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Research and Development of Biomass conversion Technology in Shanghai JiaoTong University

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There are 5 main parts

1. Introduction to Shanghai JiaoTong University(SJTU),China
2. biomass pyrolysis
3. Bio-ethanol
4. Biogas
5. Conclusion

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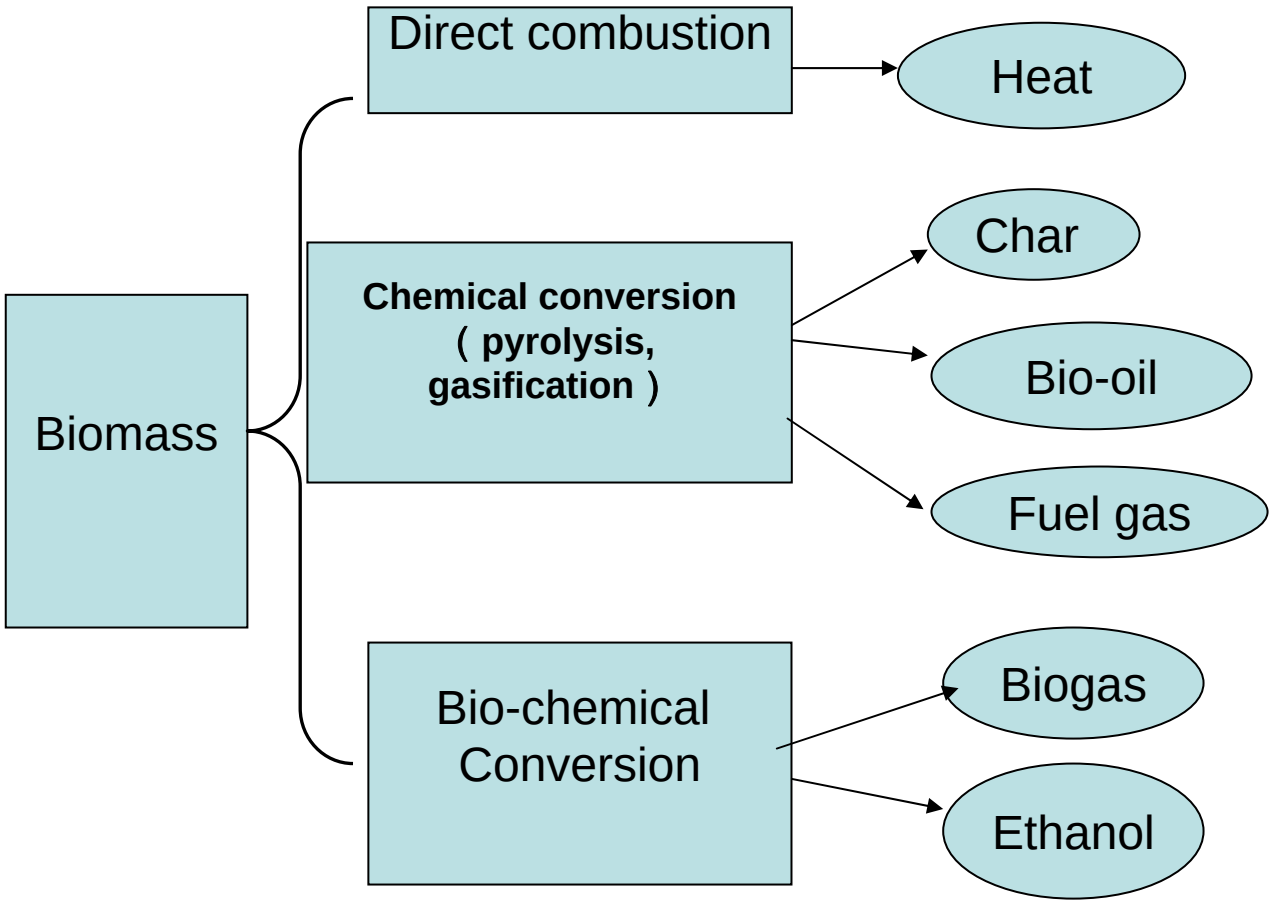
1.Shanghai JiaoTong University(SJTU)

- Established in 1896
- There are 20 schools, including school of Agriculture and Biology, School of Mechanical and Power Engineering, School of Environment Engineering, etc.
- Students:38,000; Teachers:2,800
- Area of campus: about 333 ha.

