LONGDOM CONFERENCES

3rd International conference on
Green Energy and Environment
May 18-19, 2023 | Rome, Italy

Scientific Tracks

Overview of numerical simulation of solid-state anaerobic digestion considering hydrodynamic behaviors, phenomena of transfer, biochemical kinetics and statistical approaches

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Anaerobic digestion (AD) is a promising way to produce renewable energy. The solid-state anaerobic digestion (SSAD) with a dry matter content more than 15% in the reactors is seeing its increasing potential in biogas plant deployment. The relevant processes involve multiple of evolving chemical and physical phenomena that are not crucial to conventional liquid-state anaerobic digestion processes (LSAD). A good simulation of SSAD is of great importance to better control and operate the reactors. The modeling of SSAD reactors could be realized either by theoretical or statistical approaches. Both have been studied to a certain extent but are still not sound. This paper introduces the existing mathematical tools for SSAD simulation using theoretical, empirical and advanced statistical approaches and gives a critical review on each type of model. The issues of parameter identifiability, preference of modeling approaches, multiscale simulations, sensibility analysis, particularity of SSAD operations and global lack of knowledge in SSAD media evolution were discussed. The authors call for a stronger collaboration of multidisciplinary research in order to further developing the numeric simulation tools for SSAD. In the present paper, an up-to-date overview of the published work is realized in order to get a state of the art of current research. According to the bibliographic analysis authors give a critical opinion to each type of the models and open the horizon for the future work. This work will help the acquirement of the knowledge about the numerical simulation of SSAD in a bid to improve the operation and, ultimately, the deployment of solid-state AD processes in biogas plant. The objectives are to (1) obtain the state of the art of the previous work related to modeling issue of SSAD processes including theoretical and statistical approaches, (2) discuss the limitation and difficulties in realizing the modeling and (3) give the perspectives for future work.

Biography: Arnaud Coutu is a lecturer in numerical mathematics (PhD) specialized in numerical optimization and modeling for environment preservation and development of renewable energies. He is in charge of the numerical modeling division at GéoLab, Institut Polytechnique UniLaSalle Beauvais (France) and his previous papers were about optimization, hydrodynamics and modeling of solid-state anaerobic digestion. His skills include modeling, CAD, CFD, 3D-printing and process engineering. He is currently working on the application of numerical tools for the optimization and modeling of anaerobic digestion and the energy mix at different scales (laboratory scale, process scale and regional scale).

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Received: 13-Feb-2023 , Accepted : 16-Feb-2023 , Published: 06-Jun-2023