SIIC100

COMPARATIVE STUDY ON THE EFFECT OF ALKALI PRETREATMENT TECHNIQUE ON REMOVAL OF LIGNIN AND REDUCING SUGAR PRODUCTION FROM DIFFERENT BIOMASS

Jason Angkin Anak Johnady [1] and Dr. Siti Sabrina Binti Mohd Sukri [2]
[1]Faculty of Chemical Engineering, Universiti Teknologi MARA Pulau Pinang, 13500 Permatang Pauh, Pulau Pinang Malaysia
[2] Faculty of Chemical Engineering, Universiti Teknologi MARA Pulau Pinang, 13500 Permatang Pauh, Pulau Pinang Malaysia

**Corresponding author: 2017485272@isiswa.uitm.edu.my*

Abstract:

In Malaysia, biomass is generated every year via wastes from agriculture mainly via harvesting and is available in abundance. Rice husks are an example of biomass which are considered as wastes are disposed of improperly as the husks were burned by farmers which resulted in environmental pollution. To address this issue, several researches are continuously carried out to harness the potential of biomass as one of the alternative sources of energy and as a low-cost biosorbent and many more. Generally, biomass is made up of complex lignocellulosic structure comprising of cellulose, hemicellulose and lignin. Prior to accessing cellulose in biomass, it is imperative that lignin is broken down and removed. Thus, there is a need for biomass to undergo chemical pretreatment. There are two most commonly used modes of pretreatment used for delignification of lignocellulosic biomass. The modes of pretreatment are acidic pretreatment and alkali pretreatment. Commonly, analysis of reducing sugars utilizes the Dinitrosalicyclic acid (DNS) method developed by Miller (1959). The treated samples of black liquor from the experiment were analyzed using UV-vis spectrophotometer. This research will evaluate the effectiveness of alkali pretreatment on lignin removal from several biomass using sodium hydroxide and calcium hydroxide. Removal of lignin and reducing sugar production is evaluated from collection of data of several studies. NaOH was found to be the best alkali for alkaline pretreatment because it works at decreased temperatures and also exhibits a remarkable capacity of delignification in relation to its severity.

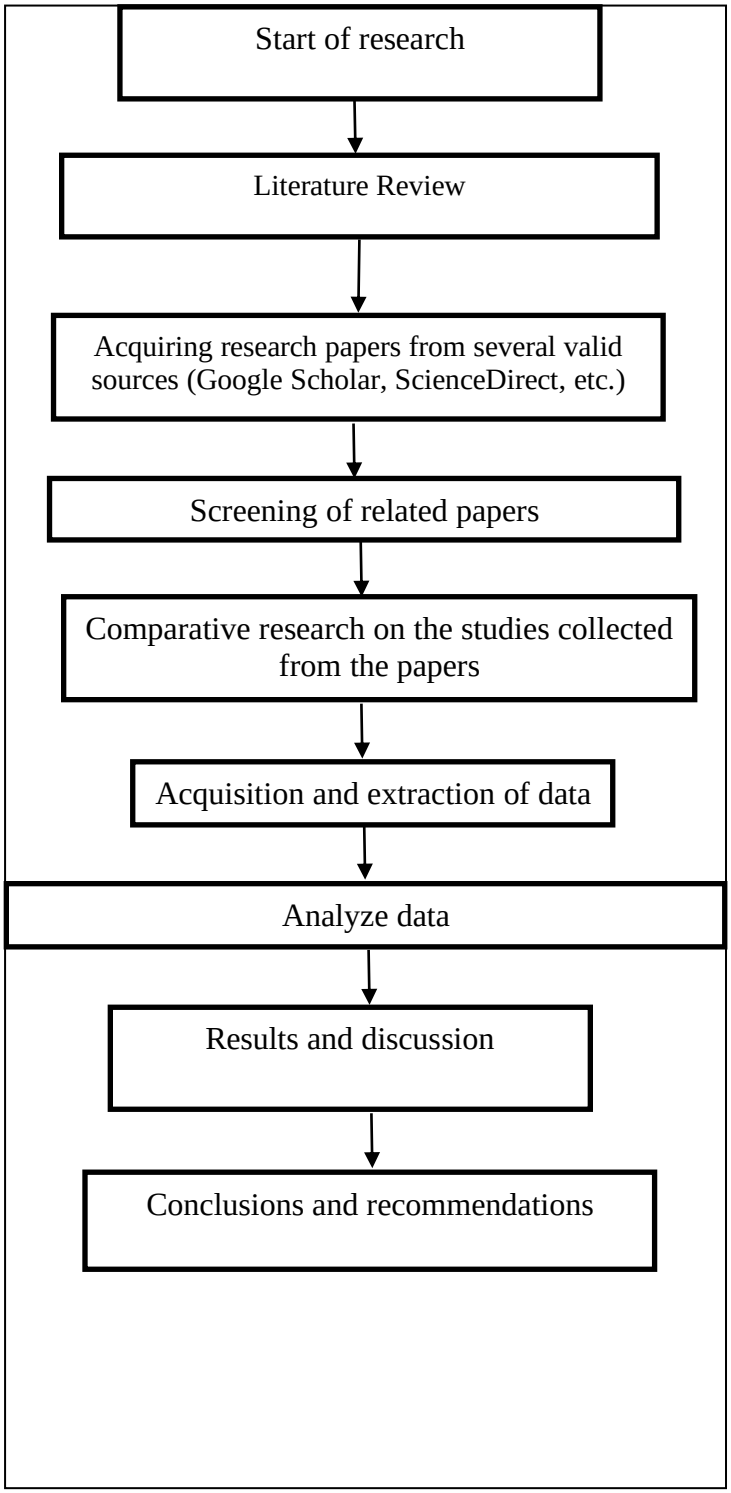
***Keywords*:**
Sodium hydroxide, Calcium hydroxide, Alkali pretreatment.

