BIO-Asie

HTMS BIOASIE PROJECT

BIOPROCESS INTENSIFICATION

CHALLENGES RELATED TO TRANSFER LIMITATION

2 nd WORKSHOP AT SBFT – HUST, 27-30 JUNE 2016

FORMIC ACID – FRACTIONATION BAGASSE FOR CELLULOSE MATERIALS

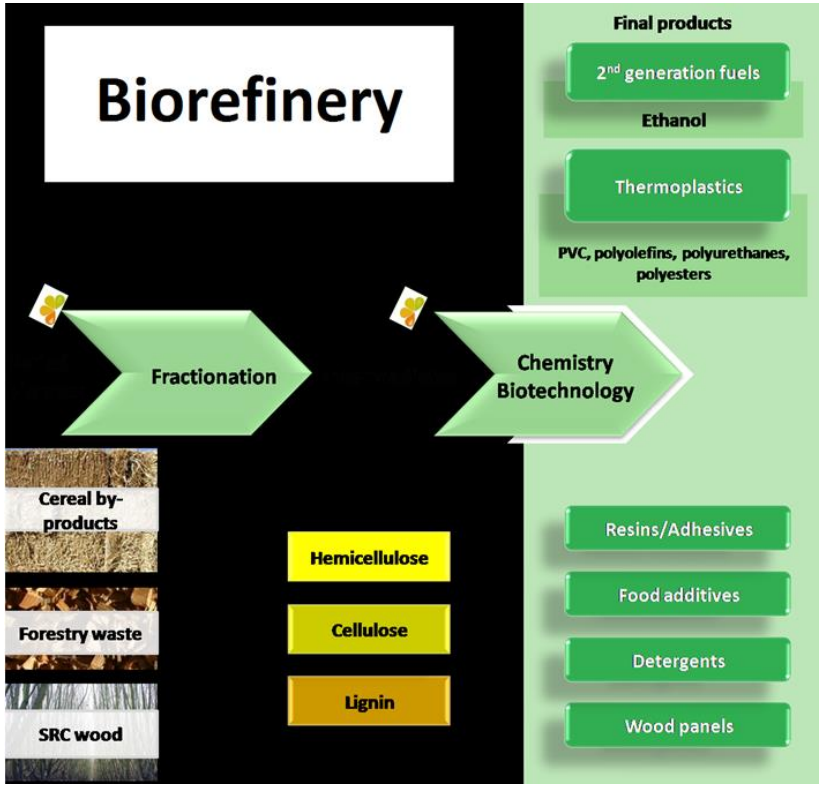
PHAM Tuan Anh, Ngo Duy Sa, Le Thi Tho, TO Kim Anh

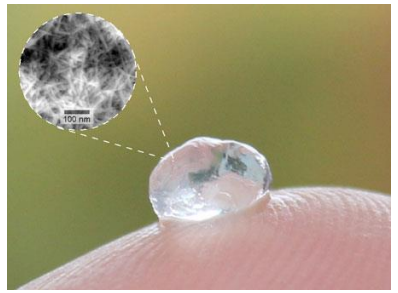
BIOREG

BioRefinery Research Group

Cassava bagasse

Sugarcane bagasse



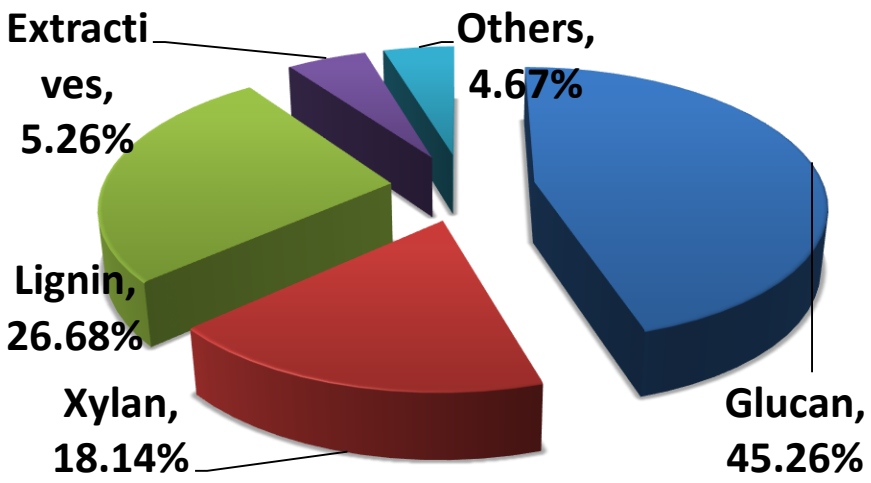


Nano cellulose

Bioethanol

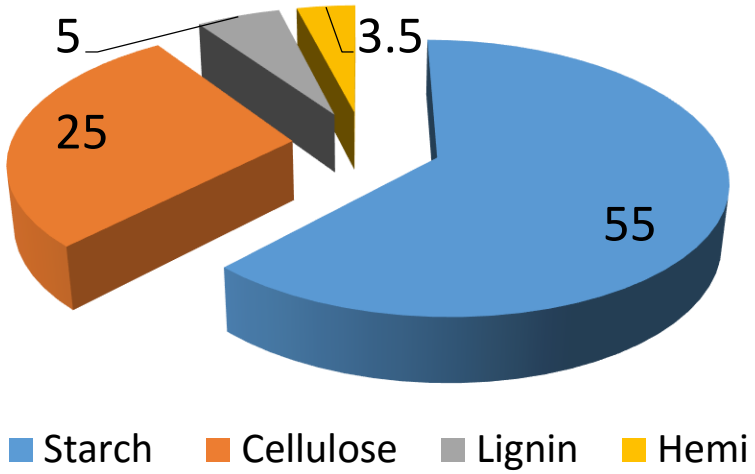
~20 million tons Sugarcane

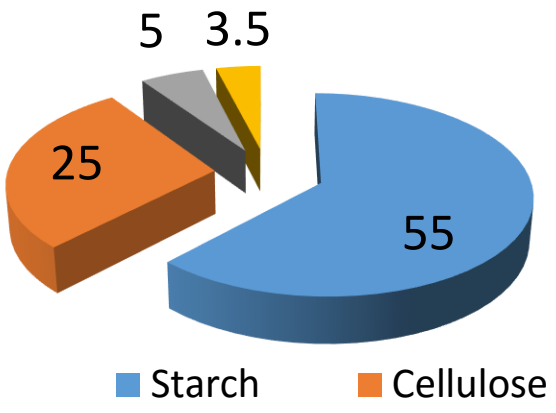
In 2012: 6.7 million tons Sugarcane bagasse



