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Screening of a wide range of pre-treatments for improving the algal biomass solubilization and biogas potential

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The microalgal biomass conversion into methane as a biofuel offers the best energetic balance among the different biomass–to-biofuel scenarios for microalgae containing less than 40% lipids. The anaerobic degradation limitation of algae at around 50% emphasizes the need for pre-treatment to obtain higher methane production from algae. This study was performed using Scenedesmus sp. AMDD, green microalgae, as a model strain. Over 20 series of different pretreatments were evaluated, alone, or in sequence. The enzymatic pretreatments were performed with pectate-lyase and cellulase at incubation time from 2 to 24 hours. Chemicals pretreatments were done with H_2SO_4, NaOH or H_2O_2, at 0.2N and 2N and 2 to 24 h of reaction time. Thermal treatments were completed in an oven or a pressure vessel at 121 – 180°C or using a microwave (175 – 300°C). The enzymatic hydrolysis of Scenedesmus sp. AMDD followed with a three hours incubation in NaOH 0.2N resulted into a 75% solubilization. Similar results were found with incubation in 0.2N NaOH followed with short thermal treatment. Caustic and thermal pretreatments improved the methane production by around 12% compared with the anaerobic digestion of untreated algal biomass, at 335 ± 28 ml CH_4 STP/g volatile solid (VS) added. The results from the enzymatic pretreatment were less encouraging with improvement of 2-7% of the methane production only. However, a combination of enzymatic with a thermal treatment successfully solubilized up to 75% of Scenedesmus sp. AMDD biomass. The resulting methane production, although up to 15% higher than for the control biomass, did not fully correlate with the increased dissolved organic matter. In anaerobic digesters continuously fed with solubilized biomass after combined enzymatic and thermal pre-treatment, the CH_4 yield was improved by up to 35% in some operational conditions, while the degradation rate was faster, allowing for lower retention time.

Biography

Serge R. Guiot is Principal research scientist at the National Research Council of Canada (NRC). After he obtained a D.Sc. degree in Environmental Science in Belgium, he joined NRC in Ottawa (Canada) in 1983, then the Biotechnology Research Institute in Montreal in 1987. He is currently leading the Bioengineering group within the Energy, Mining & Environment Portfolio (EME) of NRC in Montreal. His research interests include: biofilm and microbial fuel cell reactors for wastewater biotreatment; enhanced anaerobic digestion of wastes and algae; acidogenic digestion towards carboxylic acids; biomethanation of syngas. He has ten patents to his credit and has published over 180 articles in peer-reviewed journals. He recently was awarded the Queen Elizabeth II's Diamond Jubilee Medal in recognition for his reputable scientific work at NRC.

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