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Waste lignocellulosic biomass utilized in two-phase anaerobic digestion process for biohydrogen and biomethane production

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Abstract

Anaerobic digestion technology has been used by humans for centuries. This process is accomplished by a specific microbial consortium under diverse digestion conditions, enabling energy production. It combines waste management practices with renewable energy production. Lignocellulosic biomass is an abundant and renewable source, containing large amounts of energy. It is an alternative to fossil fuels, allowing the production of biofuels. Microorganisms are the core of the anaerobic digesters and play an important role in the succession of hydrolysis, acidogenesis, acetogenesis, and methanogenesis processes taking part. The diversity of participating microbes can provide new information on digester performance for waste biomass valorization and biofuels production. In this study anaerobic systems, operating under mesophilic conditions realized biodegradation of waste wheat straw - a renewable source for biohydrogen and biomethane production. Their management and optimization aimed at increased production of hydrogen and methane separately but when combined in a two-stage system higher yields and positive energy balance was achieved. The first phase included biohydrogen production from lignocellulosic waste followed by a second one - production of biomethane with the participation of different anaerobic microbial consortia. These mixed cultures were identified by metagenomics. The relation between substrate degradation and biogas accumulation was followed, together with determination of the profile of fatty acids as intermediate products obtained during the conveyed processes. The biohydrogen concentration in the biogas reached 14.43 %, while methane percent was 69%. Calculations about the cumulative yield of energy carrier during the two-stage process was much higher than that obtained for the one-stage process.

Keywords: Key words: waste biomass, microbial consortia, anaerobic digestion, energy production

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