Biomass energy conversion technologies



2.Biomas fast pyrolysis for biooil production
Mechanism of biomass pyrolysis

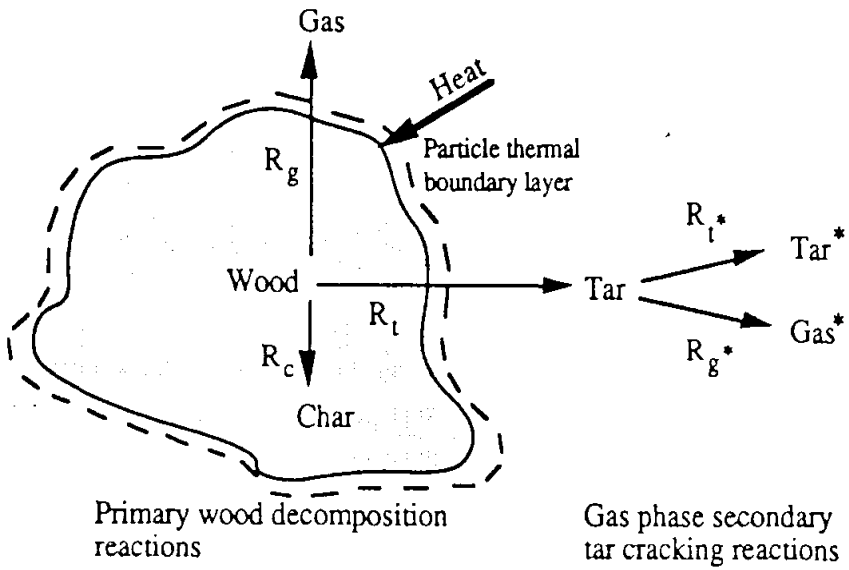


Fig.1 Sketch of a Decomposing Wood Particle Including the Reaction Paths Involved

If the pyrolysis conditions are proper, 100kg biomass can produce 70kg biooil.

Typical biomass fast pyrolysis reactor - Rotating Cone Reactor

It was key project of Science &Technology Commission of China,Professor Liu Ronghou was Vice coordinator)

The biomass throughtput: 50 kg/h

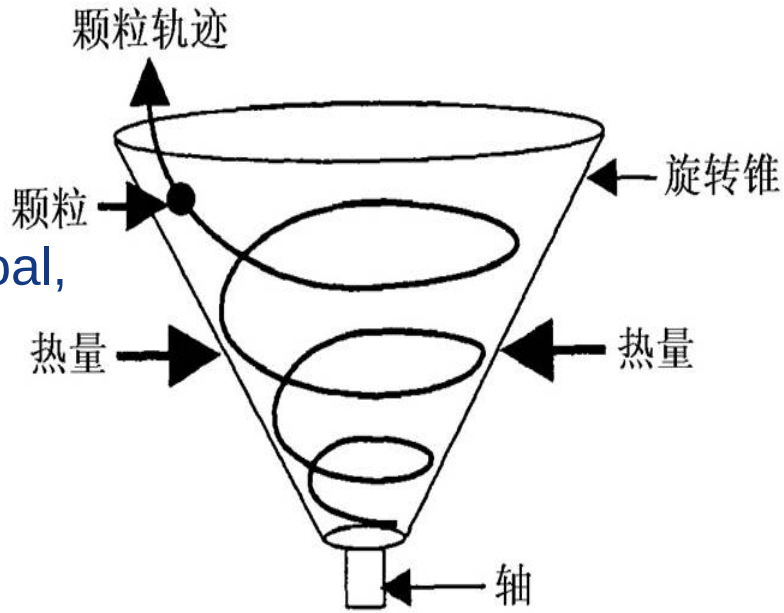
The bio-oil yield : 53%

Rotating Cone Reactor

【Characteristics】：

- Flash reaction:

  solid residence time: 0.5 s
- Higher heating rate：5000k/s
- Vapor residence time:0.3 s
- Materials to be treated:Biomass, coal, oil shale,Polymer



【Products yields】：

- Bio-oil ：60wt%
- Non-condensible ga
  30wt%
- Char ： 10wt%

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(6) Fluidized bed reactor for biomass fast pyrolysis for bio-oil production developed by Shanghai JiaoTong University