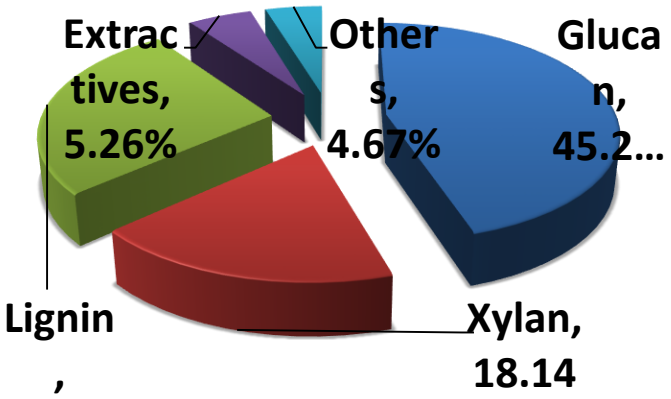
~ 9.6 million tons Cassava

~ 0.5 million tons Cassava bagasse

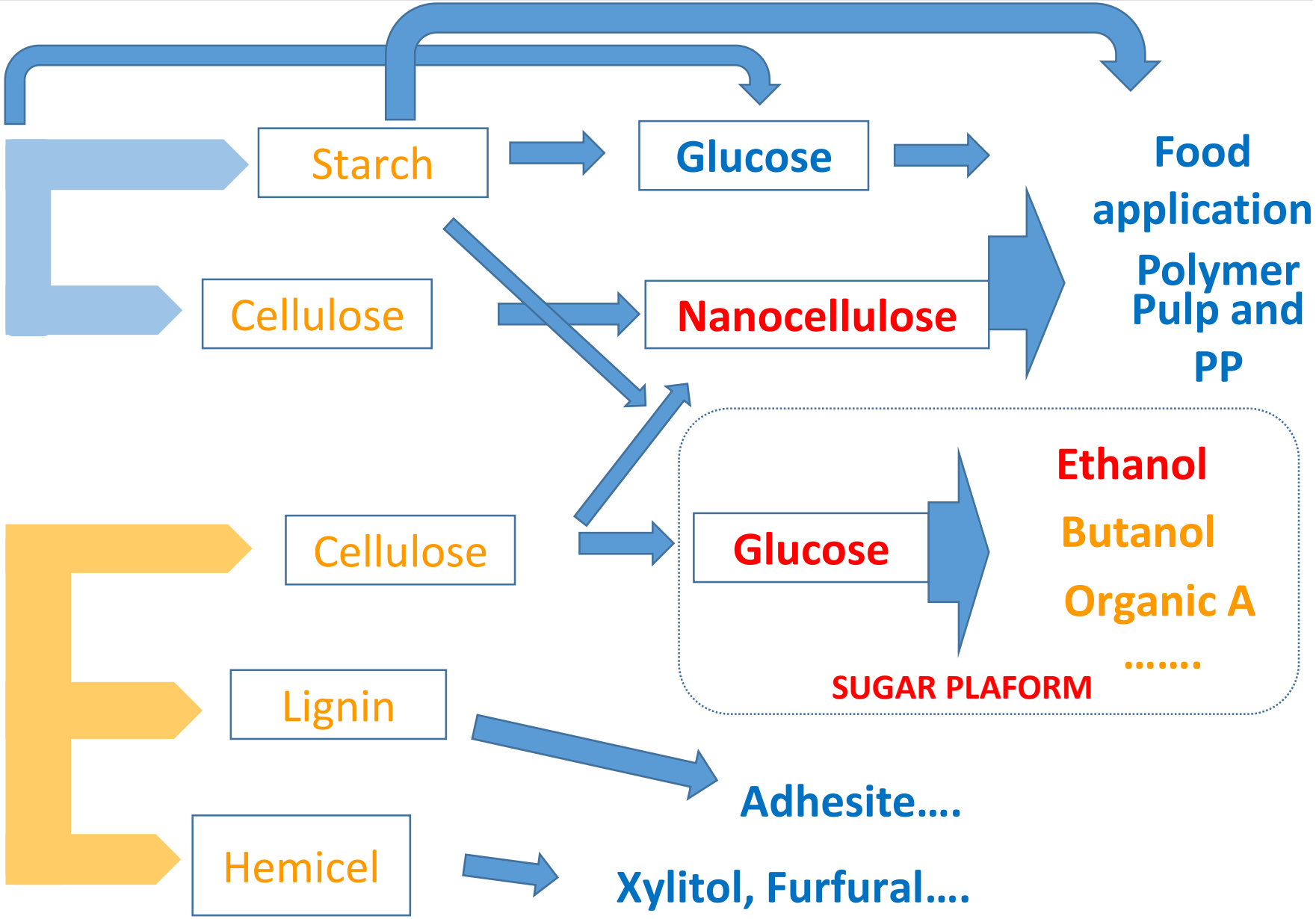


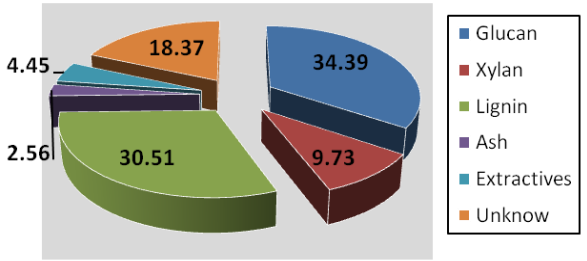


Cassava bagasse



Sugarcane bagasse





Fractionation Process

ORGANOSOLV pretreatment

Sugarcane bagasse

↓

Fractionation

↓

Separation

Solid (cellulose) ← → Liquid (Organosol+ lignin+ sugar syrup) → Distillation

Wash

↓

Cellulose

↓

C6 sugar

Liquid (Organosol+ lignin+ sugar syrup) ← Water

↓

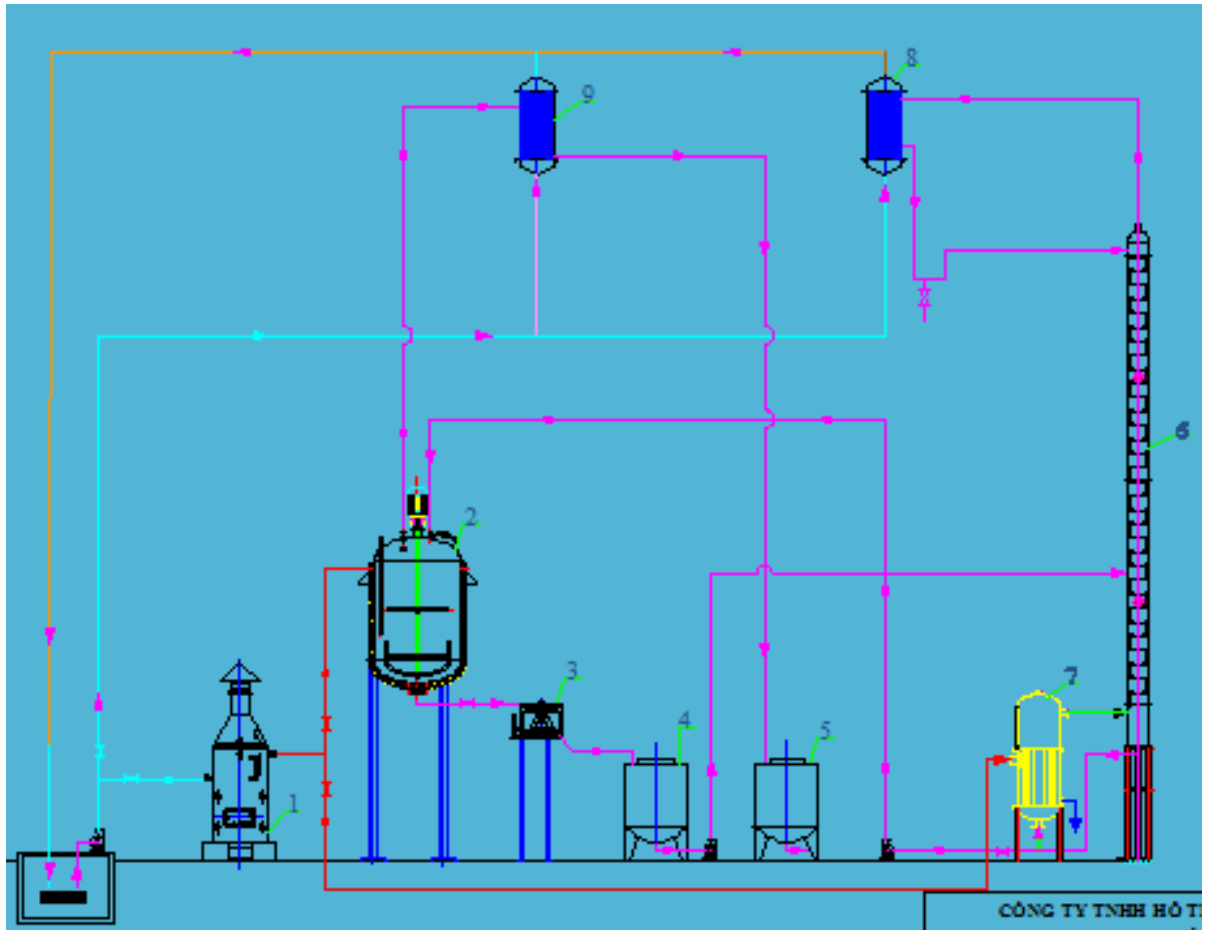
Separation

↓ Lignin

↓ Sugar soluble

Re-use: Distillation → Fractionation

Eco-friendly process


1
2
3
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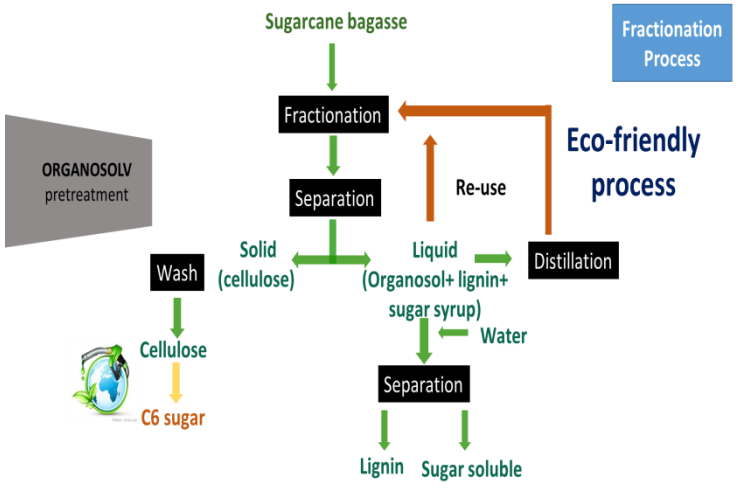
CÔNG TY TNHH HÒ T



