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An Integrated Alkanolamine-Fenton Pretreatment Process for Biomass Deconstruction: Enhancement of Degradation Process and Liquid Fuel Production

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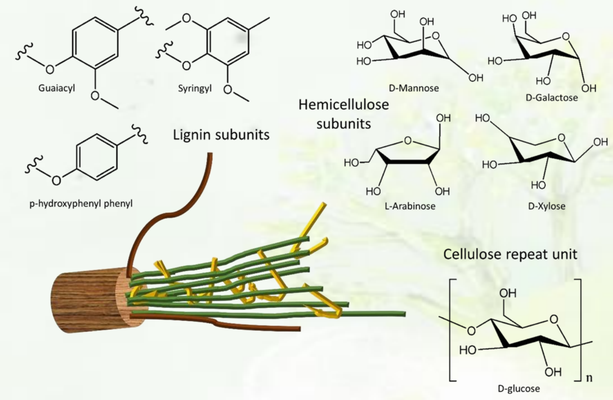
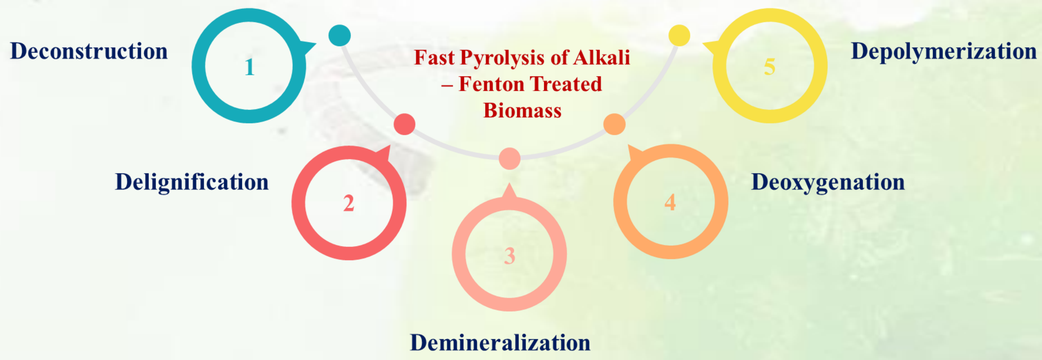
Introduction

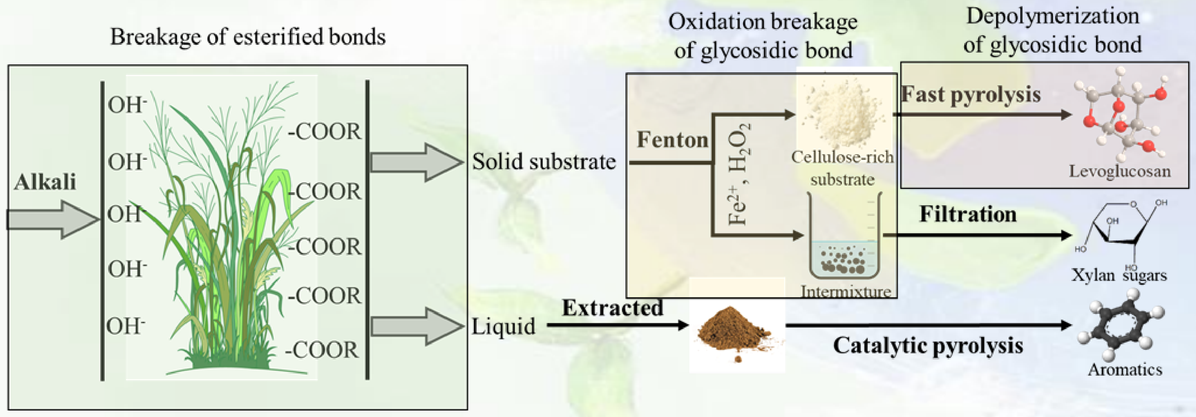
- Biomass pyrolysis has taken an increasing interest in producing biofuels and bio-based chemicals, but the complex compositions of pyrolytic liquid hinder its development and utilization.
- Fractionation of biomass is the most energy intensive, expensive and challenging step of biomass valorisation.



