Wood2Wood project: Decontamination and material recovery of post-consumer wood by coupling thermochemical and biological processes.

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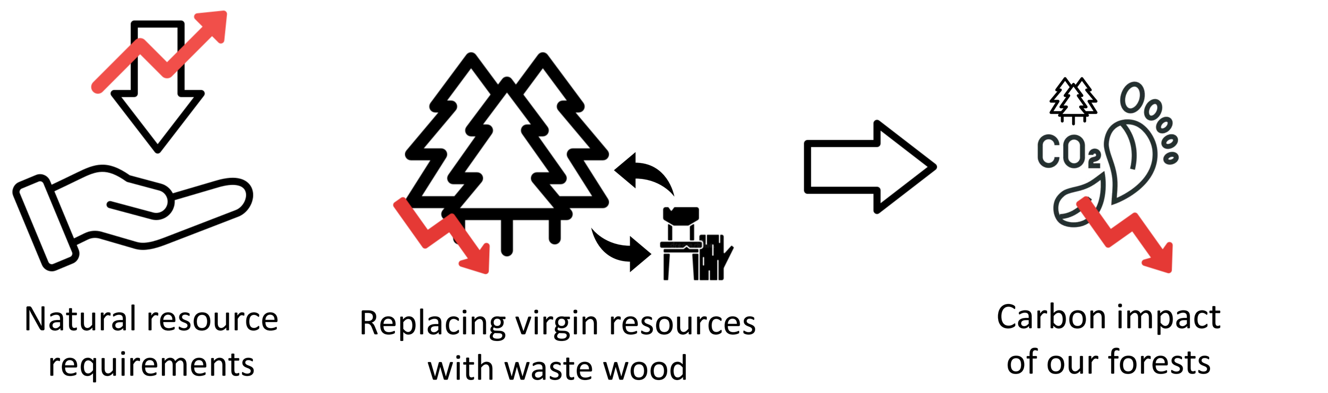
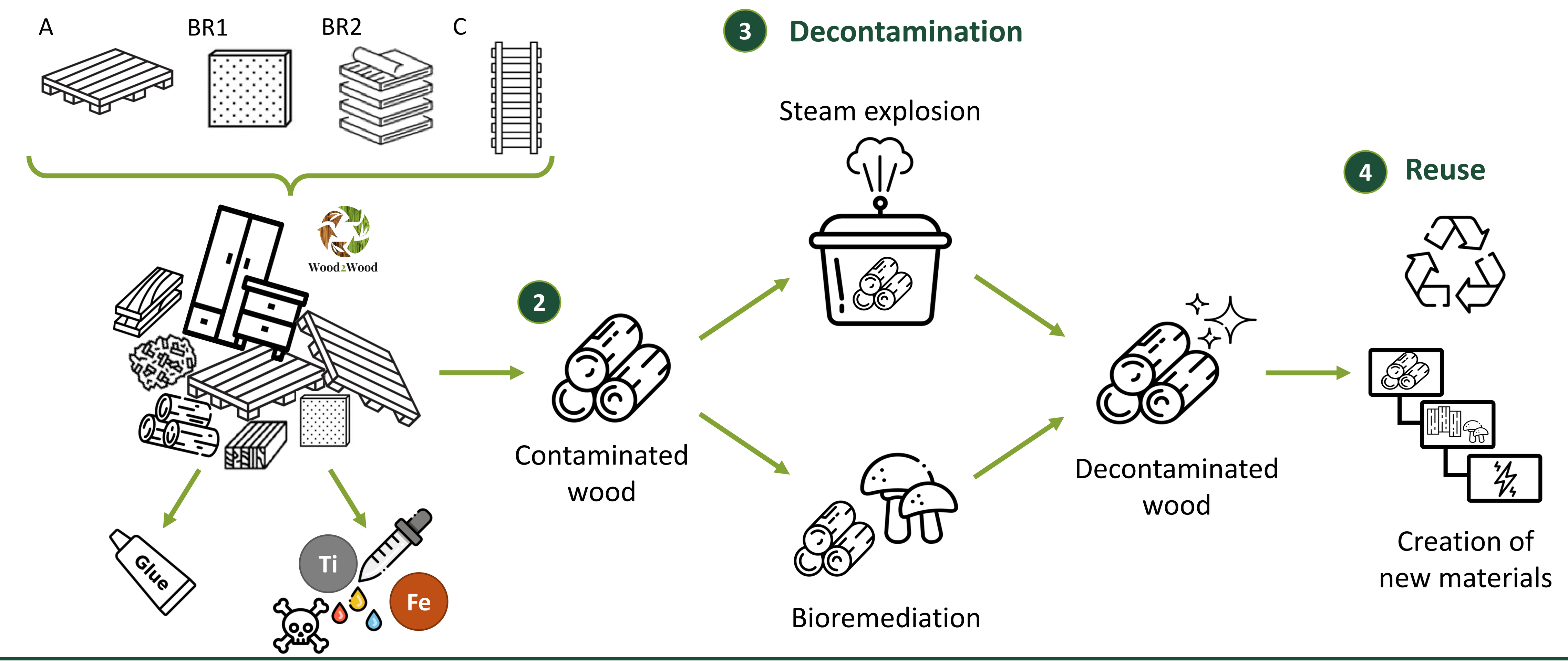
Context and objective

