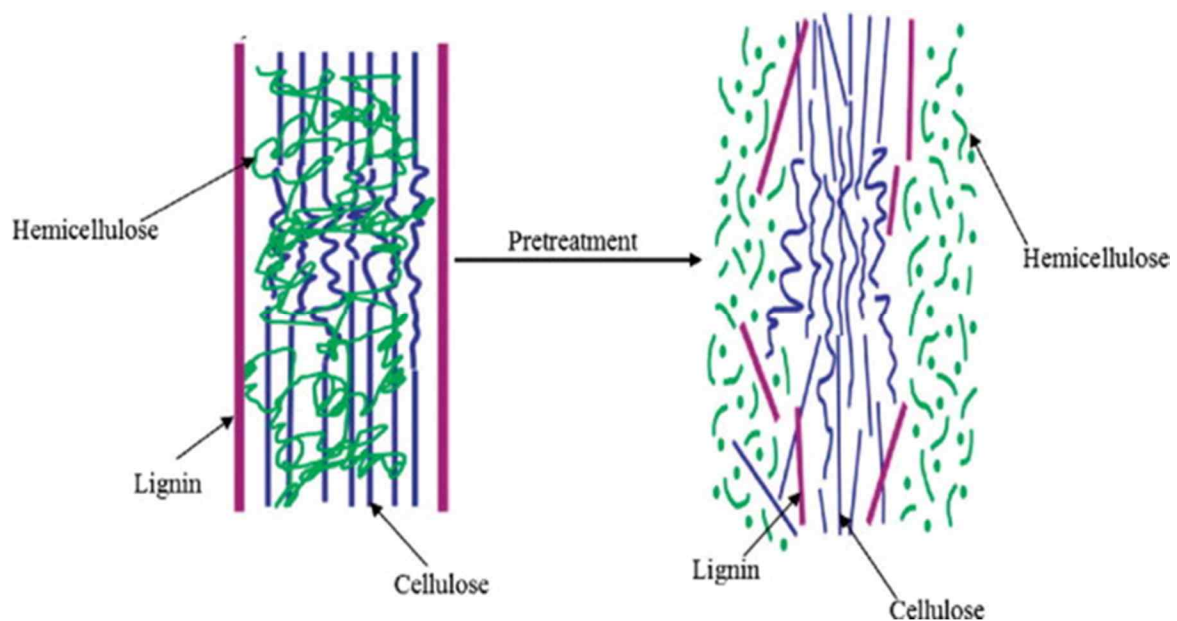


## Bioenergy Production ( I ) – Biomass Pretreatment (Degradation of biomass)

After industrial revolution, increase of fossil fuel consumption makes human life convenient with technological development. However, since the last decades, depletion of fossil energy, which caused environment pollutions have aroused the interest of renewable energy in many countries. Among the renewable energy, lignocellulosic biomass has remarkable ability in carbon fixation and can also produce bioethanol and green chemical. These advantage can contribute to overcome environmental problem and global warming.

To produce bioethanol and green chemical from biomass, saccharification and fermentation process are required. However, the recalcitrance of lignocellulosic biomass hinders microbial activity, and it enforces a pretreatment process for facilitating enzymatic digestibility. Furthermore, appropriate pretreatment process design improves saccharification and fermentation efficiency. Therefore, in this lab, students will learn how to pretreat lignocellulosic biomass and analyze liquid hydrolyzate and solid residue.

Lignocellulosic biomass → Pretreatment → Enzymatic hydrolysis → Fermentation → Bioethanol  
Green chemical



### 1. Materials

- ① Biomass : 0.5 mm size milled **Mongolian Oak** (1 group), **Larch** (2 group), **Rapeseed stalk** (3 group)
- ② Equipment : Pretreatment reactor, Aspirator, Ice maker, Oven, Heating mantle, etc
- ③ Solvent : 1% sulfuric acid (w/w, aqueous solution)

## 2. Methods

- ① Put 20 g of biomass and 140 ml of sulfuric acid (1 : 7) in inner container.
- ② Insert inner container to a pretreatment reactor, assemble the reactor, and lock the exhaust valve.
- ③ Set a heating mantle's temperature at 159°C and raise temperature (Heat-up time : 50 min).
- ④ When reactor's temperature reach 160°C, maintain temperature for 20 min. After 20 min, cool the reactor using ice chamber.
- ⑤ After cooling, take out the inner container and separate liquid hydrolyzate and solid residue by filter paper.
- ⑥ Collect liquid hydrolyzate and make 1 ml of sample. Sample is filtered by 0.45 µm membrane filter.
- ⑦ Liquid sample will be characterized by HPLC (High Performance Liquid Chromatography) in NICEM (National Instrumentation Center for Environmental Management) and students will analyze content of sugars (glucose, xylose, and etc.) and organic acid (furfural, 5-HMF, levulinic acid, acetic acid, formic acid).
- ⑧ Wash the solid residue on the filter is washed by 500 ml of distilled water (DI water) and student will calculate water-insoluble solid (WIS) recovery rate.
- ⑨ Pack the rest of solid residue in zipper-bag and stored in 4°C refrigerator.

$$\text{Solid Content (\%)} = \frac{\text{ODW (Oven Dried Weight) sample (g)}}{\text{ADW (Air Dried Weight) sample (g)}} \times 100$$

$$\text{WIS recovery rate (\%)} = \frac{\text{Soil residue (g)} \times \text{soil content of soil residue (\%)} \div 100}{\text{ADW sample (g)} \times \text{soil content of sample (\%)} \div 100} \times 100$$

## 3. Report – 3<sup>rd</sup> week (reference must be mentioned)

- ① Investigate advantage and disadvantage of bioethanol production from non-lignocellulosic biomass (1<sup>st</sup> generation biomass, edible) and bioethanol production from lignocellulosic biomass (2<sup>nd</sup> generation biomass, inedible).
- ② Investigate cause of recalcitrance which is characteristic of lignocellulosic biomass.
- ③ Investigate type of pretreatment process and describe advantage and disadvantage of each process.

## 4. Notice

- ※ Report should be written by MS words(10 points, line spacing 1) or hancom office(10 points, line spacing 120).
- ※ Writing procedure of report (in Korean or English): 1. Introduction, 2. Materials and methods, 3. Results and discussion, 4. Conclusions, 5. References
- ※ You should report 3<sup>rd</sup> week data, 4<sup>th</sup> week data and 5<sup>th</sup> week data together, share data with other groups and compare pretreatment result respectively.
- ※ Assignment should be appended to report. (If you copy and paste, you cannot get a grade.)
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