Fractionation Process

Eco-friendly process

> 90 % delignification

high glucan content (>92 %)

More delignification -> more glucan conversion

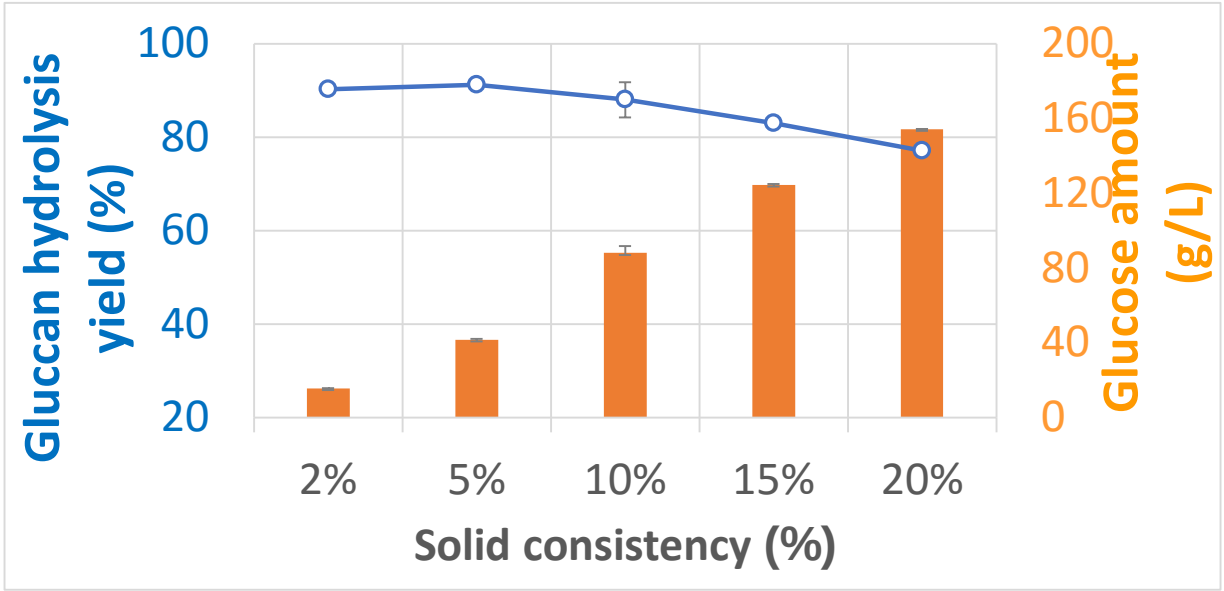
Fractionated sugarcane bagasse → **Ethanol** →

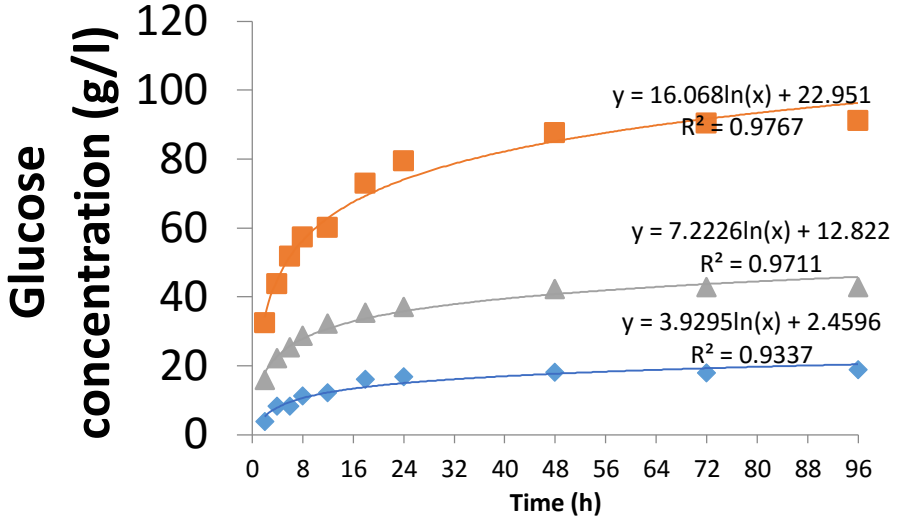
Saccharification ability ?

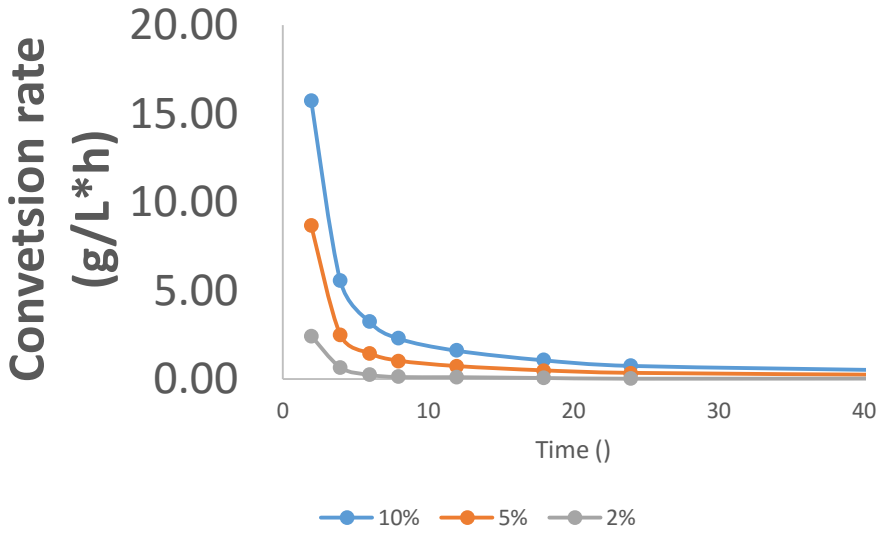
Non yeast inhibitor ??

High ethanol conc ??

Saccharification ability ~ good







Glucan conversions ~ 90 % at solid consistency from 2-10 %

Glucan conversions decreases when using more than 10 % solid consistency

yeast inhibitors ??

