

NON BACTERIAL WAY OF SYNTHESIS OF BIO-FUEL FROM CELLULOSE..

BY

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Introduction

- As a result of draining of petrochemicals, alternate fuels got attention.
- As a part of alternate fuel, bio-fuels occupy significance as they fit the existing automobile engines.
- Bio fuels can diversified upon their utility and efficiency into many forms.
- Classification is also made with reference to the natural source of bio-fuel.

Generations of biofuel production

Bio-fuel production mainly has undergone four generations of production techniques:

- 1) I generation -----from sugar, starch, oils, etc.,.
- 2) II generation-----from non-food crops
- 3) III generation-----from algae
- 4) IV generation-----conversion of oil to gasoline.

Comparision between I & II generation bio-fuel production

- I generation of bio-fuel production used seeds, food crops, starch, oils, etc., as feedstock.
- It was mainly observed that the production was significant from corn and sugarcane.
- The use of food seeds effected the global economy. Thus arise the necessity of using non food crops as feedstock.
- Thus obtaining biofuel from cellulose feedstock turned prominent.

- If we consider both I and II generation of bio-fuel production, they follow a similar process for the reason both starch and cellulose are isomers.
- Feedstock is exploited for cellulose or starch content. They are sent for a fermentation reaction in order to produce bio-fuel.
- Fermentation involves the metabolic activity of conversion of feedstock content to smaller alcohols.
- The need to optimize the production of desired bio-fuel raised the effort to induce strain on yeasts that perform fermentation.
- This however was not successful in creating a desired product of higher concentration.

Requirement of an idea

- Though 2G of bio-fuel productions is beneficial when compared to 1G, both includes a common unit chemical process of fermentation involved in them.
- Fermentation is a metabolic activity thus is definitely a time taking process.
- The desired bio-fuel, Bio-ethanol or Bio-butanol or any other hydrocarbons or alcohols cannot be obtained at greater concentrations. Thus another unit process of distillation is engaged in the aggregate chemical flow sheet.
- The loss of interest on capital Investment of an entrepreneur is high for following a delayed process.

- To clear off the defects and make a rapid production of bio-fuel introduced an idea to introduce strains on bacterium.
- Clostridium was previously used for bio-ethanol production.
- In 2007, it was found that Butanol is more applicable as gasoline than that of ethanol.
- Production of bio-butanol in spite of bioethanol has to fledge its applicability.
- All these claim for a same idea of discovery or a method of laboratorial synthesis of bio-fuel without using a bio-catalyst.

Lets look at some facts regarding fermentation

- Fermentation is a well known process where feedstock is meant for a chemical change.
- 2G feedstock is selected on the basis of the lignocelluloses composition which mainly is made of cellulose, hemicelluloses and lignin.
- Cellulose and hemicelluloses are treated by the bacterium races for yeast fermentation.
- The final product of the fermentation is a smaller alcohol such as ethanol that suit as gasoline.

Possible reactions involved in the fermentation.

- If we start considering the possible reaction involved in the metabolic reaction of fermentation, reaction can be explained as 'cellulose is converted to smaller alcohols'.
- Firstly, we can consider formation of bio-fuel through formation of sugars as reaction intermediates.
- Thus, we can extend the idea by the reactions cellulosis, followed by reduction or hydrogenation and then pyrolysis.
- Cellulosis gives rise to sugars or disaccharides.
- The obtained sugars are then possibly be reduced to an alcohol which is a very well known reaction.
- The obtains ones then be cracked so as to obtain required smaller alcohols.

Viability of artificial synthesis of biofuel following the same reactions.

- We can assume a chemical reaction process as seen before to happen in metabolic reaction.
- After having an over look on the possible chemical reactions involved in fermentation, we can observe that the reactions can even be operated in laboratory.

How reactions proceed

- Reactions involved can be categorized into 3 main processes excluding distillation.
- Firstly, cellulosic feedstock is meant for a catalytic hydrolysis where cellulose is expected to form cellubiose which is a disaccharide of polysaccharide cellulose.
- The obtained sugar can then be reduced or hydrogenated by using a typical acid catalyst.
- Thus obtained alcohols can be cracked to form the smaller alcohols, hydrocarbons and biofuels.

Cellulose hydrolysis

- Cellulosis is the hydrolysis of cellulose.
- Cellulose though resists greatly to get hydrolyzed when compared to hemicelluloses, it is an observed fact that the cellulose gets hydrolyzed upon inducing ionic medium as catalyst.
- It is known that the catalyst ionic medium from a complex coordinate ionic sphere is more effective than the ordinary ionic medium.
- Thus a platform of encouragement of cellulose ions to get hydrolyzed is established by complex ionic medium.

- It was also reported by many researches that cellulose hydrolysis was successfully performed by using a complex ionic compounds.
- As the process involves just treating the cellulose feedstock with a strong acid under vigorous conditions using an ionic medium as catalyst, the process is a fast reaction when compared with that of the metabolic hydrolysis.
- It can also be observed that it can be done through laboratorial synthesis without a biocatalyst.

Obtaining of alcohols

- The monosaccharide or disaccharide formed after hydrolysis can then be forwarded to the a reduction using a hydrogenation catalyst such as HI so as to obtain an alcohol.
- The alcohol obtained with higher carbon number can then be cracked at anaerobic conditions so as to obtain a smaller alcohol with few more byproducts.

Benefits with this idea

- When you compare the laboratorial synthesis with that of a metabolic activity, former takes very much low time.
- Selection of feedstock and then obtaining of required product is possible with greater precision with artificial synthesis.
- Since the time taken is less, the cost expenditure is minimized thus it results into a reduced cost of biofuel which also benefits users.

General overlook on feedstock

When we look at the major cellulosic feedstock, we can observe that the following are significant cellulose providers.

- 1) Switch grass which is a native crop of America
- 2) Jatropha seed, which is a native crop of south Asian countries.
- 3) Few more crops where cellulose contents are high.

Suggested feedstock

- In accordance to the synthesis, as the process requires cellulose as reactant, we would best consider cotton as our resource.
- Cotton is estimated as pure form of cellulose as it contains 95% + or cellulose content and a low content of lignin.
- Nearly 70% of total cotton produced in tropical countries as India have depleted fiber quality. Thus these are named as second quality cotton and are used for other that fabric designs.

Economics behind selection of cotton

- Cotton with depleted fiber content costs around 4\$/lb. Thus if we consider at the cost effectiveness, it best suits producing around 19lts of bio-butanol through it.
- Thus when we compare it with the current rate of bio-fuel, after a depression of bio-fuel rate by 40%, a 190% profit is assured that proves the benefit of using cotton through a synthesis.

Acknowledgements

- Since this is only an idea on future research activity, I thank all technical authors scholars, professors of my university and many more people who helped me in reaching my research at this stage.
- Thanks to AIChE and other organizations for their valuable support.