BIOFUEL PRODUCTION FROM BIOMASSES, MUNICIPAL SOLID WASTE AND SEWAGE SLUDGE

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The aim of this research line is to study and optimize the production of biofuels through the anaerobic digestion (AD) of organic waste (biohydrogen and biomethane) and the exploitation of lipid-rich biomasses and waste matrices (biodiesel).

The research on anaerobic digestion has the following goals: a) the study of the biomethanization of unconventional waste matrices, such as algae, municipal solid waste, activated sludge from the treatment of industrial waste, food industry waste; b) the development of chemical, physical and enzymatic pretreatments for the subsequent biomethanization of organic matrices with a high ligno-cellulosic content; c) the development of innovative bioreactors (biofilm reactors; non-conventional mixing techniques); d) the development of two-stage processes, with bioproduction of hydrogen in the 1st stage and methane in the 2nd; e) the development of prototype reactors aimed at the study and optimization of the process fluid-dynamics, using techniques such as Particle Image Velocimetry and Tomography; f) the kinetic and fluid-dynamic modeling of the process, including the use of Computational Fluid Dynamics (CFD), and its subsequent optimization. The research approach includes the biochemical, physiological, phylogenetic and kinetic characterization of the microbial cultures. A second research line aims at the optimization of the process of biodiesel production from lipid-rich seeds, algae, bacteria and organic wastes. The specific research goals are: a) the energetic optimization of the process; b) the study of innovative mixing techniques (such as static mixers), also through CFD; c) the development of innovative processes with heterogeneous and/or enzyatic catalysis; d) the optimization of the separation of biodiesel from the polar phase (glycerin and process water) through the use of coalescers; e) the biotechnological exploitation of glycerol through its conversion to 1,3-propanediol; f) the kinetic and fluid-dynamic modeling of the process.

The available equipment includes several reactors, with pH and temperature control and mechanical agitation, in the 1-30 L volume range.

Fig. 1. Bioreactor for the biological production of hydrogen.

Fig. 2. Bioreactors for the biomethanization of organic wastes.

MAIN PUBLICATIONS

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RESEARCH PROJECTS

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BIOHYDRO Project (Combined production of hydrogen and methane from agro-industrial wastes by biological processes) (2009-2013), financed by the Italian Ministry of Food and Agriculture (MIPAAF).

EXTRAVALORE Project (Valorization of the by-products of the biodiesel production process) (2010-2013), financed by the Italian Ministry of Food and Agriculture (MIPAAF).

EU Project FP7-2012-ID 311933: WATER4CROPS (Integrating bio-treated wastewater with enhanced water use efficiency to support the Green Economy in EU and India).

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