Technical University of Denmark

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Tsapekos, Panagiotis; Kougias, Panagiotis; Egelund, H.; Larsen, U.; Pedersen, J.; Trenel, P.; Angelidaki, Irini

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P. Tsapekos, P.G. Kougias, H. Egelund, U. Larsen, J. Pedersen, P. Trénel and I. Angelidaki

Meadows, marginal and environmentally sensitive areas are often considered as the source to find the needed organic feedstock for the proliferated full-scale biogas plant. However, the anaerobic digestion (AD) of biomass from these areas is connected with specific challenges, originated from their complex lignocellulosic structure. Thus, pretreatment methods are typically applied in order to disrupt their rigid matrix and improve the digestibility.

Despite the fact that a lot of research has already focused on various pretreatment methods for lignocellulosic substrates, their overall process efficiency is still doubted and thus, they are not widely used in full-scale biogas plants. In addition, these methods are typically associated with increased costs or energy demands. Hence, there is a need to find effective and cost-efficient solutions that boost biomass decomposition. In this concept, one way to improve the overall process efficiency is to minimize the number of individual process steps prior to feeding the biomass to the reactor.

The present study examined the effect of full-scale harvesting machines (i.e. a simple front mounted disc mower and a disc mower equipped additionally with a number of coarse barbs) to simultaneously mow and mechanically pretreat two different lignocellulosic substrates. Thus, ensiled meadow grass was initially examined at the first experimental set up. Regarding the second field test, an area sowed with regularly cultivated grass was harvested. In order to determine the treatment with the best energy balance, the energy demand during harvesting was compared to the practical methane yield. The biomethanation process was evaluated using triplicate batch assays under thermophilic conditions following the guidelines of the biochemical methane potential (BMP) protocol.

The findings showed that methane production can efficiently be enhanced by mechanical pretreatment applied at the harvesting step. More specifically, the most effective treatment yielded more than 10% increase in the bioenergy production from both examined grass silages. Our study demonstrates that the appropriate harvester can improve the energy output by approximately 2.4 GJ/ha under optimal conditions and subsequently, the overall sustainability of grass-based AD.