Research Topic for the ParisTech/CSC PhD Program

*Field (cf. List of fields below):
1. Environment Science and Technology, Sustainable Development, Geosciences

2. Life Science and Engineering for Agriculture, Food and the Environment

3. Energy, Processes

Subfield: (Applied Physics, Chemistry, Mathematics, Mech. Eng. etc…)
Bioprocesses,
Microbial ecology, Molecular biology,
Analytical chemistry, Metabolomics,
Biostatistics

Title: Improving the operation of anaerobic digesters: high-throughput molecular ecology approaches to understand and prevent disturbances occurring during co-digestion.

ParisTech School: AgroParisTech

Advisor(s) Name: Laurent Mazéas and Olivier Chapleur, research scientists at HBAN Research Unit, Irstea, FRANCE

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Short description of possible research topics for a PhD:
Anaerobic digestion (AD) is a microbial bioprocess of degradation of the organic matter which ultimatelyproduces biogas rich in methane that can be converted to electrical and thermal energy. It is used to recover different types of organic waste. However AD is very sensitive to different types of perturbations that can lead to process failure.
In this PhD project we want to focus on perturbations of AD that can occur during co-digestion of different substrates by using the omic methodologies. Laboratory experiment simulating digesters disruption will be performed. DNA sequencing will enable to follow the microbial dynamics after the perturbation and metabolomic analyses will describe evolution of metabolic pathways. The analysis of these omics data by biostatistical toolswill allow extracting the relevant correlations between the various types of data to identify the causes ofthe failure and propose strategies of successful management to improve co-digetion. In particular we want to set microbial indicators of optimal performance and warning indicators of process failure.

Required background of the student: (Which should be the main field of study of the applicant before applying)
Analytical chemistry or microbial ecology/molecular biology or experience in biotechnology and bioprocesses engineering. Good knowledge of bioinformatics and biostatistics will be considered positively as well as lab work experience.

A list of 5(max.) representative publications of the group: (Related to the research topic)
1.   **Hao L, Bize A, Conteau D, Chapleur O, Courtois S, Kroff P, Desmond-Le Quéméner E, Bouchez T, Mazéas L.** 2016. New insights into the key microbial phylotypes of anaerobic sludge digesters under different operational conditions. Water Res **102:**158-169.

2. **Lü F, Bize A, Guillot A, Monnet V, Madigou C, Chapleur O, Mazéas L, He P, Bouchez T.** 2014. Metaproteomics of cellulose methanisation under thermophilic conditions reveals a surprisingly high proteolytic activity. ISME J **8:**88-102.
3. **Madigou C, Poirier S, Bureau C, Chapleur O.** 2016. Acclimation strategy to increase phenol tolerance of an anaerobic microbiota. Bioresour Technol **216:**77-86.
4. **Poirier S, Bize A, Bureau C, Bouchez T, Chapleur O.** 2016. Community shifts within anaerobic digestion microbiota facing phenol inhibition: Towards early warning microbial indicators? Water Res **100:**296-305.
5. **Poirier S, Desmond-Le Quéméner E, Madigou C, Bouchez T, Chapleur O.** 2016. Anaerobic digestion of biowaste under extreme ammonia concentration: Identification of key microbial phylotypes. Bioresour Technol **207:**92-101.