Unlocking Bamboo's Biofuel Potential: A Delignification and Crystallinity Study Using Deep Eutectic Solvent Pretreatment

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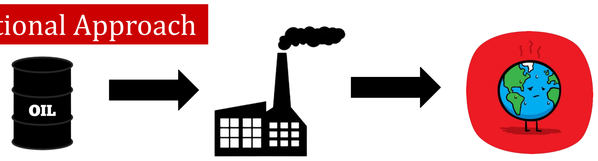
Motivation & Challenges

Traditional Approach

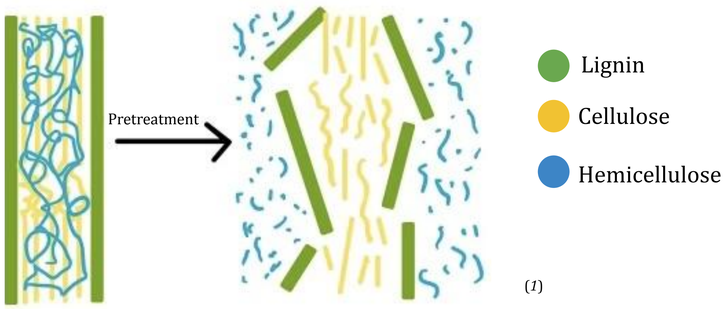


Fossil Fuels | Energy | Climate Change

Sustainable Approach

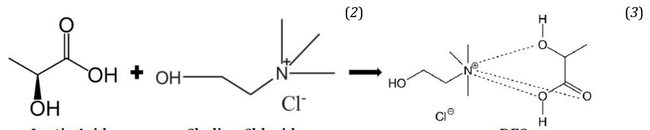
Biomass | Treatments | Clean Energy

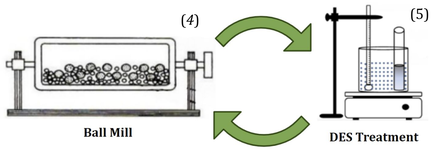
Chemical Pretreatment	Inexpensive	Nonhazardous	Reusable
DES	✓	✓	✓
Alkaline	✗	✓	✗
Organosolv	✗	✗	✓
Ionic Liquid	✗	✓	✗
Acid	✓	✗	✗



(1)

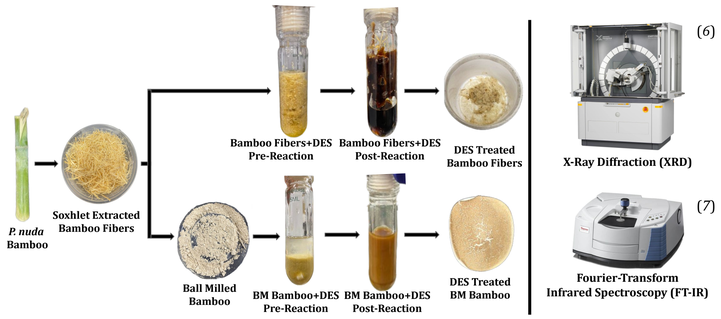
Experimental Objectives





Significance of pretreatment order?

Bamboo Pretreatment Strategy



DES Recrystallizes Amorphous Bamboo

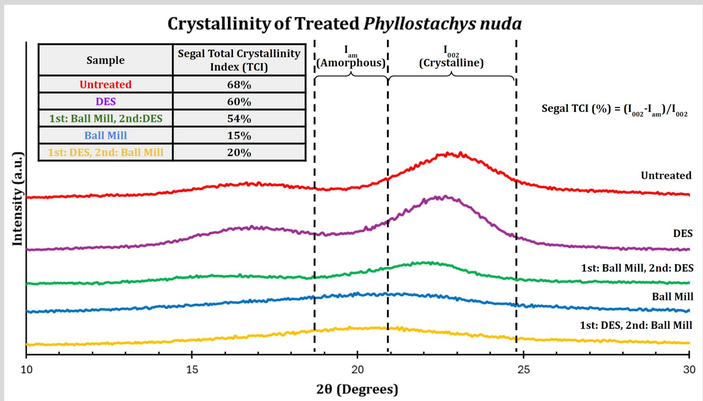


Figure 1. X-ray diffractograms of *P. nuda* bamboo and associated Segal total crystallinity indexes across varied pretreatment strategies.