- Biomass throughput:1-2 kg/h;
- Reactor Temperature:400-600°C
- Biomass particle size:1-2mm

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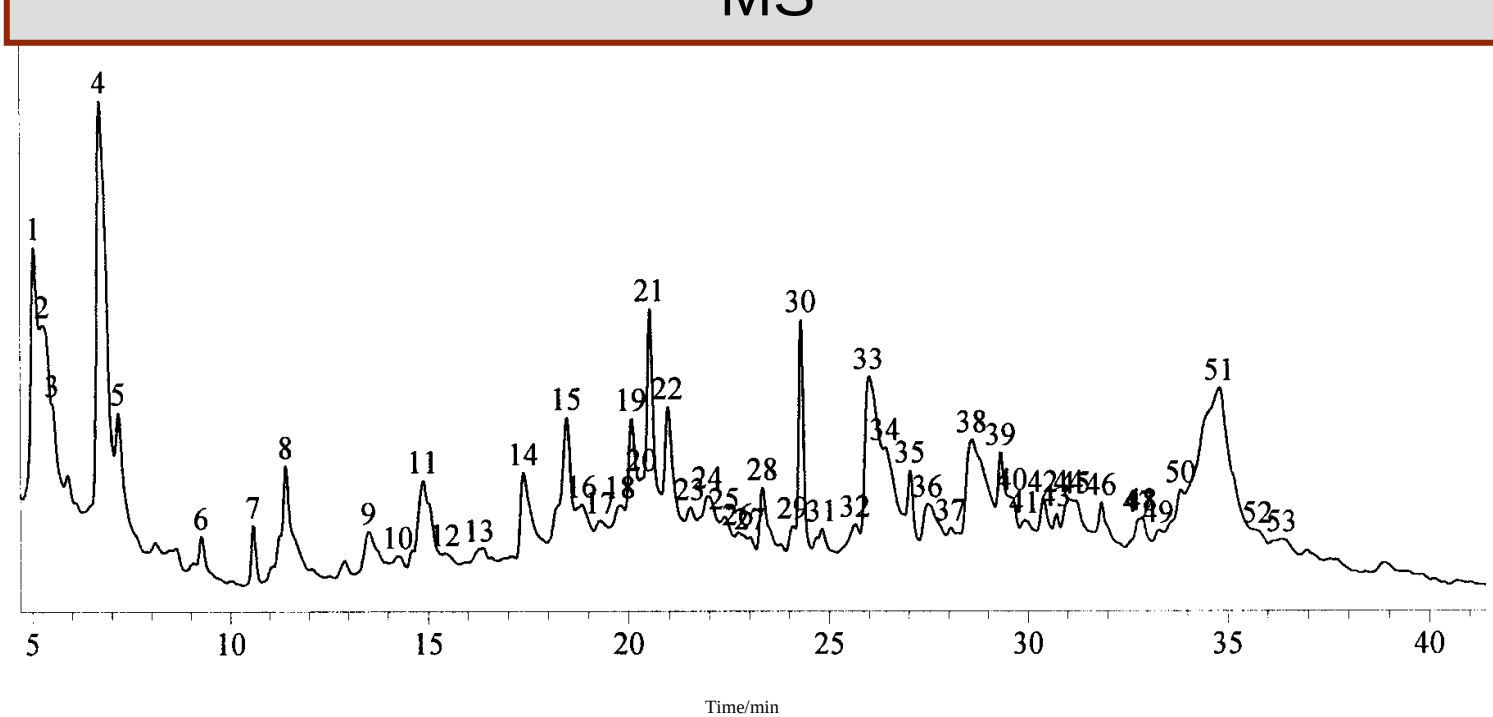
Bio-oil from stalk by fast pyrolysis (National Natural Science Foundation of China , Coordinated by Prof.Liu Ronghou, Biomass Energy Lab. SJTU)

Chemical composition of bio-oil, analyzed by GC-MS



Total ion current diagram of bio-oil from pine sawdust pyrolysis at 500℃

- **Bio-oil is a complex mixture of organic compounds**

Properties of Bio-oil

Properties of bio-oil from fast pyrolysis of corn stalk

property	value
density at 20℃, kg/L	1.04-1.12
Water content,%	10-30
kinematical viscosity at 20℃, cSt	9.01-9.58
heat value, MJ/kg	9.027-9.477