State of the art

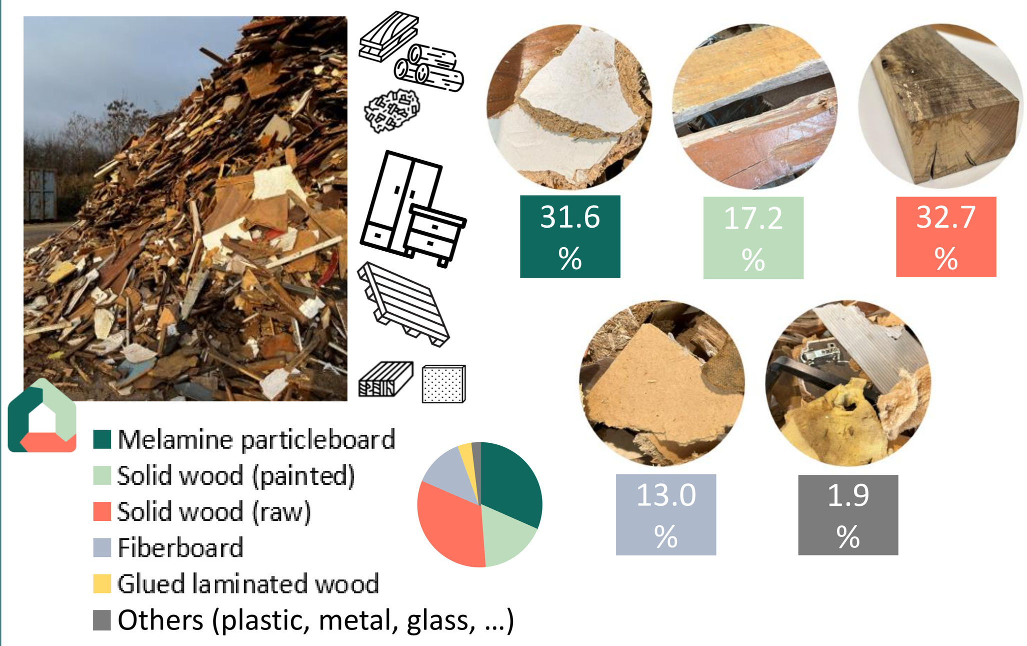


1. **Problematic:** Post-consumer wood waste streams are highly **heterogeneous**, containing various adhesives, coatings, and preservatives that limit their recycling potential.
2. **Challenge:** Developing efficient **decontamination** strategies capable of dealing with this variability.
3. **Objectives:** This study aims to evaluate a hybrid approach combining thermochemical and biological processes to **decontaminate** and
4. **valorize** post-consumer wood into new bio-based materials.