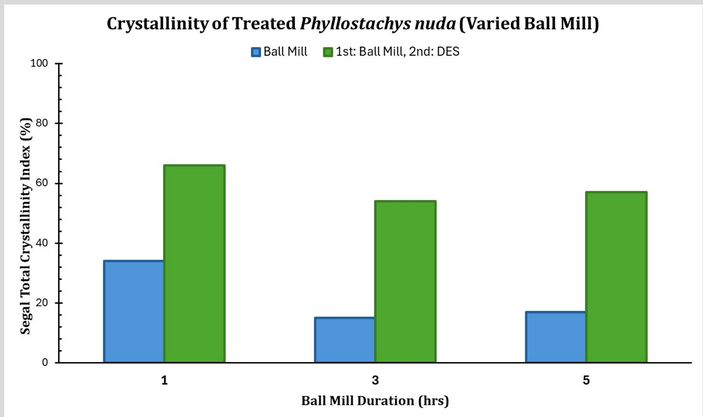


Figure 2. Ball mill duration versus Segal total crystallinity index for *P. nuda* bamboo with and without subsequent DES pretreatment.

Effective Delignification Post Ball Mill

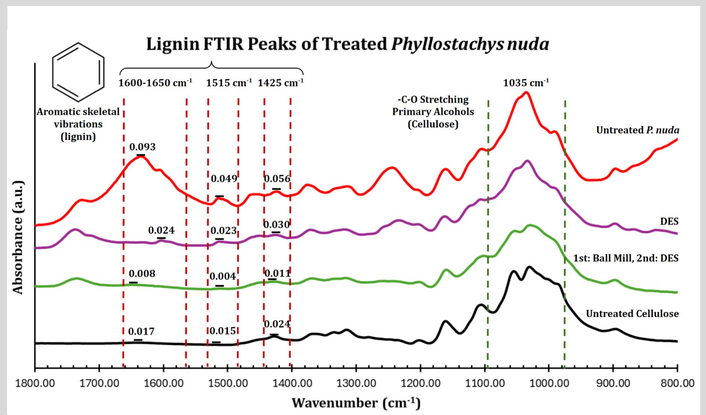
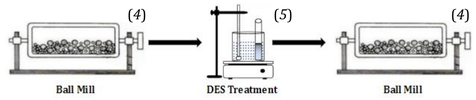


Figure 3. FT-IR absorbance curves for *P. nuda* bamboo across varied pretreatment strategies. Relative peak intensities have been provided at three key wavenumber regions for lignin identification.

Conclusions & Future Work



Pretreatment Order is <u>Important</u>

- DES recrystallizes cellulose
- 3-hr ball mill enhances lignin removal

Future Work

- Acetyl Bromide Method
- Improve extraction
- Recycle DES

Acknowledgments

We would like to sincerely thank **Professor Michael Timko** and **Tim Woodard** for their continuous advising and support throughout this process. We would also like to thank **Avos Bioenergy** and **UC Riverside** for their assistance on this project.

References

[1] Kumar, P.; Barrett, D. M.; Delwiche, M. J.; Stroeve, P. Methods for Pretreatment of Lignocellulosic Biomass for Efficient Hydrolysis and Biofuel Production. *Ind. Eng. Chem. Res.* **2009**, *48* (8), 3713–3729. https://doi.org/10.1021/ie801542g.
[2] *Structures of choline chloride (ChCl) and lactic acid (La)*. ResearchGate. https://www.researchgate.net/figure/Structures-of-choline-chloride-ChCl-and-lactic-acid-La_fig1_362245353 (accessed 2024-04-09).
[3] Kuehn, K. M.; Massmann, C. M.; Sovell, N. R. Choline Chloride Eutectics: Low Temperature Applications.
[4] rajibray. *Principle construction, and working of ball mill*. Pharmacy Gyan. https://pharmacygyan.com/principle-construction-and-working-of-ball-mill/ (accessed 2024-04-09).
[5] Duangthong, S.; Rattanadaecha, K.; Cheewasedtham, W.; Wararattananurak, P.; Chooto, P. Simple Digestion and Visible Spectrophotometry for Copper Determination in Natural Rubber Latex. *ScienceAsia* **2017**, *43* (6), 369. https://doi.org/10.2306/scienceasia1513-1874.2017.43.369.
[6] Empyrean Multi-Purpose Research X-Ray Diffractometer XRD. AZoNano. https://www.azonano.com/equipment-details.aspx?EquipID=374 (accessed 2024-04-09).
[7] Fourier Transform Infrared (FTIR) Spectroscopy and Microscopy Archives - Analysis. https://analysisdoo.com/products/fourier-transform-infrared-ftir-spectroscopy-and-microscopy/ (accessed 2024-04-09).