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conversion of lignocellulose to bioethanol, biohydrogen and biomethane

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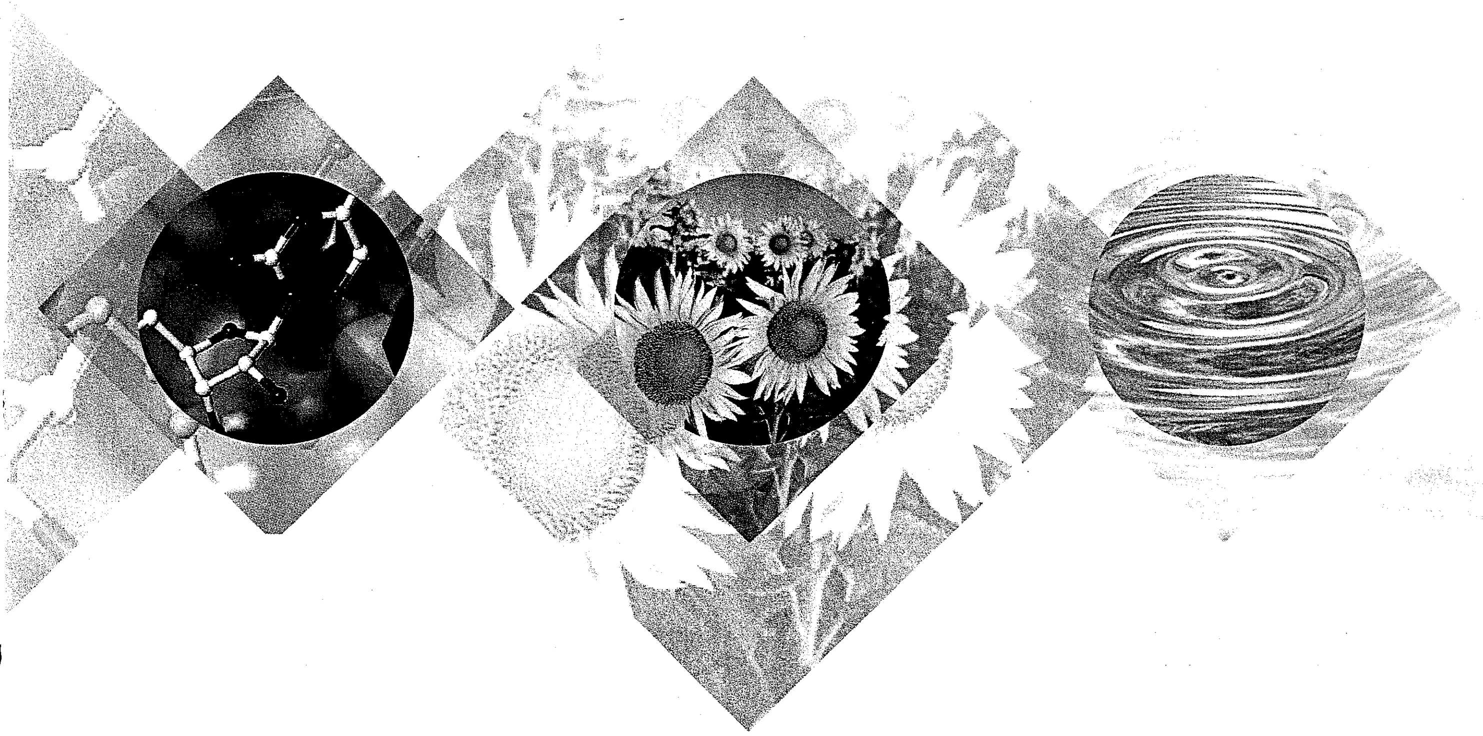

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ABSTRACTS

Biofuel Production: A new Biorefinery for Sustainable Energy from Crops; Conversion of Lignocellulose to Bioethanol, Biohydrogen and Biomethane

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Sustainable production and utilization of biofuels has an enormous potential for the world's energy supply. Most research studies usually focus on individual conversion processes and specific end-products. To gain full benefits however, it is important to investigate production and utilization cycles in an integrated way and to consider all important aspects involved: e.g. crop production, residues, supply chain, flexibility of end-products, and environmental aspects. Agricultural residues are excellent examples of crops with a large potential for flexible production of several end-products, such as: bioethanol, biohydrogen, biogas as well as biopolymers. In this multidisciplinary study we tried to integrated innovative approaches to produce a multi-product biofuel from these important crops based on a number of novel and mutually synergistic production methods, and at the same time include an assessment on the environmental benefits and drawbacks related to the concept. The combined production methods will significantly simplify the overall production process and thereby substantially reduce the product costs and the environmental impacts. The scheme for multi-product biorefinery process that is under investigation is including the following steps: pretreatment of lignocellulosic biomass for release of carbohydrates; conversion of hexoses to bioethanol; conversion of pentoses to biohydrogen and finally waste streams treatment in anaerobic biogas reactors for production of biogas. In the present paper we show that pretreated lignocellulosic material could successfully be converted to bioethanol (for the solids hexoses part) with a yield of 90-100% and to biohydrogen for the hydrolysate mainly containing the pentoses with a specific yield of 2.95 $mmoleH_2/gVS_{added}$. The hydrolysate was converted to hydrogen in a thermophilic process using continuous stirred tank (CSTR). A productivity of 113 ml $H_2/(d \cdot l)$ was achieved from the CSTR reactor experiments. The effluents of the process could be converted to methane in a CSTR reactor. The present study shows that it is possible to extract different biofuels from lignocellulosic material in order to optimize for the highest value products in a chain different production steps, where all available organic material is optimally utilized.