Motivation



Materials and Methods



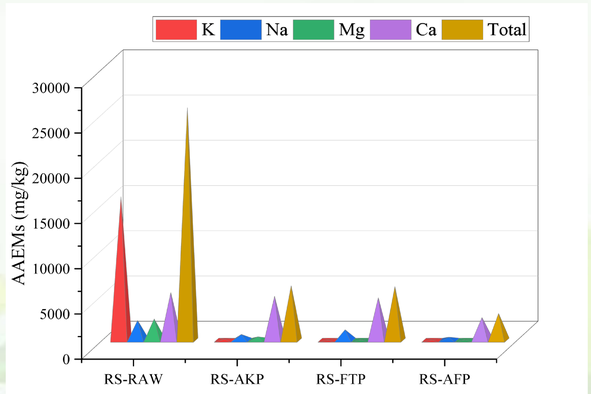
Results & Discussion

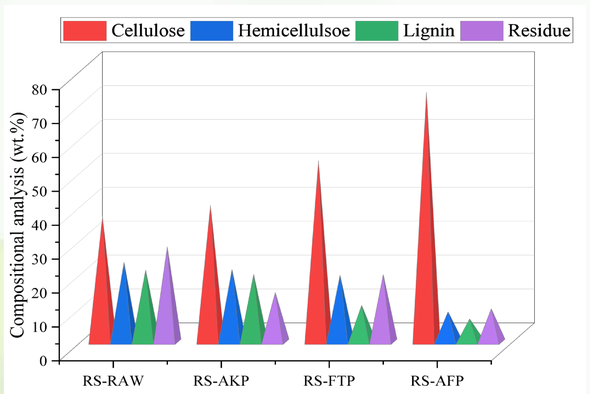
Proximate and Ultimate Analysis of Raw and Pretretad Biomass

Sample	C wt.%	H wt.%	N wt.%	S wt.%	O wt.%	HHV MJ/kg	MC wt.%	VM wt.%	ASH wt.%	FC wt.%
RS-RAW	42.80	5.50	1.70	0.30	49.70	16.13	8.75	80.60	7.24	3.41
RS-AKP	43.90	5.90	0.90	0.10	49.20	17.05	7.10	82.53	6.32	4.05
RS-FTP	44.40	5.95	0.60	0.06	48.99	17.32	6.32	83.14	6.03	4.51
RS-AFP	45.80	6.20	0.40	0.02	47.58	18.25	5.79	84.10	5.87	4.24

RS – Rice Straw; AKP – Alkali Process; FTP – Fenton Process; AFP – Alkali-Fenton Process

Alkali and Alkaline-earth metals (AAEMs and Compositional analysis of Raw and Pretretared Biomass



