistry and Process Engineering team (CIP-ENSCR).

Skills requested

The candidate must have knowledges and skills in the fields of water chemistry, chemical engineering or environmental engineering. Modeling and simulation skills will be very appreciated.

He (She) must be autonomous in his (her) work. He (She) must have also specific skills for a research project: curiosity, scientific precision, perseverance, perspective, teamwork. French language will be appreciated.

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Duration - Funding

3-years with an ENSCR doctoral contract
Thesis start date: September 2023
Doctoral specialty: Chemistry: Environmental Processes
Monthly remuneration: Amount defined by the doctoral contract

Application form

Candidates should submit a CV and a letter of motivation by email before 15/06/2023 to:
Thesis Director : Aymen ASSADI: aymen.assadi@ensc-rennes.fr
Co-supervisor : Abdelkrim BOUZAZA : abdelkrim.bouzaza@ensc-rennes.fr