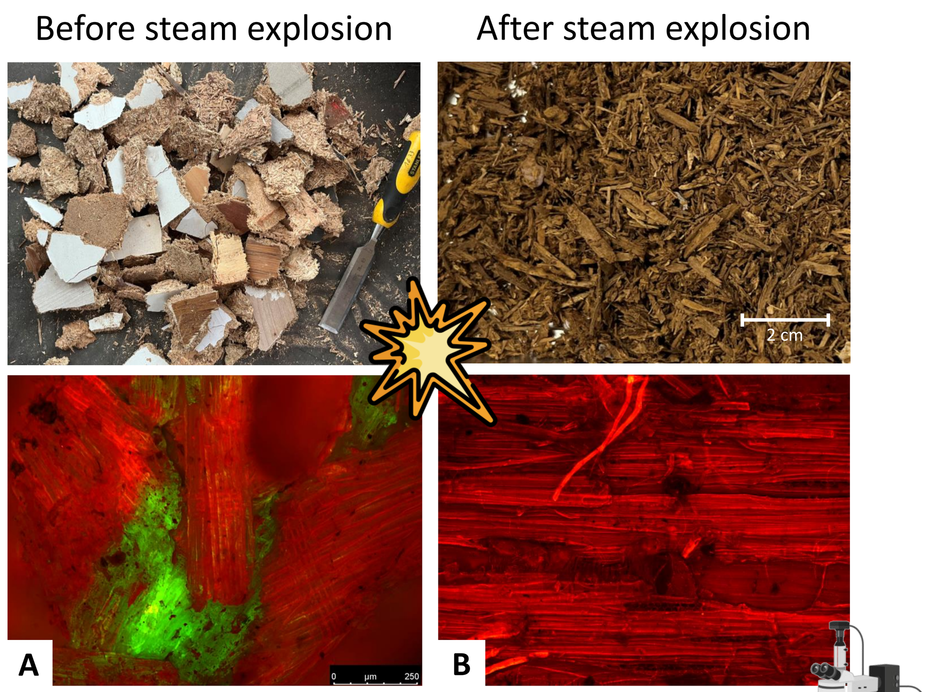


Results

1 Wood waste deposit

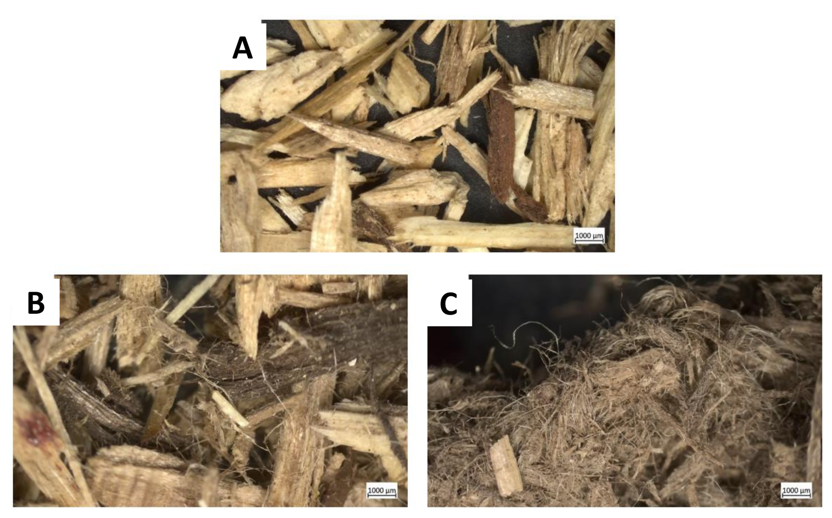


2 Glue elimination and defibration

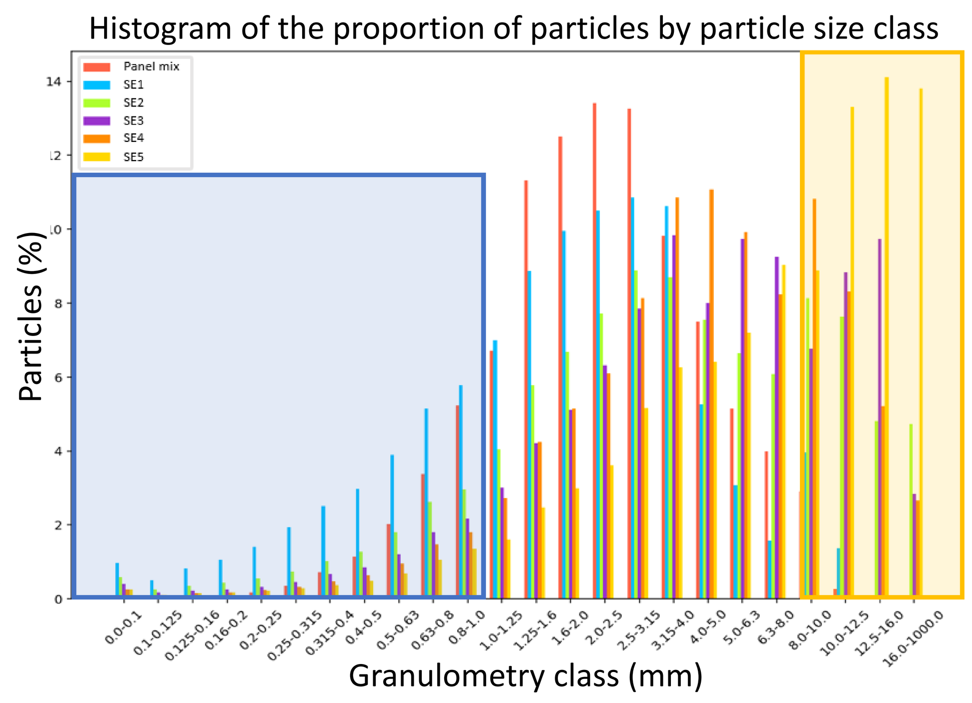


Fluorescence microscope images of a particle from the panel mix. A/ Before and B/ after steam explosion. The green areas indicate the presence of glue clusters.

