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Chemical Pretreatments of Rice Straw for Anaerobic Digestion

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Abstract

Rice (*Oryza sativa*) is an important staple food for approximately half of the world population. In addition to the grains also the straw can be used if not needed as organic fertiliser for the fields. Although rice straw has potential to be used for anaerobic digestion (AD) to produce biogas, its large scale application is still limited. The utilisation of rice straw for AD must particularly be developed regarding the pretreatment of the lignin biomass for the hydrolysis process and the biogas yield and quality. Among the pretreatment methods, the alkalisation method was found to be effective. In the present study the effects of rice straw pretreatment was investigated in a multifactorial approach. For this purpose, calcium hydroxide ($\text{Ca}(\text{OH})_2$) and potassium hydroxide (KOH) were applied at different concentrations. Furthermore, the reaction time and inoculum-to-substrate ratio were included in the investigations. Results showed that the degradation of lignin, cellulose, and hemicellulose was higher after the chemical pretreatment. The main end-products identified were acetic and propionic acids. The highest hydrolysis yield was observed at a reaction time of 4 h, with an alkali concentration of 10 g per g rice dry matter, and an inoculum-to-substrate ratio of 50 %. Here also the maximum concentration of volatile fatty acids was observed with $187 \pm 0 \text{ mg L}^{-1}$. The composition of the acidified effluent was similar when both chemical compounds were used. Economically, the optimal amount of $\text{Ca}(\text{OH})_2$ for the pretreatment of rice straw was 4 g per g rice dry matter. The results showed, that the additional effort of a pretreatment of rice straw can be worthwhile to improve the AD and to increase the biogas yield.

Keywords: Bioenergy, biogas, biomass, digestion