

Supplementary Materials

Solvent Assisted Adsorption of Cellulose on a Carbon Catalyst as a Pretreatment Method for Hydrolysis to Glucose

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Table of Contents

1. LCA for phosphoric acid treatment method
2. LCA for mix-milling method

1. LCA for phosphoric acid treatment method

In the phosphoric acid pretreatment method, 85% H_3PO_4 was added to crystalline cellulose for partial hydrolysis. Then, carbon catalyst was added, and the mixture was stirred. Water was added as an antisolvent, and the liquid was filtered off. The filtered solid underwent hydrolysis reaction, and the catalyst was recovered and reused.

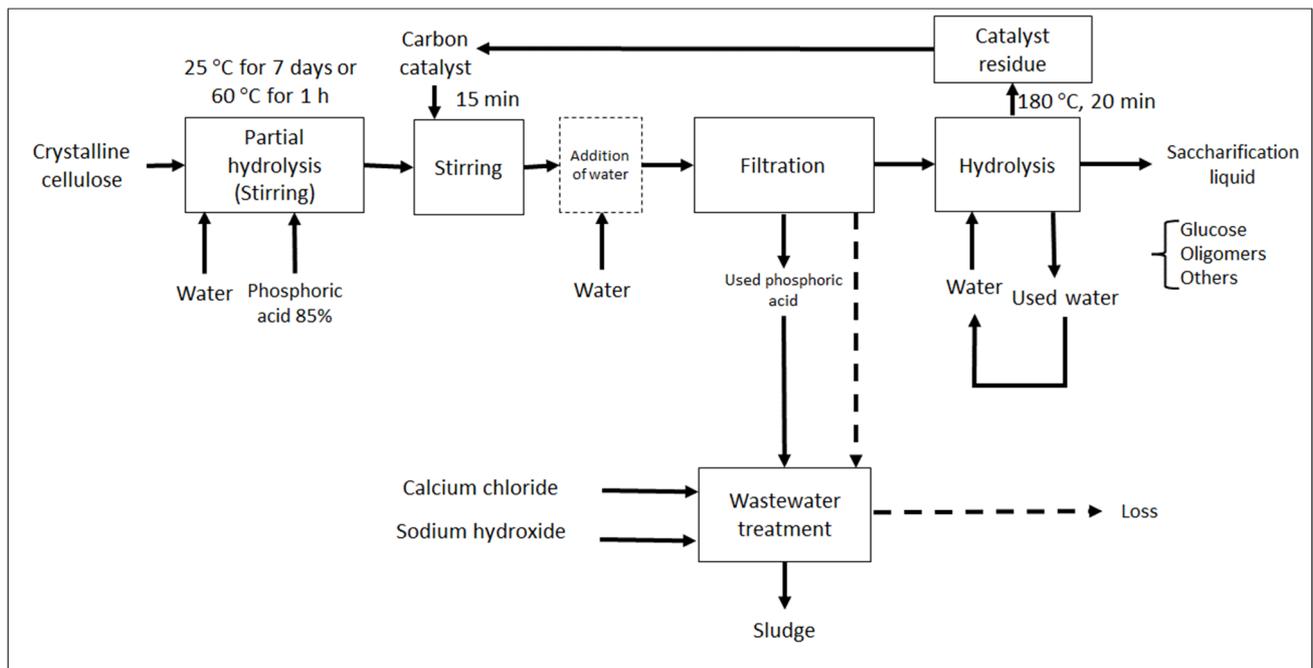


Figure S1. System boundaries of phosphoric acid treatment method.

Conditions.

Partial hydrolysis was done at 25 °C for seven days or 60 °C for 1 h.

Recovery of phosphoric acid were 90%, 95% and 99%.

Glucose yield was assumed at 73% from the result of Figure 6a. The treatment at 25 °C for seven days gave 70% glucose yield in Figure 6b, but in this calculation the yield was set at 73%.

Energy consumption: Assuming an equipment efficiency of 50% for heating, the energy requirement was set as 9.2 kJ/g-cellulose. This is equivalent to 2.54 Wh when converted to electricity (3.6 kJ Wh⁻¹). Stirring for 1 h is equivalent to the electric energy of 0.00855 Wh (g-cellulose)⁻¹ based on the catalog value of the rotary stirrer. From the above values, the energy consumption for 1 h of heating and stirring is estimated to be 2.52 Wh (g-cellulose)⁻¹.

System boundaries: From crystalline cellulose to production of glucose.

Reference: LCI database IDEA version 1.1 and version 3.1. Available online: <https://sumpo.or.jp/consulting/lca/idea/> (accessed on 11 January 2023).

2. LCA for mix-milling method

In the mix-milling method, crystalline cellulose and carbon catalyst were mixed and ball-milled for 2 h. Then, the mixture was stirred, and the liquid was filtered off. The recovered solid underwent hydrolysis reaction.

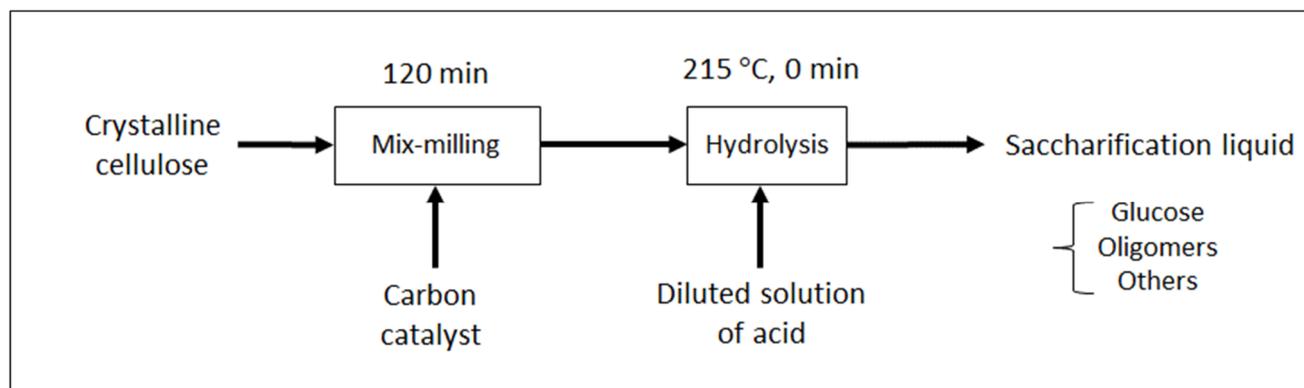


Figure S2. System boundaries of mix-milling method.

Conditions.

Mix-milling was done at 25 °C for 2 h at 60 rpm.

Yields of glucose and oligomers were 20% and 70%, respectively.

Energy consumption was assumed to be 160 kWh per glucose 1 kg.

System boundaries: From crystalline cellulose to production of glucose.

Reference: LCI database IDEA version 1.1 and version 3.1. Available online: <https://sumpo.or.jp/consulting/lca/idea/> (accessed on 11 January 2023).