

不同预处理方式对玉米秸秆结构及产气特性的模拟研究

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Simulation of Structure and Biogas Production Properties of Corn Stalk Relative to Pretreatment Method

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摘要

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摘要 以玉米秸秆为原料, 在25 °C条件下, 分别采用沼液及不同含量的NaOH溶液对秸秆进行预处理, 研究NaOH投加量与秸秆纤维结构、预处理液理化性质以及产能特性之间的关系。结果表明, 采用 $4 \text{ mg} \cdot \text{g}^{-1}$ NaOH溶液预处理7 d后, 料液中COD浓度已基本稳定, 溶液pH值在7~8之间, 可直接装罐发酵。利用扫描电镜观测预处理后秸秆结构变化状况, 发现经 $4 \text{ mg} \cdot \text{g}^{-1}$ NaOH溶液预处理后的秸秆表层结构粗糙、多孔, 有助于厌氧微生物与可发酵底物的接触, 产气量较未经处理的玉米秸秆提高5.5倍, 其干物质产气率为 $225.8 \text{ mL} \cdot \text{g}^{-1}$ 。综合考虑产气效率、生产成本及工程操作, 采用 $4 \text{ mg} \cdot \text{g}^{-1}$ NaOH溶液预处理秸秆更利于工程推广应用。

关键词: 玉米秸秆 NaOH 预处理 厌氧发酵 沼气

Abstract: An experiment was carried out using biogas slurry and NaOH solutions different in concentration to pretreat corn stalks at 25°C for biogas production to explore relationships of NaOH dosage with fiber structure of the pretreated corn stalk physico-chemical properties of the pretreatment solution, and energy production characteristics. Results show that 7 days after pretreatment with NaOH solution $4 \text{ mg} \cdot \text{g}^{-1}$ in concentration, COD concentration in the pretreated material solution became basically stable, with pH ranging between 7 and 8. At that time, the material was ready to be packed into the biogas tank for fermentation. A scanning electron microscope (SEM) was used to observe changes in fiber structure of the pretreated corn stalks. It was found that the corn stalks pretreated with $4 \text{ mg} \cdot \text{g}^{-1}$ NaOH became rough and porous on the surface, thus facilitating contact of anaerobic microbes with the substances, and eventually increasing biogas production by 4.5 times as compared with the use of untreated corn stalks, reaching $225.8 \text{ mL} \cdot \text{g}^{-1}$ dry matter. Taking anaerobic digestion performance, pretreatment cost and engineering operation into consideration, the method of using $4 \text{ mg} \cdot \text{g}^{-1}$ NaOH solution to pretreat corn stalks is easier to be extended.

Keywords: corn stalk NaOH pretreatment anaerobic fermentation biogas

Received 2013-04-07; published 2014-01-25

Fund:

“十二五”国家科技支撑计划(2011BAD15B03, 2010BAD03B01); “十二五”农村领域国家科技计划课题(2011BAD36B01)

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引用本文:

李萍, 韦秀丽, 蒋滔, 李平, 郑吉澍, 高立洪. 不同预处理方式对玉米秸秆结构及产气特性的模拟研究[J] 生态与农村环境学报, 2014, V30(1): 84-89

LI Ping, WEI Xiu-Li, JIANG Tao, LI Ping, ZHENG Ji-Shu, GAO Li-Hong. Simulation of Structure and Biogas Production Properties of Corn Stalk Relative to Pretreatment Method[J] Journal of Ecology and Rural Environment, 2014, V30(1): 84-89

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