Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

One-pot pretreatment, saccharification and ethanol fermentation of lignocellulose based on acid-base mixture pretreatment

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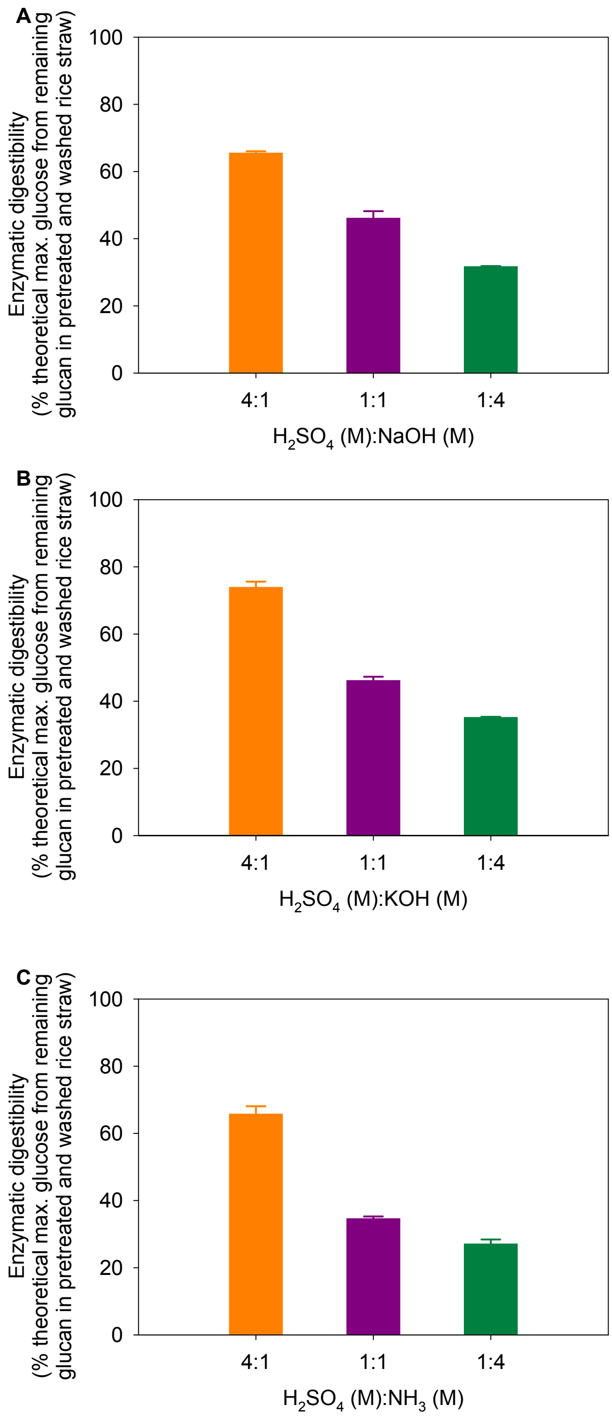
Fig. S1 Effects of the molar ratio of acid–base mixtures using different combinations of acid (HC1, H_2SO_4) and base (NaOH, KOH and NH_3) on the enzymatic digestibility of pretreated and washed rice straw. Pretreatment was performed using various mixing ratios of 0.05 M acid-base mixture at 190°C and a solids loading of 10% (w/v) with 3 min ramping to 190°C and 2 min holding in a microwave digester. Enzymatic hydrolysis was performed using 15 FPU of cellulase (Accellerase 1000) g^{-1} glucan at 50°C (pH 4.8) and at 200 rpm for 50 h.