Glucose

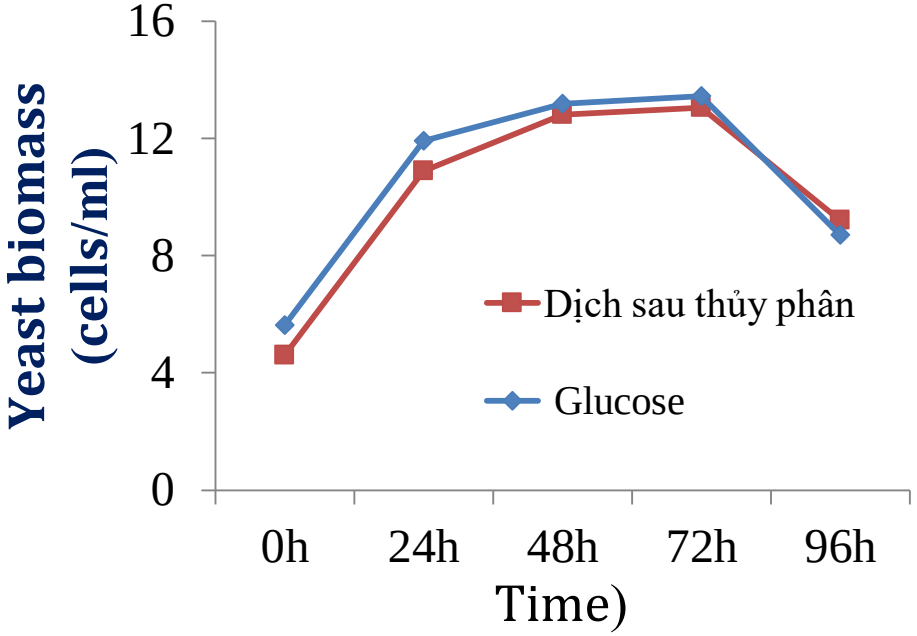
Glucose from hydrolysat

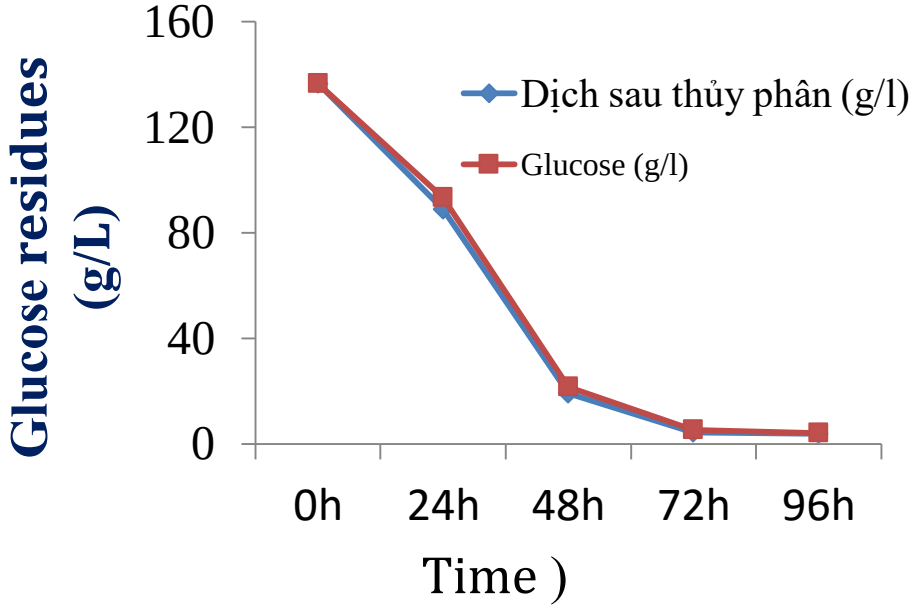
Ethanol Red

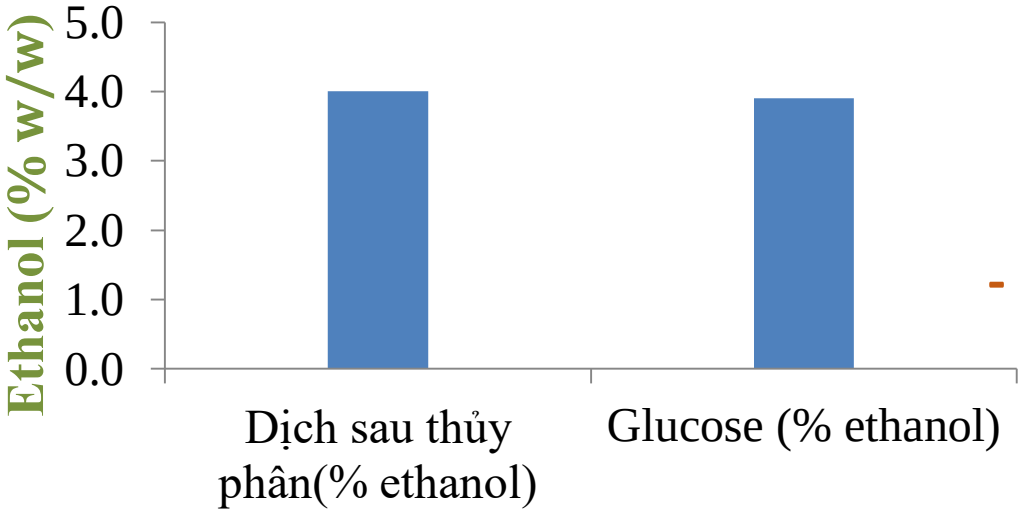
Cultivation

Biomass

Ethanol



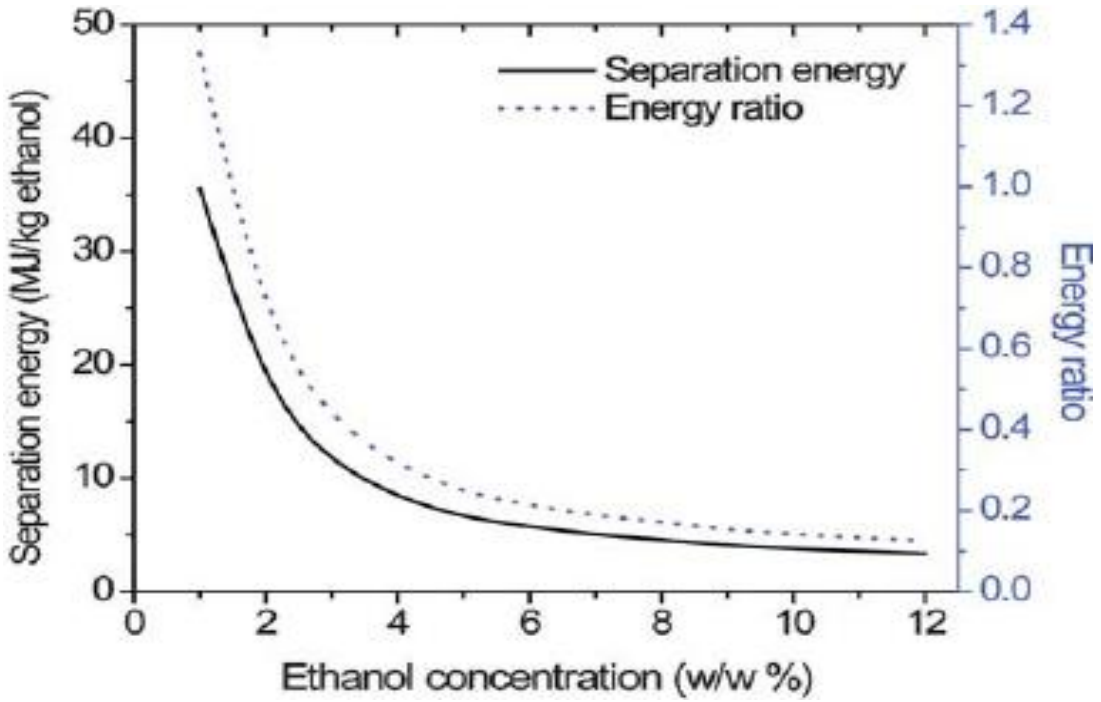


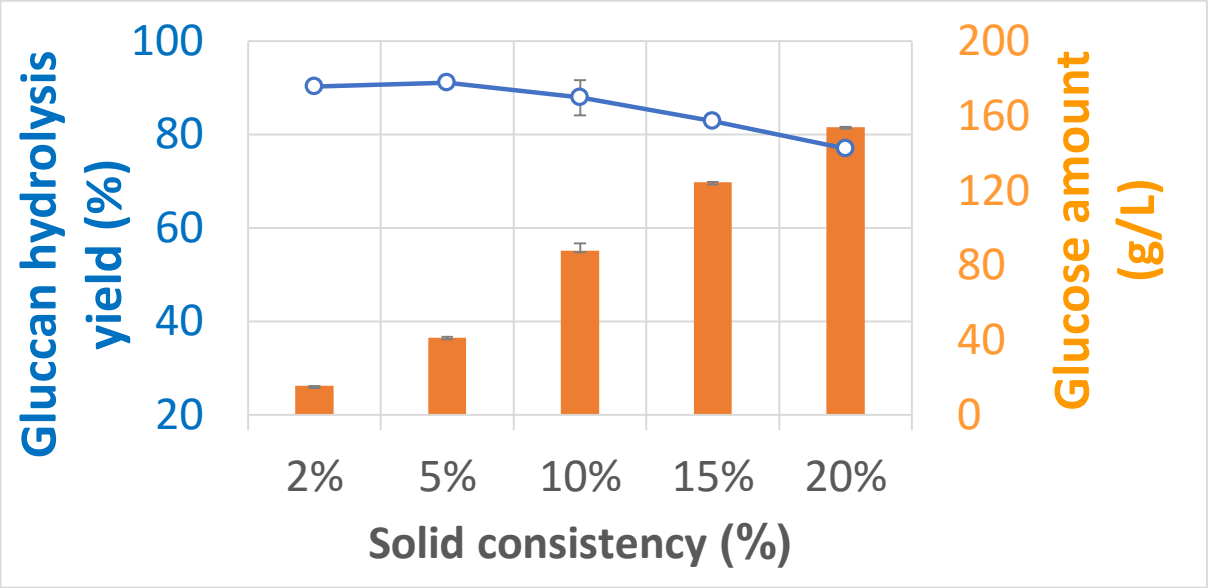


- **Non product toxic was produced**

High ethanol conc ???