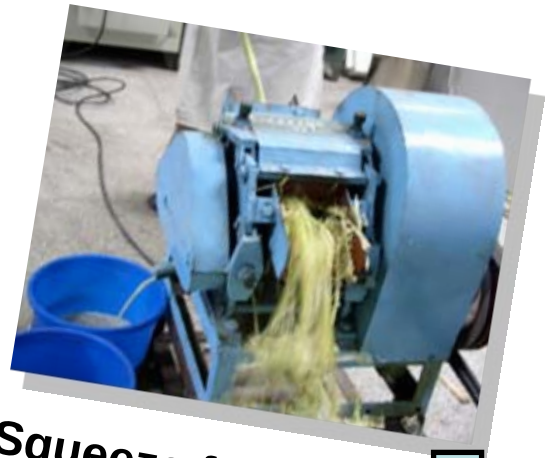
3.Ethanol from sweet sorghum

Yield of sweet sorghum

- Yield of stem:50t/ha2 ,
- Grain yield:5t/ ha2,
- Juice alcohol yield:1.5-2t/ ha2

Juice fermentation

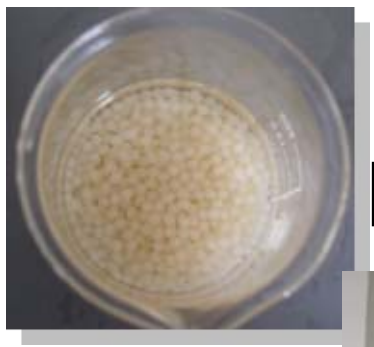
Sweet sorghum



Squeeze for juice

Stalk juice

Fermentation

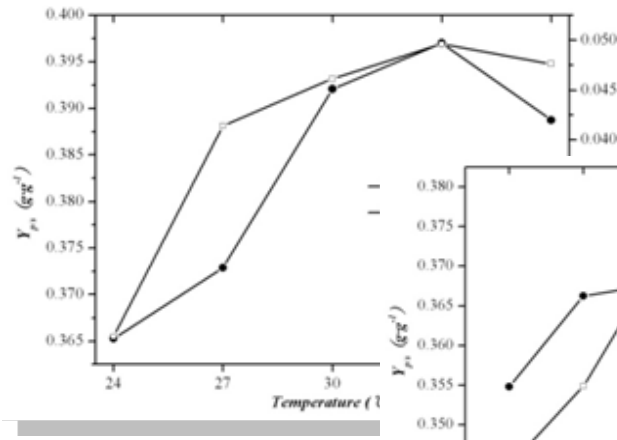


Immobilized yeast

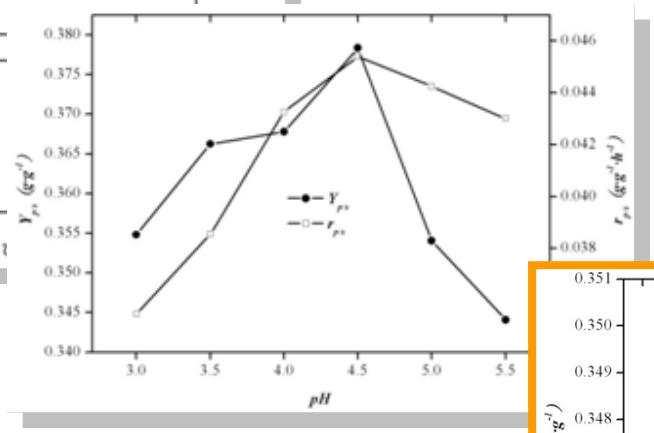
Immobilization

Juice fermentation

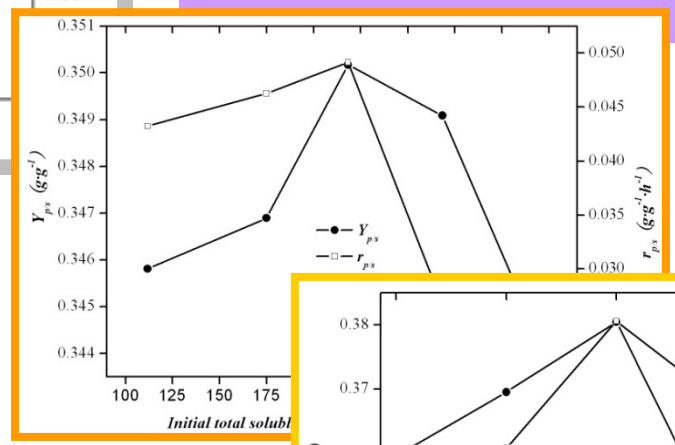
Juice fermentation at different conditions (temperature and pH initial substrate concentration and particle stuffing rate)