3 Cascade recycling

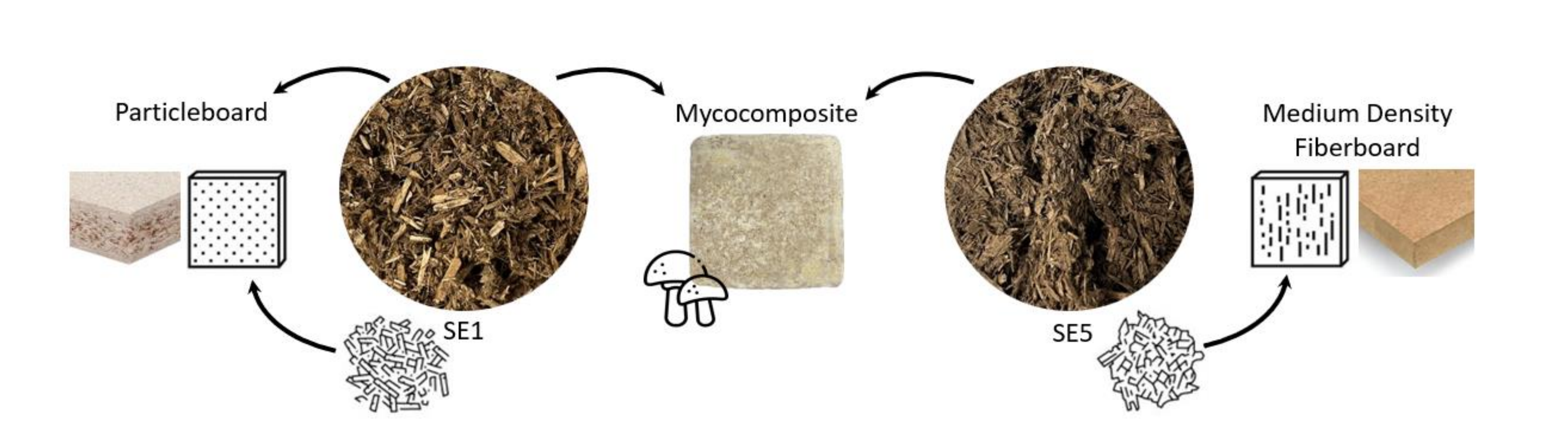


Binocular images of panel mix (A), the steam-exploded SE1 sample (B), and the steam-exploded SE5 sample (C).



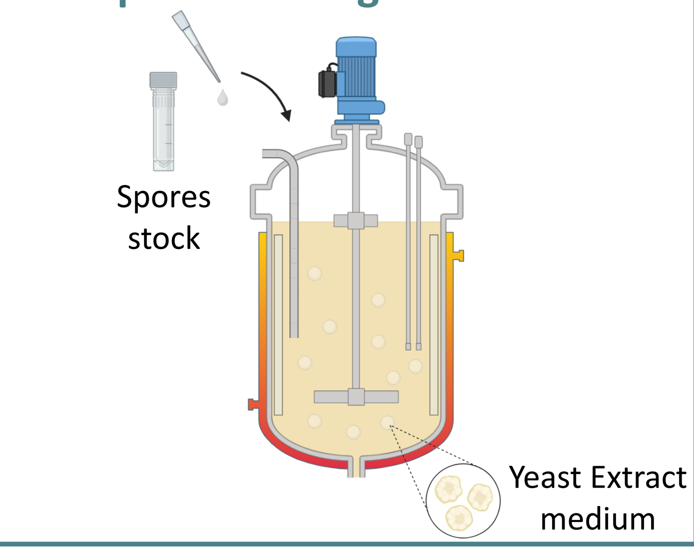
Histogram of particle size distribution for the panel mix and after successive steam explosion treatments (SE1 to SE5). The blue area highlights the disappearance of fine wood dust particles (< 0.63 mm) after the second explosion (SE2). The yellow area corresponds to the presence of large fiber clusters (> 8 mm).