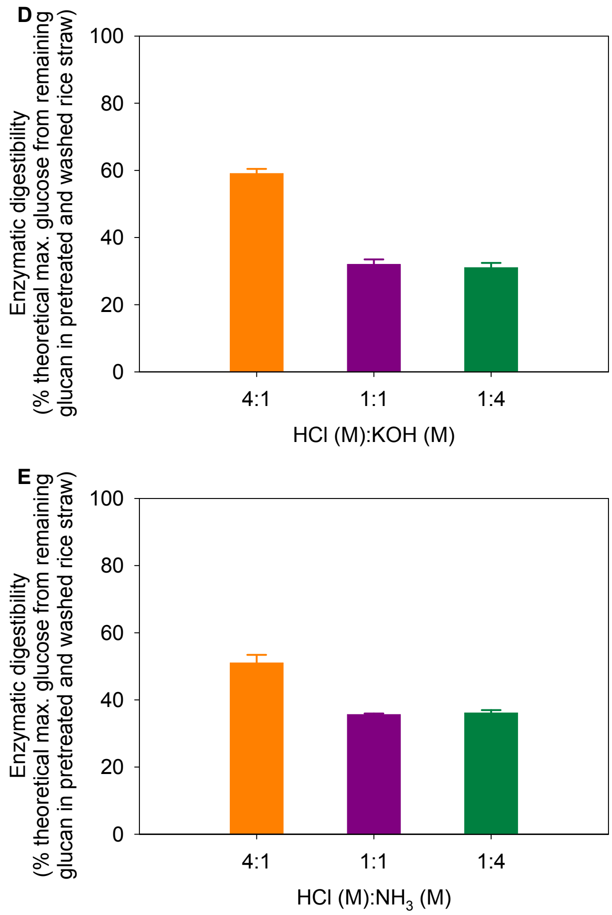


Fig. S2 Schematic diagrams of various process scenarios. All scenarios and process parameters were on the basis of NREL Technical Report (NREL/TP-5100-47764).[1] Schemes A and B are based on the conventional technologies, which indicate separate conditioning/separate fermentation and separate conditioning/whole slurry fermentation, respectively. Scheme C for whole slurry conditioning and fermentation is the advanced technology that is being tested by NREL.[2,3] Scheme D proposed in the present study is the one-pot pretreatment (using the acid-base mixture), saccharification and fermentation. Estimated costs for each scenario were presented in Fig. 8.

