# METHADIAG

agence nationale de la recherche

# *Development of fast diagnosis tools to monitor anaerobic digesters operation*

Project ANR-22-CE43-0014-01
CE43 - Bioeconomy: chemistry, biotechnology, processes and system approaches, from biomass to uses

## Abstract

Anaerobic digestion is a process of degradation of the organic matter carried out by a complex network of microorganisms that produces biogas rich in methane, which can be ultimately converted to energy. The process performance hinges on the structure and the interactions among the species in the microbial community, which is at the same time determined by the digesters operational conditions.

Currently, the control of the anaerobic digestion process relies on monitoring physico-chemical indicators that do not allow precise identification of the origin of the disturbances, since these physico-chemical indicators cannot describe in detail the biological dynamics in the digesters. This represents a real difficulty for operators because digesters failure can be due to many different causes. As the microbial community in the digesters is very sensible to the alterations in the operational conditions during AD, our research hypothesis is that the monitoring of the microbial community can be used as a more effective method to evaluate the digesters' functioning than classical physicochemical indicators.

The use of high-throughput techniques from the biological field (i.e. 16S DNA metabarcoding and metabolomics) could be a very powerful mean to realize such monitoring and reveal the nature of the process disturbances. However, until recently, high-throughput techniques were limited to selected lab studies as they were expensive, time-consuming, and the results were not easily transferable to industrial systems. Methodological developments now allow more feasible and faster approaches able to capture the biological particularities of the ADs systems and to develop fast diagnosis tools.

In this line, the Methadiag project has three main objectives: (i) First, we will develop specific analytical protocols for high-throughput techniques that could be used on-site or enable a quick response (Task1a) (ii) Second, we will evaluate to what extent anaerobic digesters are comparable at the microbial and molecular levels and common diagnosis tools could be developed (Task1b) (iii) Finally, based on data obtained from full scale digesters and additional lab-scale experiments, we will establish a set of microbial and molecular biomarkers to monitor digester functioning by the fast diagnostic tools developed (Task2).

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This project includes both basic and applied research lines, and results from the two types are therefore expected. On the one hand, the expected results from the basic research line are 1) the development of analytical methods to allow the on-site handling of anaerobic digester sludge for 16S metabarcoding and metabolomics analysis, 2) the improvement of the general understanding of the functioning of full-scale ADs in terms of 16S metabarcoding and metabolomics data, and 3) the design of data analysis pipelines for the discovery of warning indicators that could be applied to investigate similar experiments.

On the other hand, the expected results from the applied research line are 1) a list of warning indicators that can be monitored to assess the ADs well-functioning, and 2) a user-friendly Graphical User Interface to visualize and interpret the ADs well-functioning on the basis to the warning indicators.

In general, the main originality of the project resides in the design of transferable tools suitable for fast diagnosis in AD plants. The results obtained in this project will allow improved monitoring of the anaerobic digesters, with the objective to achieve more efficient processes and a higher level of sustainability.


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**Scientific and technical partners**

- Suez Group
- IDAEA-CSIC - Chemometrics for environmental omics group

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