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COMPARATIVE STUDY FOR OPTIMIZED ALKALINE PRETREATMENTS FOR PRODUCTION OF REDUCING SUGAR FROM VARIOUS TYPE OF BIOMASSES

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Abstract:

Lignocellulosic biomass is a renewable source that can be found plentifully that contribute to a global yield of up to 1.3 billion tons in a year and is an appropriate raw material that can be used in numerous applications for human sustainability. It is mainly consisting of cellulose, hemicellulose, and lignin, which are strongly associated with each other. The aim of pretreatment for lignocellulosic biomass is to break down the complex structure of biomass and to provide better accessibility to the components to be converted into useful reducing sugar, thus becoming a crucial step in a extensive range of applications mainly for biomass to energy, fuels and other useful materials. However, a main obstacle is the removal of strong and uneven lignin component which is highly unaffected to solubilization and is also a major inhibitor for hydrolysis of cellulose and hemicellulose. This has led to wide research in the development of numerous pretreatment processes. The major pretreatment methods are physical, chemical, and biological methods. Thus, alkaline pretreatment is the essential stage in production of reducing sugar from lignocellulosic biomass. The optimization of alkaline pretreatment by using Design Expert software is required to attain the optimum value for the variables affecting the pretreatment to get high conversion of reducing sugar. The total reducing sugar was determined by using DNS method. The data for comparative between of optimized alkaline pretreatment using various type of alkaline reagents for production of reducing sugar is obtained from previous studies or research. Different types of biomass will have different optimum conditions for pretreatment and different types of alkaline reagents used also influenced the production of reducing sugar.

Keywords:

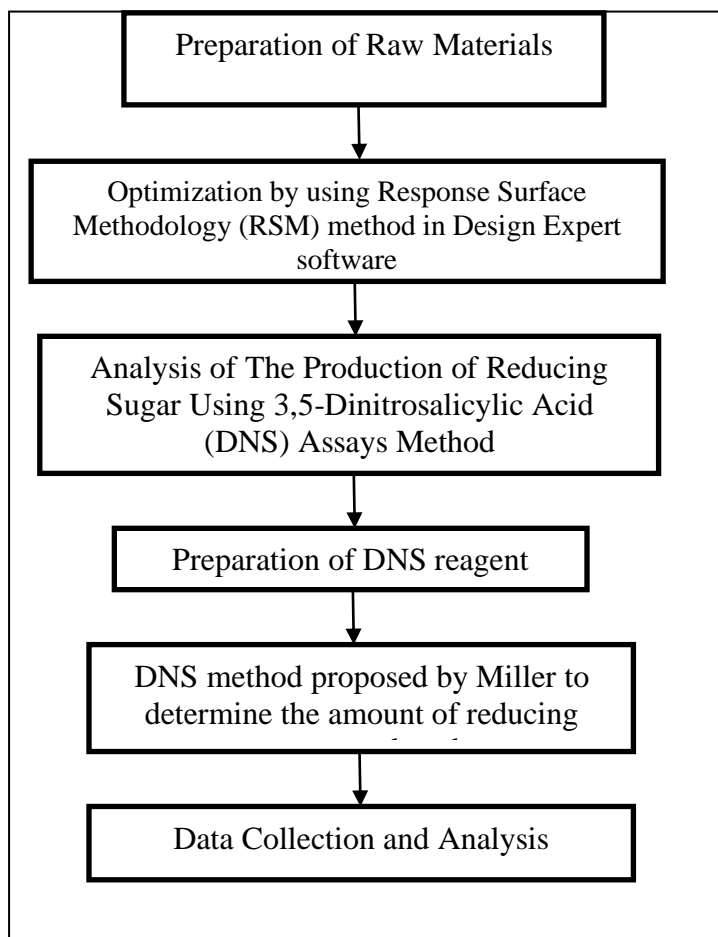
Lignocellulosic biomass, alkaline pretreatment, optimization, reducing sugar

Objectives:

- To compare the efficiency of different types of alkaline pretreatment for production of reducing sugar from various biomasses focusing on few parameters which are concentration of the alkali, temperature and solid-liquid ratio.

- To find the best alkali agents used for alkaline pretreatment and the optimized conditions which can lead to high yield of reducing sugar.

Methodology:



Results:

Types of alkaline reagents	Pressure	Temperature	Concentration or chemical loading	Recovery process	Corrosiveness
1. Ammonia	High	High	~15-30% aqueous or gaseous	Simple evaporation, high pressure equipment needed	Low
2. Sodium hydroxide	Low	Low	1-5%	Kraft process, expensive	High
3. Sodium carbonate	Low	High	5-15%	Partial Kraft process, less expensive	Medium

4.	Calcium hydroxide	Low	Low	0.1 g Ca(OH) ₂ /g solid	CO ₂ carbonating, less expensive	Low
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Conclusion:

The main parameters that are important during alkaline pretreatment are reaction temperature, pretreatment time, concentration of alkaline reagents and solid-liquid ratio. The value for the main parameters differs according to the type of alkaline reagents used. According to the previous studies, alkaline pretreatment is typically conducted in mild conditions. Thus, make it as an advantage for alkaline pretreatment because when pretreatment is conducted in mild conditions, low equipment cost is required. For each types of alkaline reagents, there are certain types of lignocellulosic biomasses suitable for certain types of alkaline reagents such as woody biomass, grass biomass and herbaceous biomass. The step of optimization for alkaline pretreatment aims to reduce the number of trials for pretreatment, thus, reducing the number of experiments to find the optimal conditions of alkaline pretreatment for production of reducing sugar.