HTMS project ?



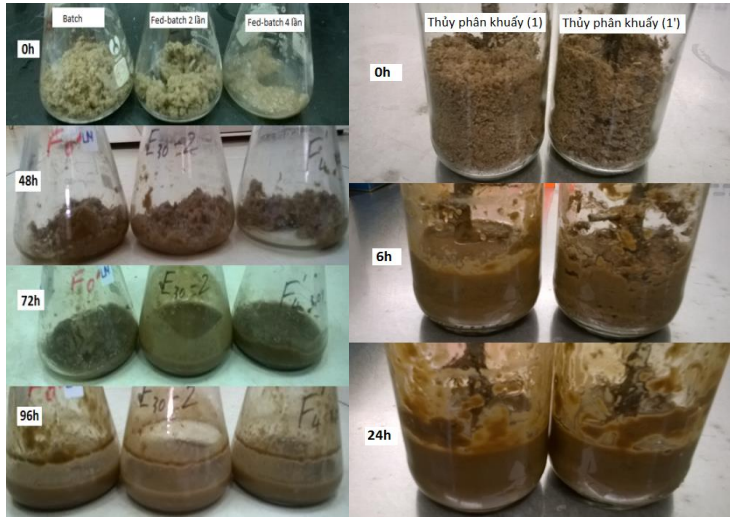


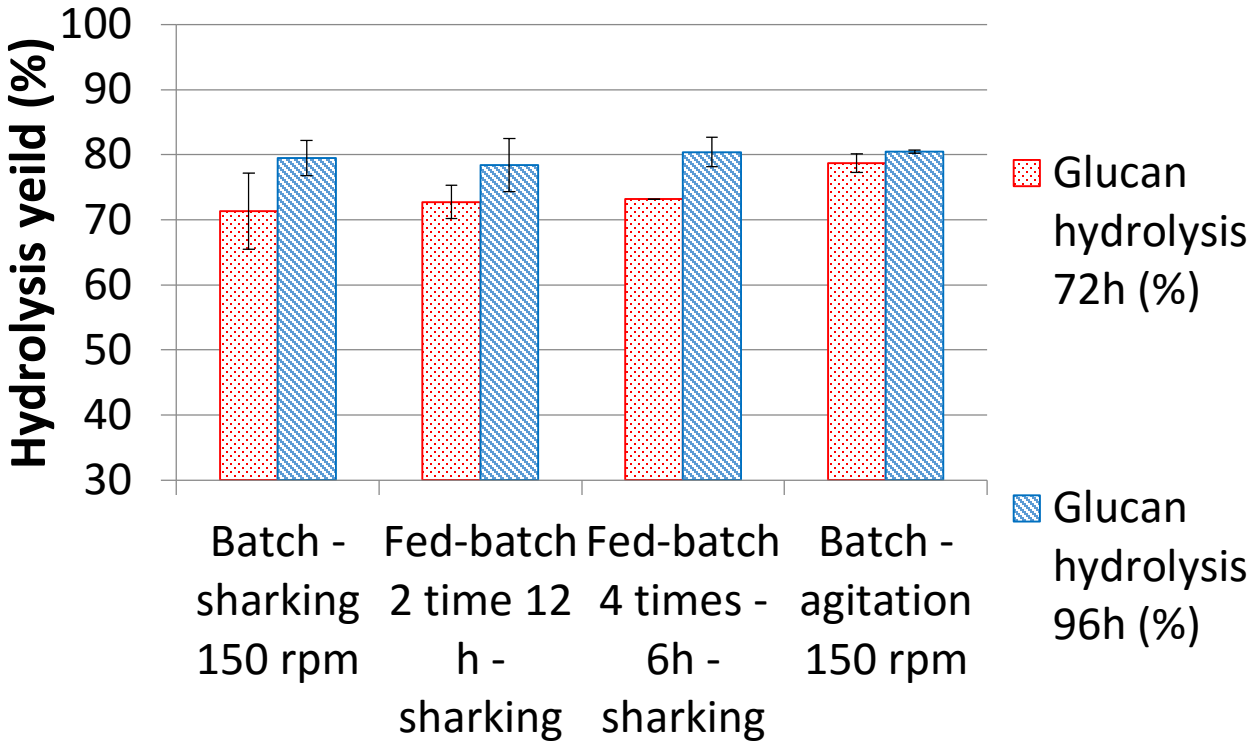
Glucan conversions decreases when using more than 10 % solid consistency

Agitation

Glucose inhition

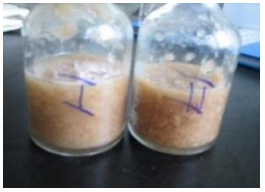
Agitation ???



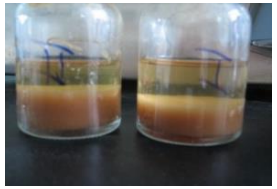


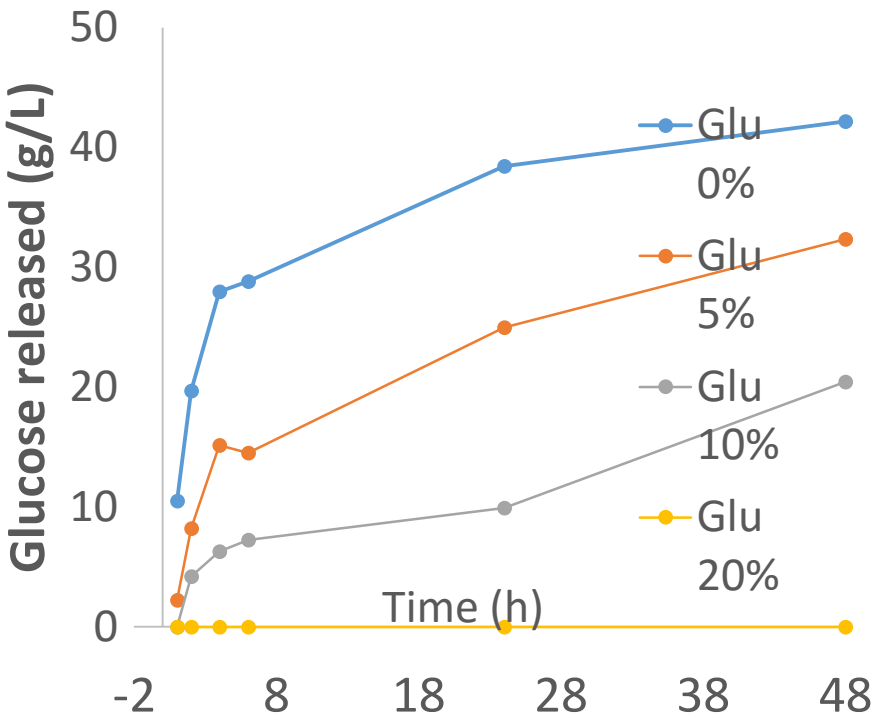
Agitation didn't improved the glucan hydrolysis