4 Reuse of pretreated biomass

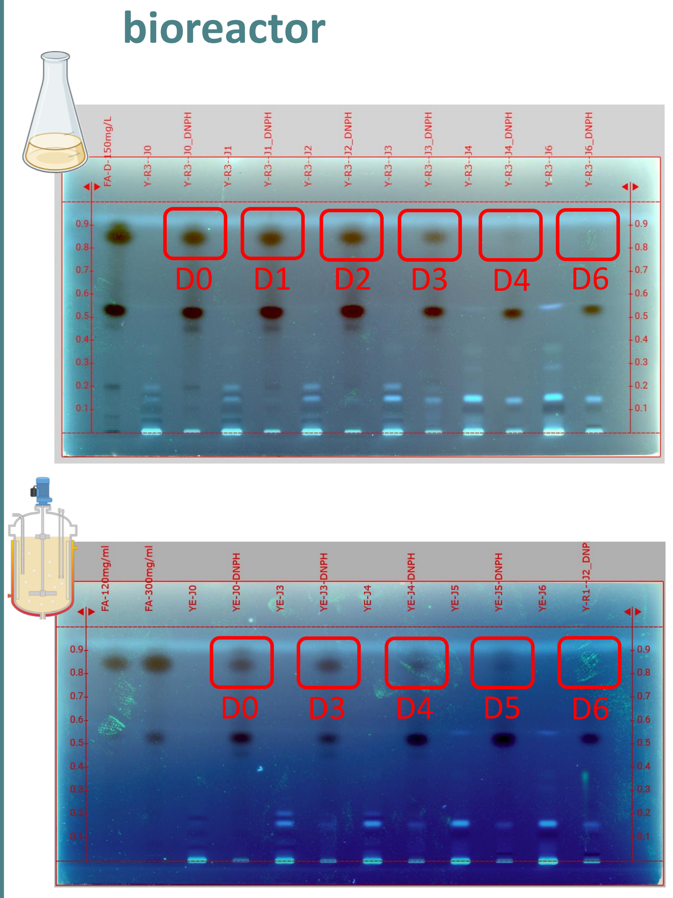


The use of biomass cleaned by steam explosion must be adjusted according to the number of recycling cycles. The morphological variations observed require the reuse processes to be adapted accordingly. This figure illustrates several examples of potential applications. Other parameters, such as hydrophobicity, etc., will also need to be taken into account.

