Enhance desilication and delignification in paddy straw via chemical and physical pretreatment

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Abstract

Paddy straw is one of the most common agricultural wastes and renewable resources available in Malaysia containing lignocellulosic values. Large parts of these plant materials are made up of complex carbohydrates such as cellulose and hemicelluloses which can be converted to fermentable sugars. In fermentation process of sugars, ethanol can be produce as by-product with the help of aerobic microorganism. However, the presence of high ash and silica content in paddy straw makes it an inferior feedstock for ethanol production. The objective of this study is set to determine the best physical and chemical pretreatment for desilication of paddy straw and encouraged delignification process. The pretreatment comprises the combination of physical and chemical treatments to maximize the process of desilication and delignification in the paddy straw. Physical treatment begins with paddy straws cut and grind to three different sizes which were 2 mm, 5 mm and 8 mm. All different sizes of paddy straw was (i) autoclave, (ii) boiled and (iii) soaked in four different concentrations (0.5%, 1%, 2% and 5%) of nitric acid and sodium hydroxide, respectively for chemical treatment. With the comparison on dry matter basis to untreated paddy straw, 5mm paddy straw pretreated with 0.5% nitric acid showed the highest cellulose content (96.6%). Through this combination, the cellulose fragment was improved by 54% but the lignin and hemicellulose were reduce to 38% and 54%, compared to untreated paddy straw, respectively. The percentage of ash content in acid treatment have total increment of 56% compared to untreated samples content while the percentage of ash content for alkali treatment have total loss of 55% and reduced compared to untreated samples. Therefore, 0.5% nitric acid was found to be the most suitable condition to break the cellulose-lignin complex.

Keywords: Cellulose, hemicellulose, pretreatment, desilication, delignification.

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