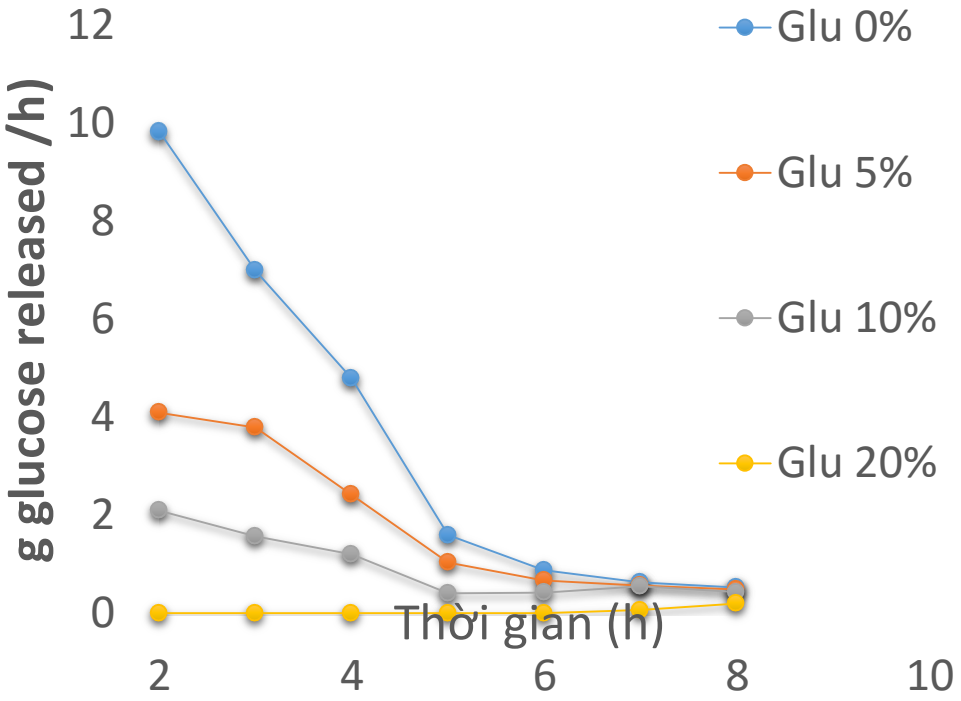
Glucose inhibition



Glucose added 5, 10, 20 %







High glucose concentration inhibited the glucan conversion

Remove glucose in hydrolysat

SSF fermentation

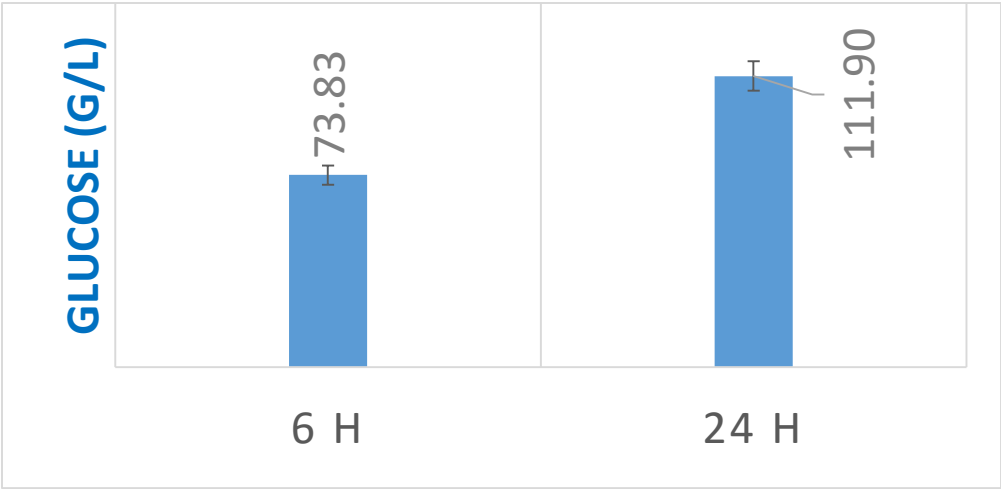
Fractionated sugarcane baggase

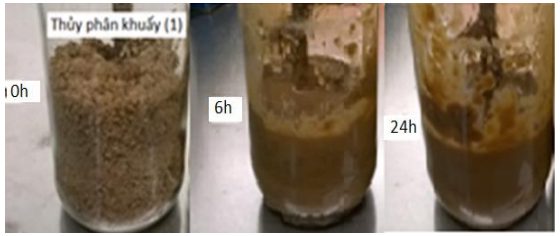
Enzyme NS22192

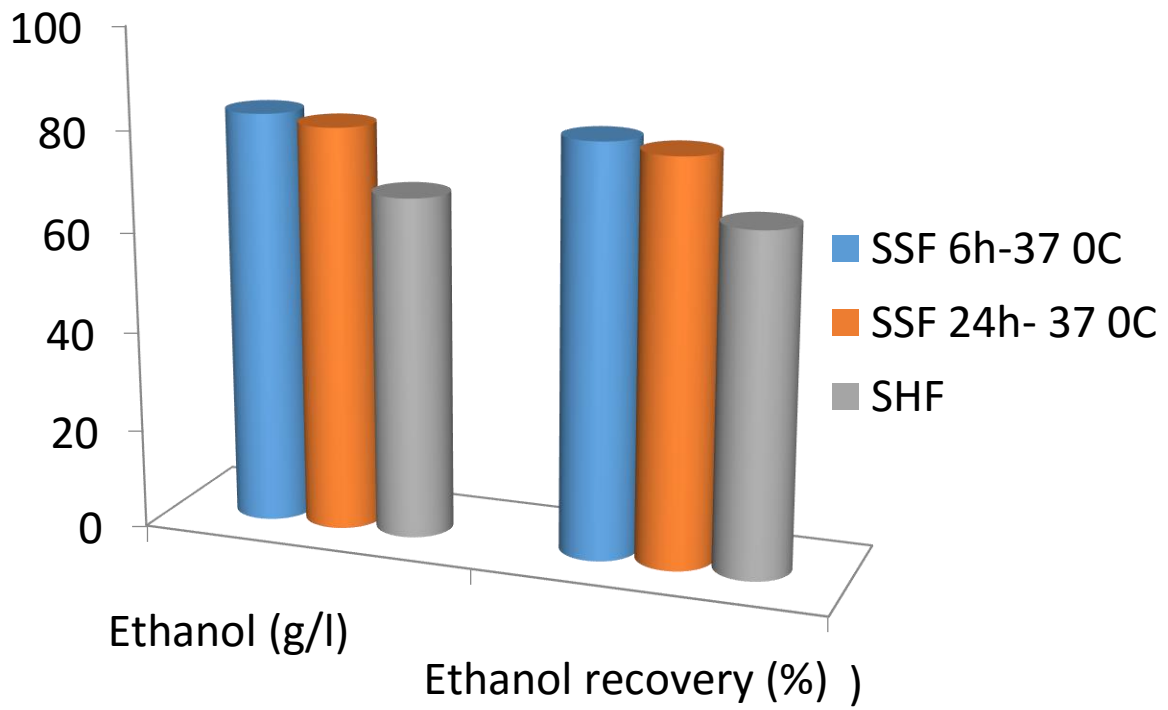
Pre-Hydrolysis 6 , 24 h

Ethanol Red

Hydrolysis and fermentation







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INSTITUT FRANÇAIS SINGAPOUR

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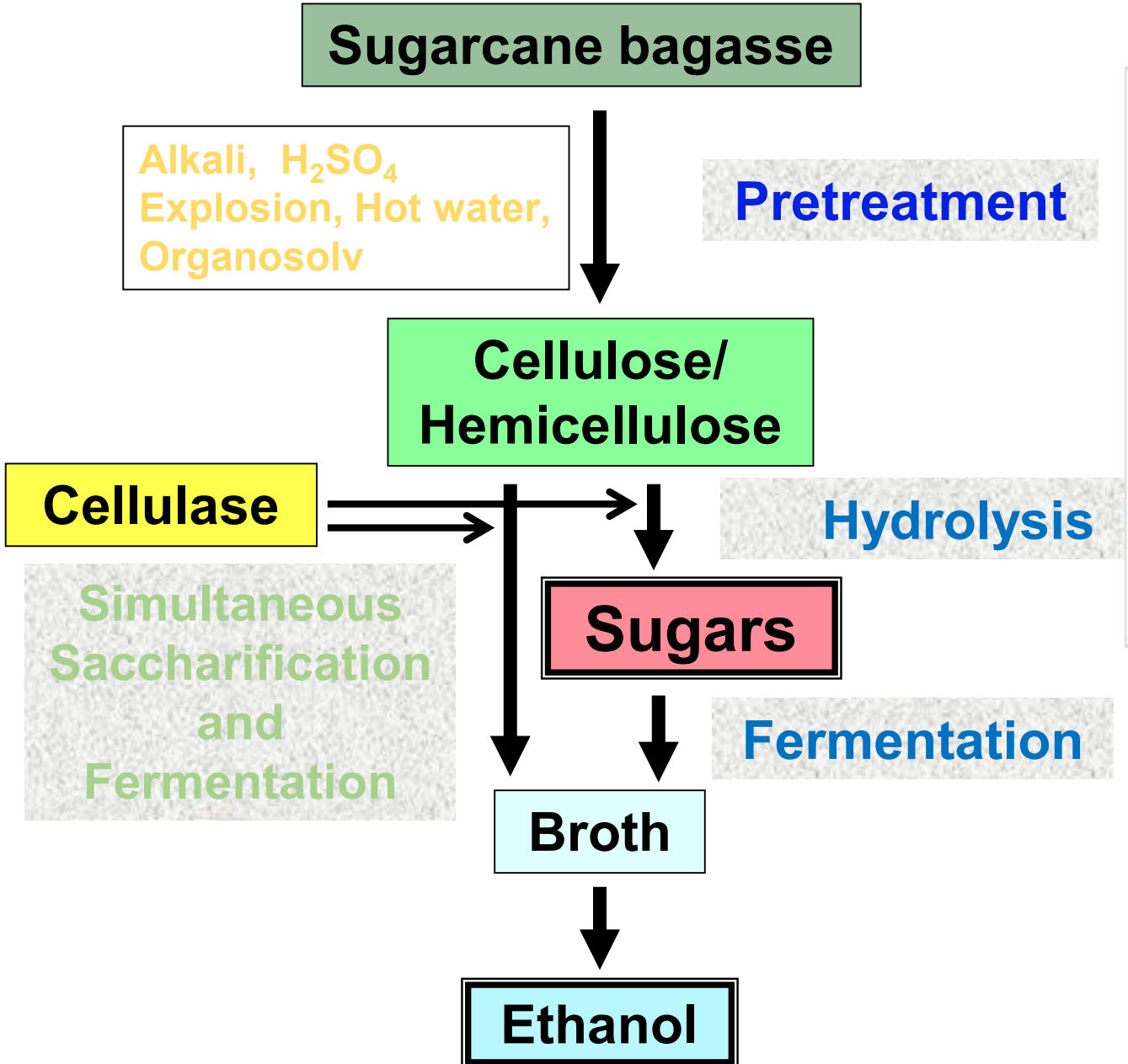
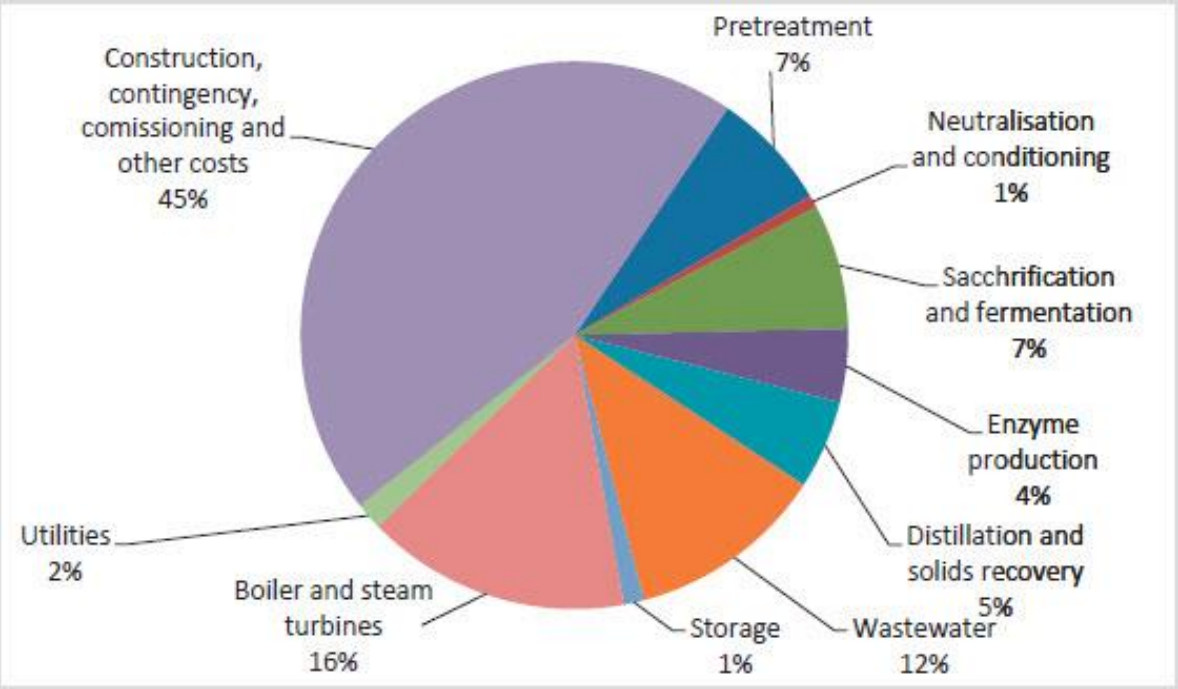
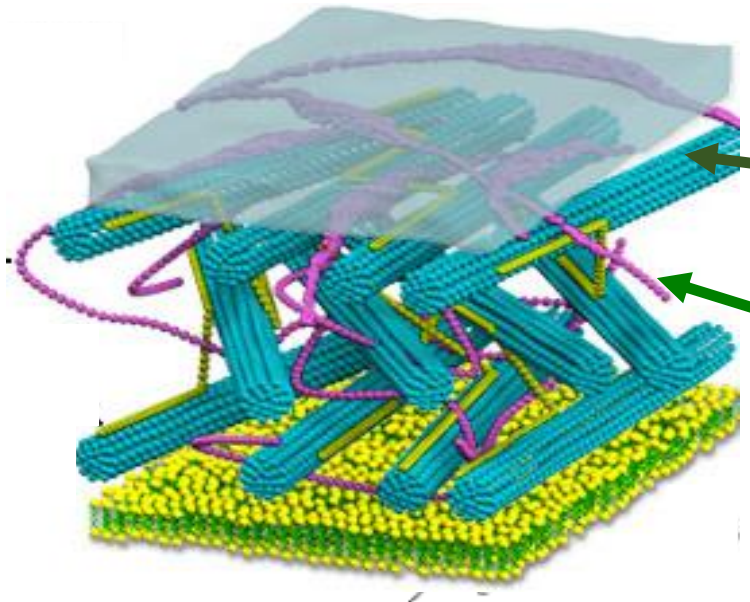
