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Effect of Enzymatic Hydrolysis and Ultrasounds Pretreatments on Biogas Production from Corn Cob

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Abstract : World economy is based on non-renewable, fossil fuels such as petroleum and natural gas, which entails its rapid depletion and environmental problems. In EU countries, the objective is that at least 20% of the total energy supplies in 2020 should be derived from renewable resources. Biogas, a product of anaerobic degradation of organic substrates, represents an attractive green alternative for meeting partial energy needs. Nowadays, trend to circular economy model involves efficiently use of residues by its transformation from waste to a new resource. In this sense, characteristics of agricultural residues (that are available in plenty, renewable, as well as eco-friendly) propitiate their valorisation as substrates for biogas production. Corn cob is a by-product obtained from maize processing representing 18 % of total maize mass. Corn cob importance lies in the high production of this cereal (more than 1 x 109 tons in 2014). Due to its lignocellulosic nature, corn cob contains three main polymers: cellulose, hemicellulose and lignin. Crystalline, highly ordered structures of cellulose and lignin hinders microbial attack and subsequent biogas production. For the optimal lignocellulose utilization and to enhance gas production in anaerobic digestion, materials are usually submitted to different pretreatment technologies. In the present work, enzymatic hydrolysis, ultrasounds and combination of both technologies were assayed as pretreatments of corn cob for biogas production. Enzymatic hydrolysis pretreatment was started by adding 0.044 U of Ultraflo® L feruloyl esterase per gram of dry corncob. Hydrolyses were carried out in 50 mM sodium-phosphate buffer pH 6.0 with a solid:liquid proportion of 1:10 (w/v), at 150 rpm, 40 ºC and darkness for 3 hours. Ultrasounds pretreatment was performed subjecting corn cob, in 50 mM sodium-phosphate buffer pH 6.0 with a solid: liquid proportion of 1:10 (w/v), at a power of 750W for 1 minute. In order to observe the effect of the combination of both pretreatments, some samples were initially sonicated and then they were enzymatically hydrolysed. In terms of methane production, anaerobic digestion of the corn cob pretreated by enzymatic hydrolysis was positive achieving 290 L CH4 kg MV-1 (compared with 267 L CH4 kg MV-1 obtained with untreated corn cob). Although the use of ultrasound as the only pretreatment resulted detrimentally (since gas production decreased to 244 L CH4 kg MV-1 after 44 days of anaerobic digestion), its combination with enzymatic hydrolysis was beneficial, reaching the highest value (300.9 L CH4 kg MV-1). Consequently, the combination of both pretreatments improved biogas production from corn cob.

Keywords : biogas, corn cob, enzymatic hydrolysis, ultrasound
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