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Short Communication

Two-step pretreatment of corn stalk silage for increasing sugars production and decreasing the amount of catalyst

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HIGHLIGHTS

- Two-step pretreatment method which is more suitable for biogas production was provided.
- Total sugars yield increased and the amount of catalyst decreased after two-step pretreatment.
- The appropriate catalyst used in two-step pretreatment can improve the methane production.

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ABSTRACT

The study investigated the effects of two-step pretreatment on fermentable sugar production from corn stalk silage. In the first step, the corn stalk silage was extracted by tepid water and then the solid was pretreated using $Fe(NO_3)_3$ as catalyst. The results showed that 45.8 g/100 g DM total sugars was obtained and the surface of remaining solid was seriously damaged after two-step pretreatment. Compared with one-step pretreatment, the production of total sugars increased by 23.8% and the amount of the catalyst of $Fe(NO_3)_3$ decreased by 28.8%. This research provides a new effective, suitable and economical pretreatment method for biogas production from corn stalk.

1. Introduction

Corn stalk is a renewable, cheap and widely available resource, which is commonly used for the production of biodiesel, bioethanol, biogas, biohydrogen and other chemicals (Lu et al., 2009). In order to obtain sugars directly available to microorganisms for the methane production, the lignocellulosic must be pretreated through certain processes due to its physical and chemical barriers caused by the close association of the main components: cellulose, hemicellulose and lignin (Lu et al., 2008; Elia et al., 2008; Martín et al., 2006). A number of pretreatment methods have been investigated by former researches (Zhang et al., 2008; Qi et al., 2009; Fox et al., 2003; Kim and Lee, 2005), including diluted acid pretreatment, liquid hot water pretreatment, steam explosion, wet oxidation, and biological treatment (Bjerre et al., 1996; Bierman et al., 1984; Fan et al., 1982; Hormeyer et al., 1988; McGinnis et al., 1983). Among all the methods, dilute acid pretreatment such as sulfuric acid, nitric acid is the commonly used and is considered to be the most promise method. Although, strong acid pretreatment is very efficient, it is not suitable for methane production because methane production is inhibited due to the production of H_2S and N_2 from reducing sulfate and nitrate, respectively. Additionally, the use of strong acid would cause serious environmental concerns.

In addition to those strong acid pretreatment approaches, inorganic salt pretreatment has also been investigated and shown some particular advantages for methane production, such as high reaction rate, less corrosion and recoverability (Sun et al., 2011a). Moreover, the appropriate amount inorganic ions such as Fe^{3+} can improve the methane production. The previous research showed that $FeCl_3$ had a particularly strong effect on the hemicellulose hydrolysis, and the yield of soluble xylose in the liquid fraction reached as high as 90% (Liu et al., 2009). Furthermore, Sun et al. (2011a) reported that $Fe(NO_3)_3$ was an effective catalyst for hemicellulose hydrolysis in corn stalk silage, and the maximum yields of monomeric xylose and monomeric arabinose in the liquid fraction reached 91.06% of initial xylose and 96.22% of initial arabinose, respectively. However, compared with dilute acid, $Fe(NO_3)_3$ is more expensive in price and less effective in pretreatment effect.

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