Thank you for your attention and enjoy…


Sugarcane bagasse
Alkali, H_2SO_4
Explosion, Hot water,
Organosolv
Pretreatment
Cellulose/
Hemicellulose
Cellulase
Hydrolysis
Simultaneous
Saccharification
and
Fermentation
Sugars
Fermentation
Broth
Ethanol


Pretreatment
7%
Neutralisation
and conditioning
1%
Sacchrification
and fermentation
7%
Enzyme
production
4%
Distillation and
solids recovery
5%
Wastewater
12%
Storage
1%
Boiler and steam
turbines
16%
Utilities
2%
Construction,
contingency,
comissioning and
other costs
45%

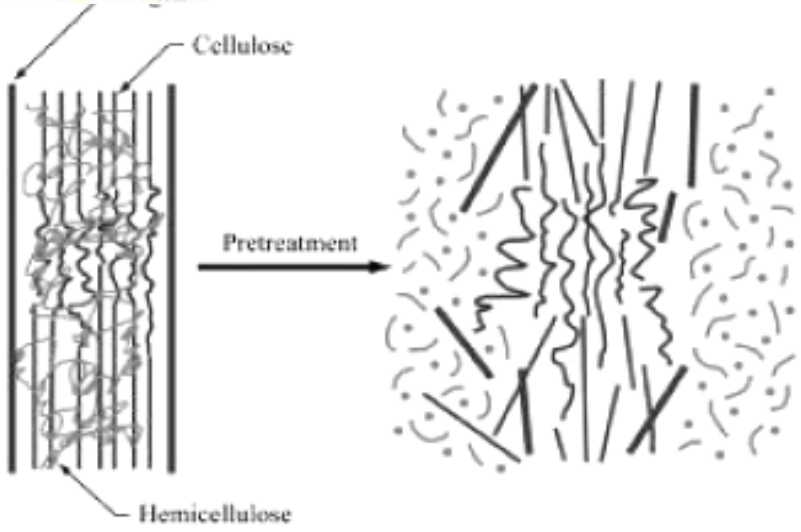
GOALS

- ✓ Maximizes lignin removal.
- ✓ Reduce cellulose crystallity.
- ✓ Limit formation of inhibitors
- ✓ Increase matrix porosity..
- ✓ Minimizes cost.