6 Upscaling the detoxification process using a bioreactor



7 Comparison of the residual CH_2O during upscaling from Erlenmeyer flasks to bioreactor

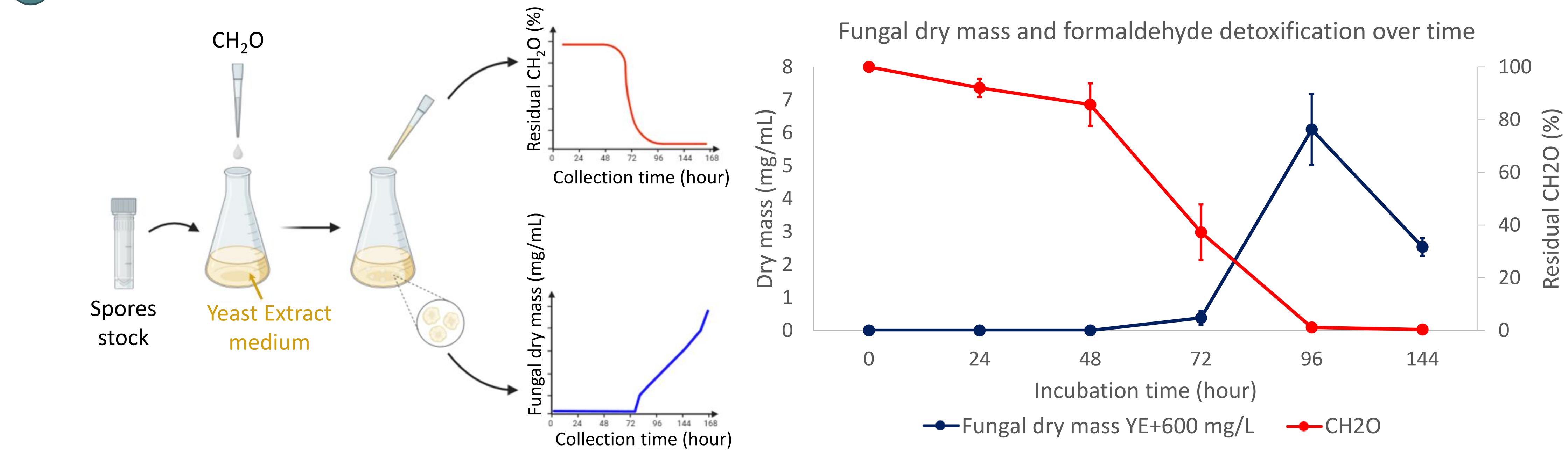


HPTLC analysis at 254 nm of Erlenmeyer flask (top) and bioreactor (bottom) cultures on silica gel. The control condition contains formaldehyde (FA). Initial formaldehyde concentration at day 0 (D0): 600 mg/L.

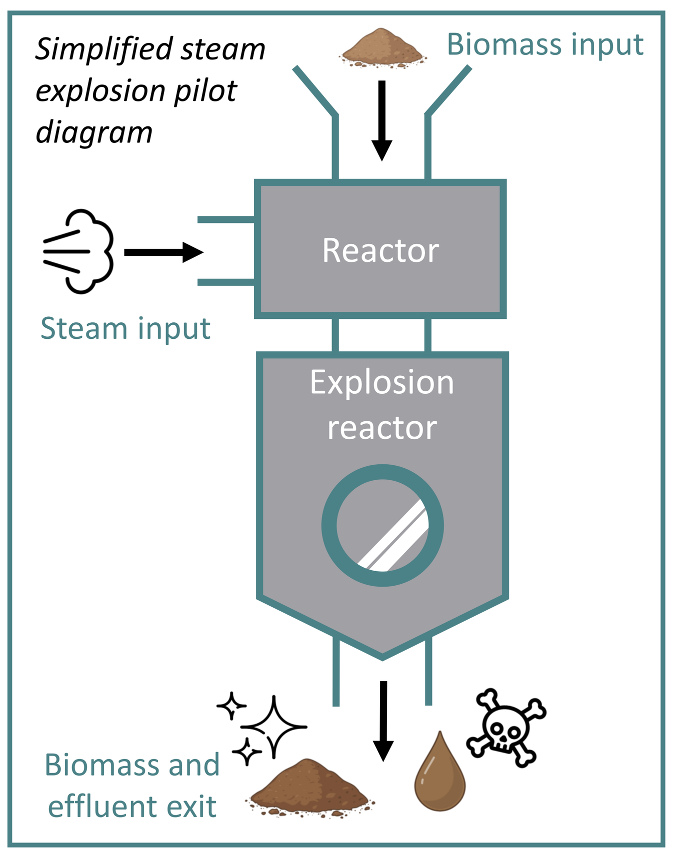
Erlenmeyer		Bioreactor	
D0	100 %	D0	100 %
D3	33 %	D4	34 %
D4	**0 %**	**D6**	**0 %**

Formaldehyde detoxification during scale-up from Erlenmeyer flasks to bioreactor (D: day). The fungal strain achieves complete detoxification of formaldehyde within 4 to 6 days.

5 Detoxification of the effluents using a standard solution



Cultures are performed in Yeast Extract (YE) medium with an initial formaldehyde concentration of 600 mg/L. An initial acclimation phase is observed, during which the strain tolerates and detoxifies formaldehyde before exhibiting significant biomass growth after 72–96 h.



Conclusion & perspectives

The **steam explosion** process removes up to **80 %** of the **glue**.

Formaldehyde decontamination reaches up to **77 %** within **72 hours** of incubation.

- Optimization of the fungal growth in the steam explosion effluents
- Optimization of the fungal growth on steam exploded wood waste
- Characterize the properties of the fibers after several explosions

References

S. Troilo, A. Besserer, C. Rose, S. Saker, L. Soufflet, and N. Brosse, "Urea-Formaldehyde Resin Removal in Medium-Density Fiberboards by Steam Explosion: Developing Nondestructive Analytical Tools," *ACS Sustainable Chem. Eng.*, vol. 11, no. 9, pp. 3603–3610, Mar. 2023, doi: 10.1021/acssuschemeng.2c05686.

K. Aguilar, L. Figel, S. Saker, L. Soufflet, N. Brosse, and A. Besserer, "Steam Explosion: A Booster for Fungal Growth in a Myco-composite," *ACS Sustainable Chem. Eng.*, vol. 12, no. 31, pp. 11650–11659, Aug. 2024, doi: 10.1021/acssuschemeng.4c03099.

Thanks

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