Objectives:

- To investigate the effect of using different alkali as pretreatment chemical on lignin removal and reduction of sugar production.

- To find the best alkali used for alkaline pretreatment with higher lignin removal and high production of reducing sugar.

Methodology:



Results:

Table 1: Research on alkali pretreatment on the lignin removal of biomass

Biomass	Alkali used	Lignin Removal
Switchgrass	NaOH	85.8 %
	$Ca(OH)_2$	33.22%
Bermuda grass	NaOH	86%
	$Ca(OH)_2$	10 to 20%
Corn stover	NaOH	86%
	$Ca(OH)_2$	18.9 g/100 g dry samples
Wheat straw	NaOH	83.68%
	$Ca(OH)_2$	82%
Rice straw	NaOH	23%
	$Ca(OH)_2$	27.0%

Table 2: Total Reducing Sugars production

Biomass	Alkali used	Total Reducing Sugars produced
Switchgrass	NaOH	330 mg/g raw biomass or 61.0%
	$Ca(OH)_2$	433.4 mg/g raw biomass
Bermuda grass	NaOH	71%
	$Ca(OH)_2$	449.8 mg/g
Corn stover	NaOH	13.3%
	$Ca(OH)_2$	440 - 460 mg equivalent glucose /g dry biomass
Wheat straw	NaOH	83.68%
	$Ca(OH)_2$	62.5 ± 1.7%
Rice straw	NaOH	55.2%
	$Ca(OH)_2$	56.3%

Conclusion:

In general, sodium hydroxide or potassium hydroxide were used for the alkali pretreatment of lignocellulosic biomass. The cheapest alternative for this form of pretreatment is the calcium hydroxide which is most commonly referred to as lime. When in reaction with carbon dioxide, calcium salts such as calcium carbonate are easily recovered. Based on several data collected from the acquired research papers, it was found that the best alkali for alkaline pretreatment is sodium hydroxide (NaOH). By using NaOH, the alkali will lead to swelling, enlargement of cellulose internal surface and thus reducing degree of polymerization (DP) as well as the crystallinity in addition to the breakdown of the structure of lignin. In general, alkaline pretreatments are performed at either room temperature or higher temperatures. Similar to acidic pretreatment, the alkaline pretreatment can be done at a lengthened period of time with low temperatures or at a shortened period with increased temperatures. It was also noted that the concentration or alkaline loading is another factor that effects the pretreatment as the enzymatic digestibility will be affected.