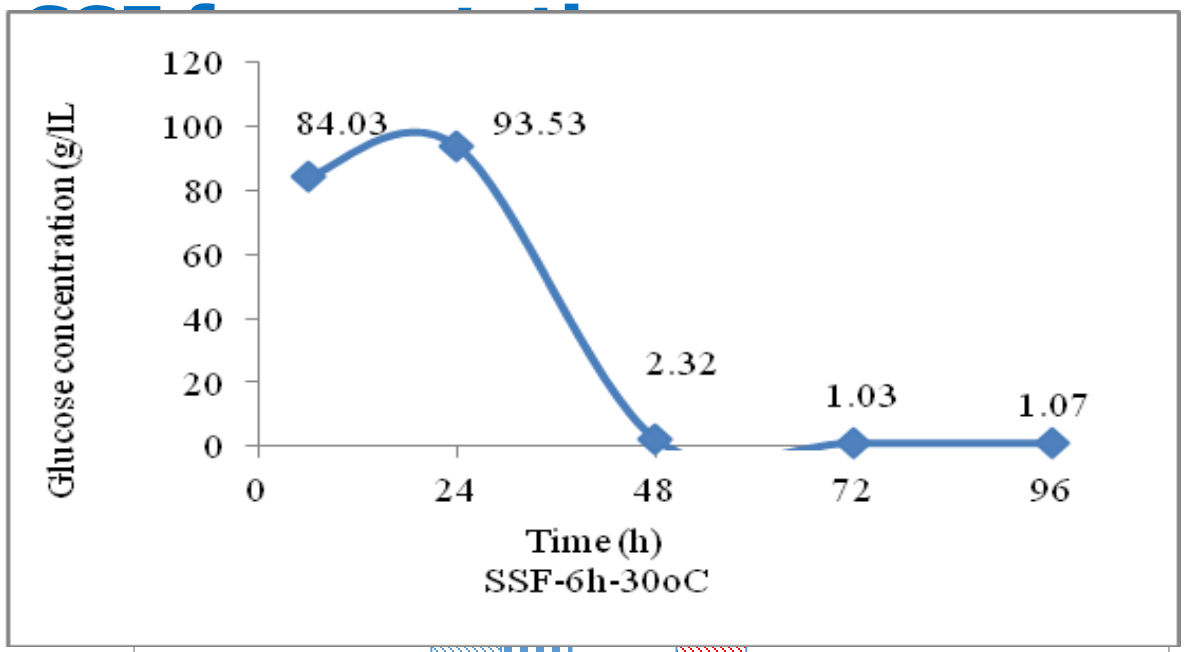
METHODS

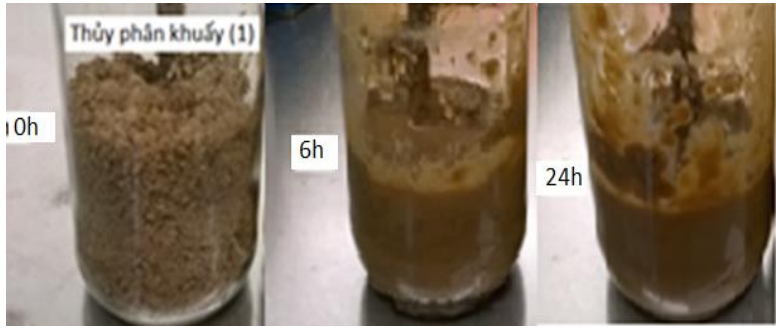
- ➢ Alkaline (NaOH)
- ➢ Dilute acid (H_2SO_4)
- ➢ Hot water
- ➢ Bio-pretreatment
- ➢ Steam

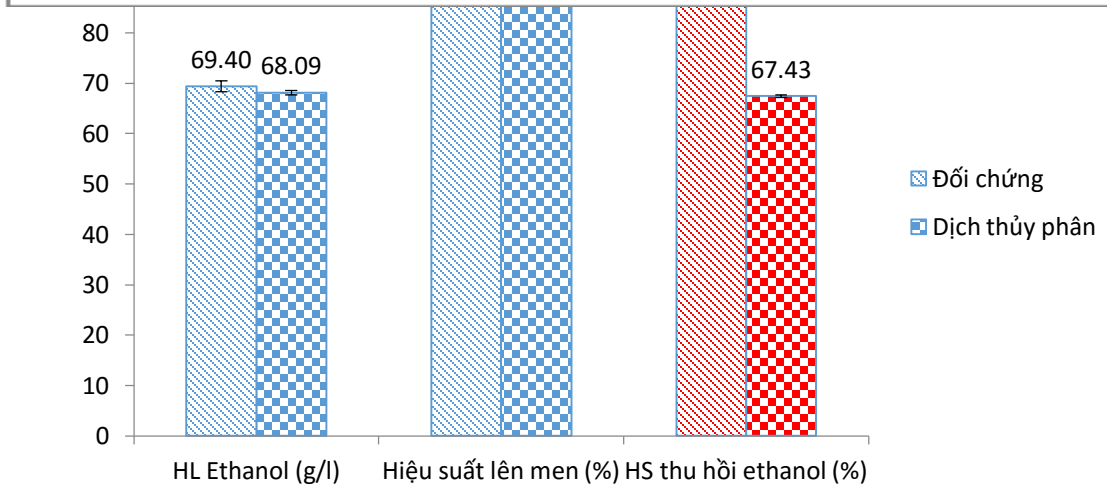


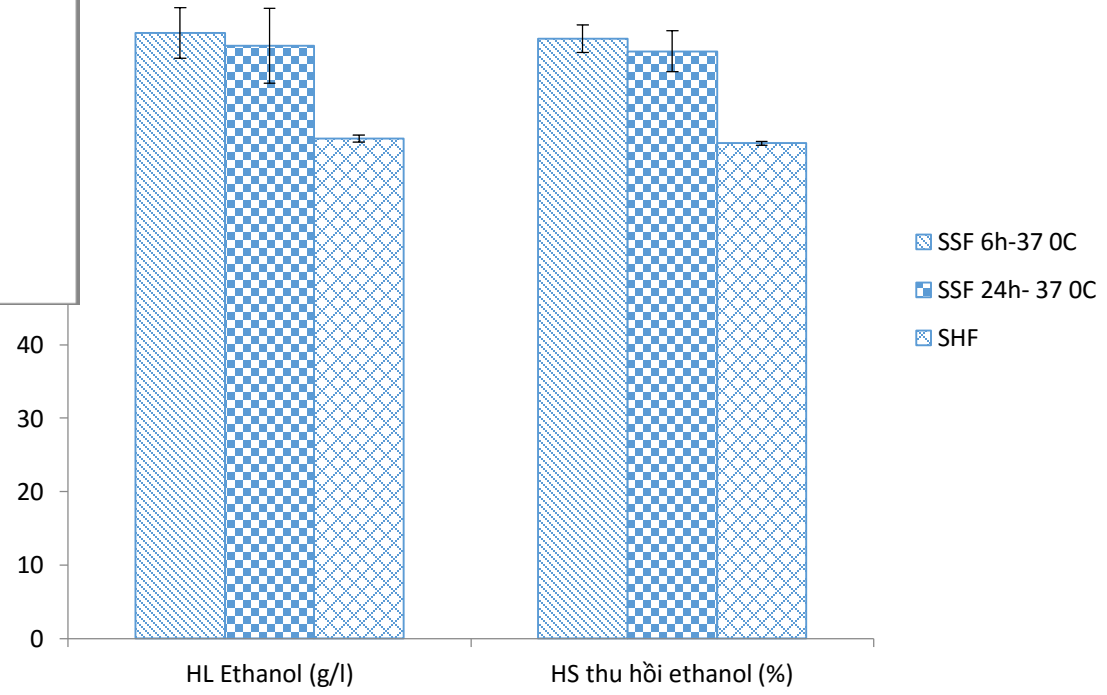
Pretreatment effect

(Hsu *et al.* 1980)


Glucose concentration (g/L)
120
100
80
60
40
20
0
84.03
93.53
2.32
1.03
1.07
0
24
48
72
96
Time (h)
SSF-6h-30oC


Thủy phân khuấy (1)
0h
6h
24h


80
70
60
50
40
30
20
10
0
69.40
68.09
67.43
HL Ethanol (g/l)
Hiệu suất lên men (%)
HS thu hồi ethanol (%)
Đối chứng
Dịch thủy phân


40
30
20
10
0
HL Ethanol (g/l)
HS thu hồi ethanol (%)
SSF 6h-37 0C
SSF 24h- 37 0C
SHF