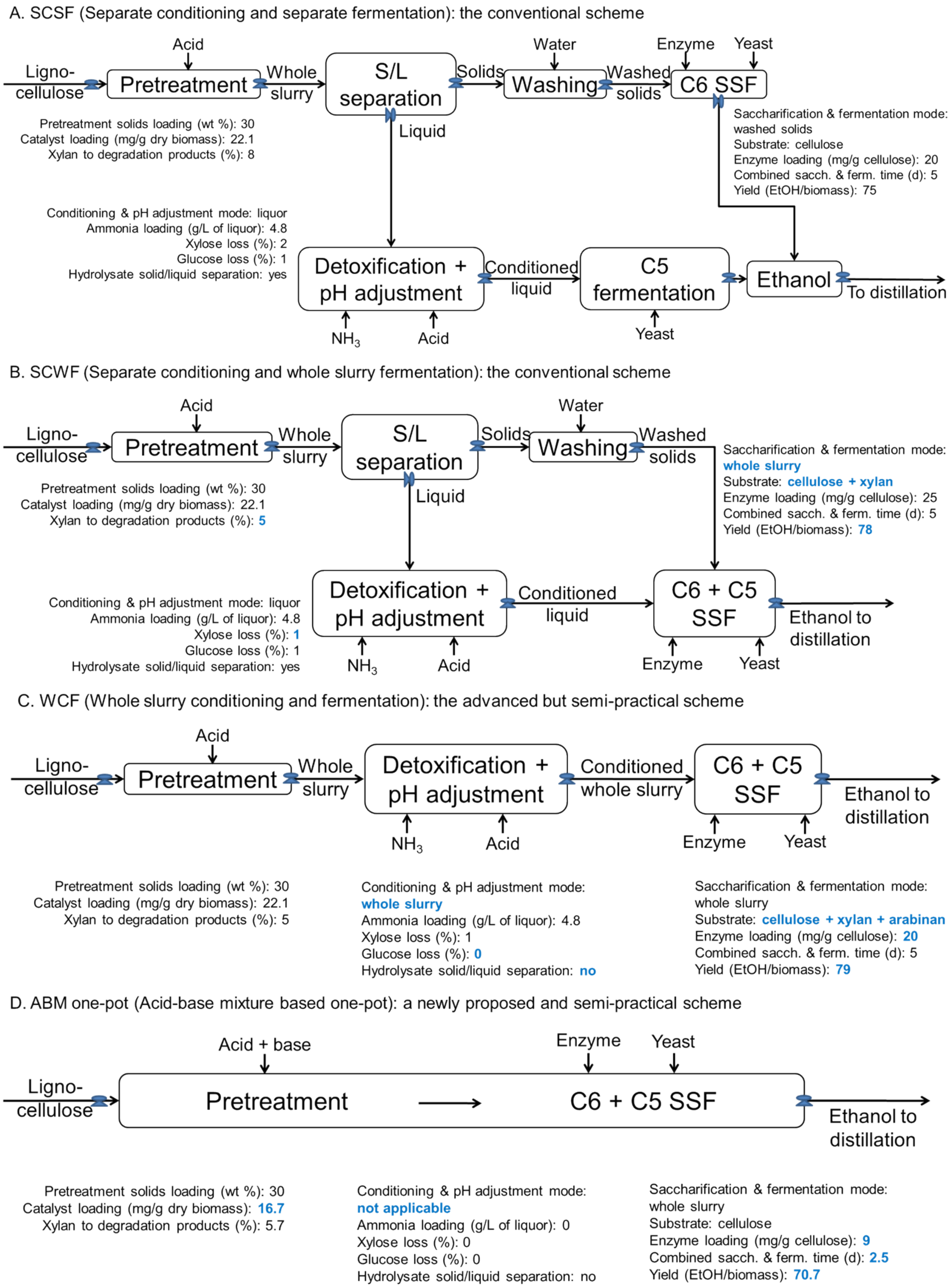


Table S1 Estimated costs for the scenarios in Figs. 8 and S2

	SCSF[a]	SCWF[a]	WCF[a]	ABM one-pot[a]
Ethanol price ($/gal)	6.47	6.42	5.95	5.07
Operating costs ($/gal)	2.67	2.62	2.15	1.96
Feedstock	0.72	0.76	0.74	0.74
Enzyme	0.36	0.43	0.34[b]	0.23[b]
Non-enzyme conversion[c]	1.59	1.43	1.07[c]	0.99[c,d]
Installed equipment costs	3.80	3.80	3.80	3.11
Pretreatment	0.49	0.49	0.49	0.55
Neutralization/conditioning	0.05	0.05	0.05	0
Saccharification & fermentation	0.51	0.51	0.51	0
On-site enzyme production	0.30	0.30	0.30	0.34
Distillation and solids recovery	0.37	0.37	0.37	0.41
Wastewater treatment	0.81	0.81	0.81	0.45[e]
Storage	0.08	0.08	0.08	0.09
Boiler/turbogenerator	1.08	1.08	1.08	1.21
Utilities	0.11	0.11	0.11	0.06[e]
Ethanol amount (gal/year)	61,000,000	61,000,000	61,000,000	54,591,139[f]

[a] Values were originated from NREL Technical Report (NREL/TP-5100-47764),[1] and installed equipment costs of SCSF, SCWF and ABM one-pot were based on the cost of WCF.

[b] Enzyme loadings in WCF and ABM one-pot were assumed to be 20 mg/g cellulose and 9 mg/g cellulose, respectively.

[c] Catalysts and neutralizing agents in WCF and ABM one-pot were assumed to be 22.1 mg/g biomass and 4.8 g/L liquor and 16.7 mg/g biomass and 0 g/L liquor, respectively.

[d] The amount of post-wash water usage was assumed to be 30 L/ton biomass[4] and the price of water was assumed to be $0.4/ton water.[5]

[e] Parameters for time duration was applied (*i.e.* half of total time consuming)

[f] Ethanol production amount was calculated on the basis of the ethanol yield of 70.7% of theoretical maximum.

References

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