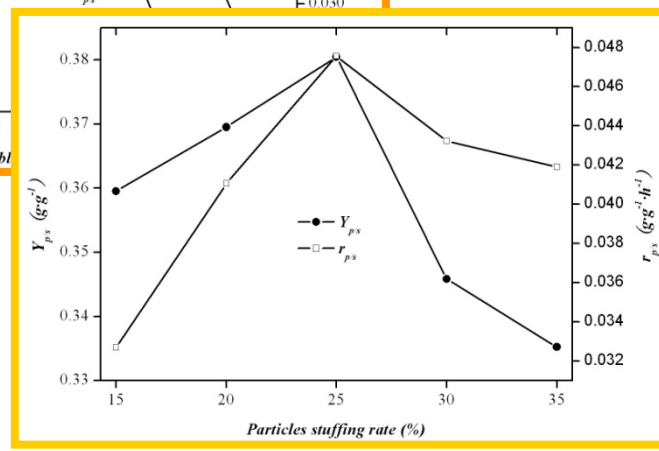
$Y_{p/s}$ and $r_{p/s}$ at different temperatures



$Y_{p/s}$ and $r_{p/s}$ at different pHs



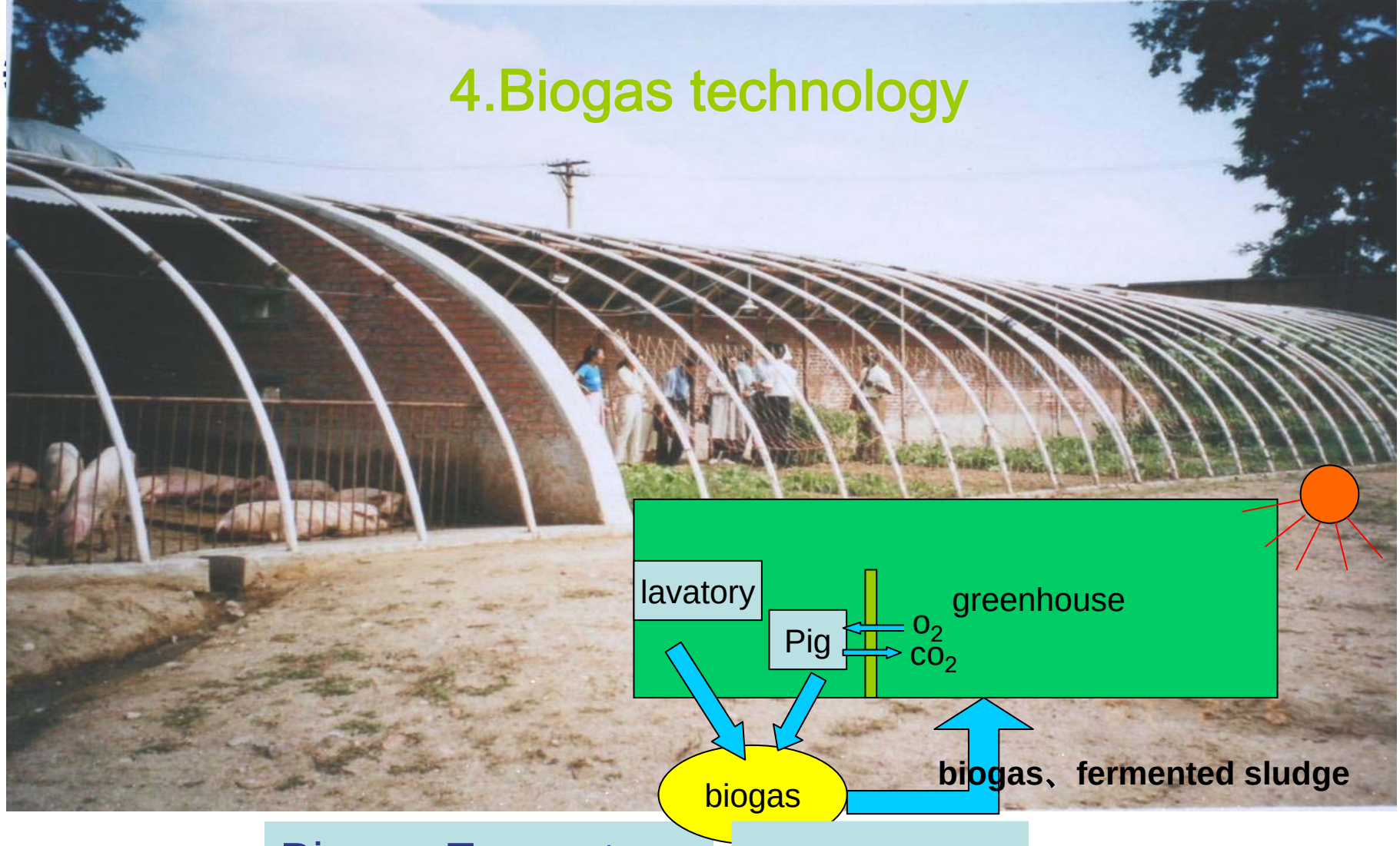
$Y_{p/s}$ and $r_{p/s}$ at different initial substrate concentrations



