

Ph.D. thesis proposal – October 2017

Biochemical impact of agricultural, Breeding and agrofood Effluents On concrete structures in biogas systems (anaerobic co-digestion) – BIBENDOM

Short title: Durability of concrete in biogas systems (biodeterioration) / Durabilité des bétons des structures de méthanisation (biodétérioration)

PRESENTATION OF THE PROJECT

The anaerobic digestion process allows the treatment and the recycling of agricultural, agro-industrial and household organic wastes, into biogas (methane, CO₂, etc.) used as green energy to produce heat and electricity by cogeneration technology. European policy currently supports financially the development of biogas installations to ensure energy transition towards greener energy systems, which has made the biogas sector a potentially attractive organic-waste recovery industry. In the dynamic market of biogas, **concrete established itself as a suitable construction material owing to its economic interest, its airtightness properties and its high thermal inertia.**

However, in contact with biowastes, concrete structures are subjected to deteriorations at every stage of biogas production cycle because of both the chemical compounds excreted by microorganisms and the microorganisms themselves which form biofilms at the concrete surface and may create very aggressive local conditions. The impact of these deteriorations on biogas plants are both economic and environmental. In a context of significant expansion of the biogas industry, the sustainable development of the sector requires a better understanding of concrete biodeterioration in order to improve the structures' durability in these aggressive environments.

The final aim of the BIBENDOM project is to **propose efficient, health- and environment-friendly solutions for increasing the durability of concrete in biogas production units.**

In the frame of the project, a 3-year Ph.D. student position is proposed, and is to start on early October 2017.

The study will aim at:

- **Characterizing real biowastes** in several situations and for various types of agricultural effluents with the view to identify **critical conditions for concrete.**
- Providing a **detailed understanding and evaluating kinetics of concrete biodeterioration phenomena both in laboratory and in situ**, notably using an **equipped platform in a biogas plant.**
- **Developing biological tests aiming to rationally investigate the phenomenology of biofilm-cementitious material interactions.**
- **Developing and assessing solutions to improve the durability of concrete in biogas systems.** Various promising avenues, from **material science (chemical and biological resistance) and from biological science (positive biofilms)** will be explored.

This project is **strongly multidisciplinary** and involves skills related to material science and civil engineering, microbiology, process engineering, biological and biochemical engineering, biofilm microscopy, etc. The PhD work will be co-supervised by two laboratories of INSA Toulouse: LMDC and LISBP.

→ **Laboratory of Materials & Durability of Constructions (LMDC, UPS/INSA, EA 3027, 120 persons, incl. 41 teaching-research staff).** Research activities in the field of building materials in civil engineering and more particularly concrete. The research activities aim at understanding the behaviour and the evolution of materials and structures in their environment and at developing durable and efficient materials. <http://www.lmdc.insa-toulouse.fr/index.php>

→ **Laboratory of Biological Systems and Bioprocess Engineering (LISBP, UMR INSA/CNRS 5504 – INRA 792)** comprises 11 teams and about 250 researchers. The SYMBIOSE team (Microbial ecosystems and bioprocesses of treatment and valorization) focuses on the analysis, the modelling, and the control of microbial functions in mixed cultures. <http://www.lisbp.fr>

REQUESTED PROFILE OF APPLICANTS:

The applicant will be graduated a Master degree, and:

- Will have training in material science and/or civil engineering, **or** microbiology/bioprocess **or** chemistry (skills in two or more of these topics will be appreciated),
- Will be strongly attracted by multidisciplinary topics and experimental works,
- Will be curious, motivated and hard-worker, will be able to integrate and adapt to different research teams with different scientific cultures

Skills and/or knowledge in analytical techniques of solids and liquids (HPIC, HPLC, ICP-OES, DRX, EPMA...), in microscopy (SEM, epifluorescence, confocal, etc.), bioreactor operating and/or cementitious materials will be appreciated. The recruited person will be trained to technical and analytical procedures, if necessary.

CONDITIONS:

36-month contract starting in October 2017. Net remuneration: about 1500 €.

Possibility to give teaching on the period, if interested.

APPLICATION PROCEDURE:

CV, letter of motivation and transcript to be sent as soon as possible and by 31 July 2017 to:

- Prof. Alexandra Bertron, bertron@insa-toulouse.fr
- Dr. Matthieu Peyre Lavigne, mpeyre@insa-toulouse.fr