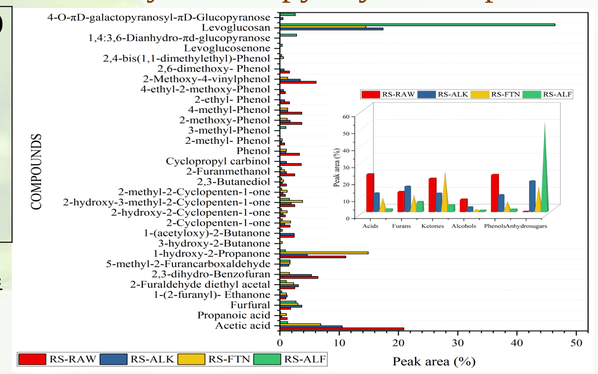


Degradation indices and kinetics analysis

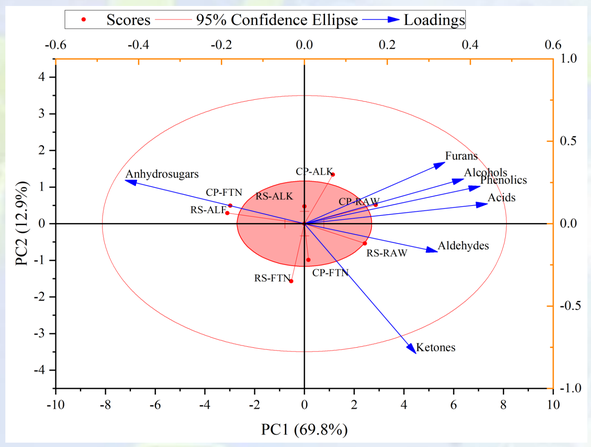
Sample	E_a (kJ/mol)	R^2 (%)	T_i (°C)	T_{max} (°C)	D_{max} (%/°C)
RS-RAW	149.52	99.40	257.14	344.28	0.80
RS-AKP	159.49	98.34	263.37	358.53	0.90
RS-FTP	168.21	99.70	265.21	353.45	1.20
RS-AFP	195.03	99.03	274.39	351.12	1.40

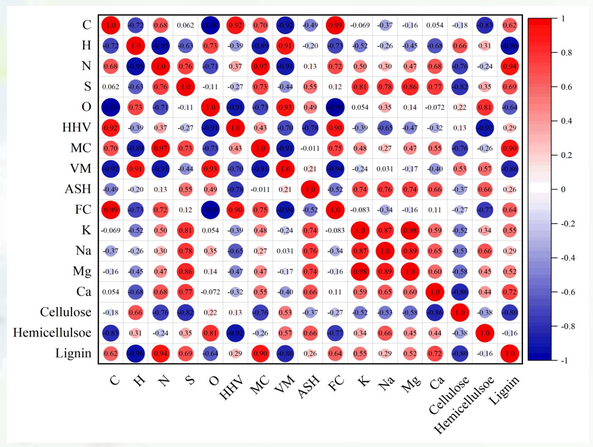
iL-INT: $$ln\left\{\frac{\beta_i}{T^2_{\alpha,i}\left[h(x_{\alpha,i})\frac{x^2_{\alpha,i}e^{x_{\alpha,i}}}{x^2_{\alpha-\Delta\alpha,i}e^{x_{\alpha-\Delta\alpha,i}}}h(x_{\alpha-\Delta\alpha,i})\right]}\right\} = ln\left[\frac{\frac{A_{\alpha-\Delta\alpha/2}}{R}}{E_{\alpha-\Delta\alpha/2}g(\alpha,\alpha-\Delta\alpha)}\right] - \frac{E_{\alpha-\Delta\alpha/2}}{RT_{\alpha,i}}$$

Relative yields of pyrolytic compounds

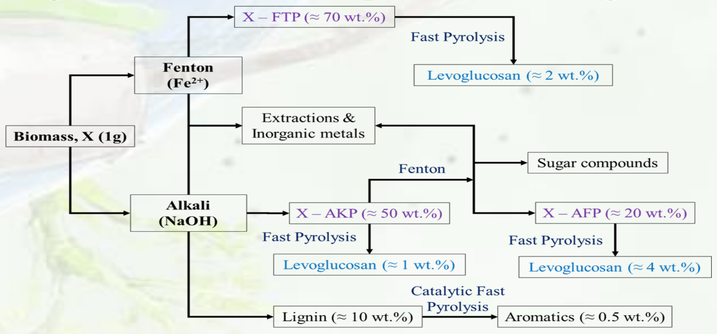


Bi-Plot of obtained pyrolytic compounds and Correlation Plot of Physicochemical parameters for Raw and Treated Biomass (RS – Rice straw, CP – Coir pith)





A general mass balance process flow diagram



Conclusion

- ✓AAF coupled with pyrolysis is an effective biorefining process.
- ✓The obtained lignin fractions are suitable to produce aromatics.
- ✓This process achieves a high-yield levoglucosan from biomass.
- ✓This process effectively removes nitrogen, sulfur and AAEMs.