$Y_{p/s}$ and $r_{p/s}$ at different particles stuffing rates

Temperature of 33℃, pH of 4.5, Initial substrate concentration of 218.1mg·ml^{-1} and particle stuffing rate of 25% were suitable

4.Biogas technology



Biogas Ecosystem

Component：Lavatory、Pig house、biogas digester、greenhouse

Function：Integration of Plant、animal、biogas、solar energy

[1] Ronghou Liu, Jinxia Li, Fei Shen.Refining bioethanol from stalk juice of sweet sorghum by immobilized yeast fermentation[J]. Renewable Energy, 3 August 2007.(SCI).

[2] Ronghou Liu and Fei Shen. Impacts of main factors on bioethanol fermentation from stalk juice of sweet sorghum by immobilized Saccharomyces cerevisiae (CICC 1308)[J]. *Bioresource Technology*, *13 March 2007*. (SCI).

[3] H. R. Yuan , R. H. Liu. STUDY ON PYROLYSIS KINETICS OF WALNUT SHELL, Journal of Thermal Analysis and Calorimetry (SCI), 2007, doi:10.1007/s00214-007-0268-8. (SCI).

[4] Junmeng Cai, Ronghou Liu. Dependence of the frequency factor on the temperature: A new integral method of nonisothermal kinetics. Journal of Mathematical Chemistry, 2006, doi: 10.1007/s10910-006-9215-5. (SCI).

[5] J. M. Cai, R. H. Liu. Errors involved in the activation energy calculated by integral methods when the frequency factor depends on the temperature ($A=A0Tm$), Journal of Thermal Analysis and Calorimetry (SCI), 2007, doi: 10.1007/s10973-006-7926-2. (SCI).

[6] J. M. Cai, R. H. Liu. New approximation for the general temperature integral. Journal of Thermal Analysis and Calorimetry (SCI), 2007, doi: 10.1007/s10973-006-8178-x. (SCI).

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[8] Junmeng Cai, Ronghou Liu, Chunjian Deng. An assessment of biomass resources availability in Shanghai: 2005 Analysis. Renewable and Sustainable Energy Reviews, 2007, doi: 10.1016/j.rser.2007.04.003. (SCI).

[9]Junmeng Cai, Ronghou Liu, Fei Shen. Improved version of Doyle integral method for nonisothermal kinetics of solid-state reactions. Journal of Mathematical Chemistry, 2007, doi: 10.1007/s10910-007-9254-6. (SCI)

[10] Junmeng Cai, Ronghou Liu. An improved version of Junmeng-Fang-Weiming-Fusheng approximation for the temperature integral, Journal of Mathematical Chemistry, 2007, doi: 10.1007/s10910-007-9252-8. (SCI)

5.Conclusion

Different conversion technologies can treat different types of raw materials, and different product can be obtained, there are both advantages and disadvantages for any conversion technology.

* Biomass pyrolysis for bio-oil production & biogas will not compete with food production;

* Ethanol from juice of sweet sorghum will not compete with food production too.

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Thank you !