Building materials: a comparative study of VOC emission rates involving commercial glued wood panels and fiberboards resulting from a coriander biorefinery

(Matériaux de construction : une étude comparative des taux d'émission de COV de panneaux commerciaux de bois collé et de panneaux de fibres auto-liés issus d'une bioraffinerie de la coriandre)

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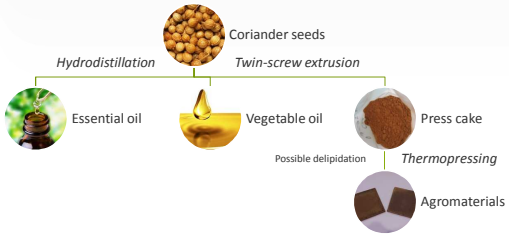
Introduction



Biorefinery of coriander (*Coriandrum sativum* L.), an annual crop belonging to the Apiaceae family, provides different products. One of them is a particleboard obtained by thermopressing of a press cake resulting from the twin-screw extrusion of coriander fruits. This renewable biomaterial could be used as a building material. However, this would need an evaluation of the emissions of volatile organic compounds (VOC), which could influence the indoor air quality and have a negative impact on human health. Qualitative and quantitative analyses are needed, as well as a study of influencing factors such as temperature or relative humidity [2, 3].

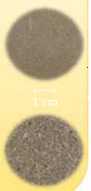
Material and methods

Materials

Self-bonded agromaterial
(150 x 150 x 5 mm)
Fiberboard obtained with straw and press cake deoiled. The cake acts as a natural and powerful binder due to the thermoplastic behavior of its protein fraction during thermopressivity [1].

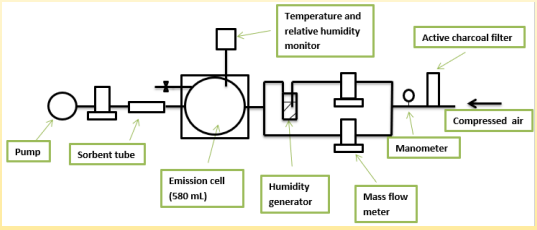
Medium Density Fiberboard
(150 x 150 x 10 mm)
Steamed and defibered wood waste, glued with a synthetic binder, pressed and packaged.

Chipboard panel
(150 x 150 x 10 mm)
Fragmented wood waste, then mixed with glue before being pressed hot and sanded.



Experimental set-up

Temperature: 23±1°C
Relative humidity: 50±1%
Sample surface: 0.025 m²
Air flow: 0.018 m³.h⁻¹



$$SER = \frac{(m - m_0)}{V} \cdot \frac{q}{S}$$

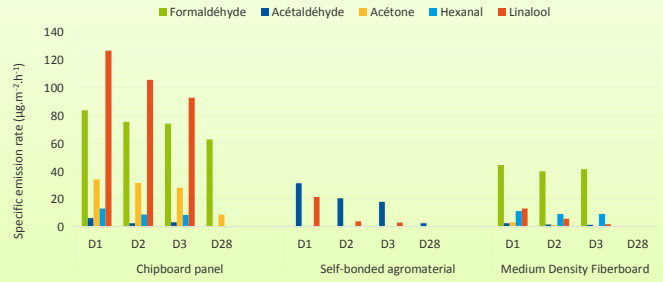
SER	specific emission rate (µg.m⁻².h⁻¹),
m	mass of VOC in the sorbent tube (µg),
m_0	background value (µg),
V	sampled volume (m³),
q	air flow (m³.h⁻¹),
S	sample surface (m²).

Sampling and analysis

- Qualitative analysis
  SPME sampling with a PDMS-DVB fiber (30 min, static mode) followed by GC-MS analysis
- Quantitative analysis
  - Sampling on Tenax TA® sorbent tubes (30 min at 195mL$_N$/min) followed by thermal desorption by GC-FID analysis
  - Sampling on DNPH cartridges (2h30 at 210 mL$_N$/min) followed by percolation with 5 mL of acetonitrile and quantitative analysis by HPLC-UV-DAD analysis
- Materials were exposed 28 days in the emission cell. Specific emission rates were determined at day 1 (D1), day 2 (D2), day 3 (D3)and day 28 (D28) and focused on the 5 more abondant compounds.

Results

Specific emission rates for 5 volatile organic compounds according to the sampling day and the type of material



Total SER (µg.m⁻².h⁻¹)	Chipboard panel	Self-bonded agromaterial	Medium Density Fiberboard
D1-3	232	33	63
Mean proportions			
D28	72	3	23

Conclusion

- Clipboard panel is the most important source of formaldehyde, acetone, hexanal, linalool.
- For formaldehyde: $SER_{Self\text{-}bonded\ agromaterial} < 0.8$ µg.m⁻².h⁻¹ (= less than the limit of detection) whatever the day of measurement whereas $SER_{chipboard\ panel} = 78$ µg.m⁻².h⁻¹, $SER_{Medium\ Density\ Fiberboard} = 42$ µg.m⁻².h⁻¹ for D1-3
- Self-bonded agromaterial emissions are only due to linalool and acetaldehyde.
- Self-bonded agromaterial is the lowest VOC emission source what makes it the most ecofriendly material.

References

[1] E. Uitterhaegen, L. Labonne, O. Merah, T. Talou, S. Ballas, T. Véronèse, P. Evon, 2017, Optimization of thermopressing conditions for the production of binderless boards from a coriander twin-screw extrusion cake. *J. Appl. Polym. Sci.* 134, 44650.

[2] E. Uitterhaegen, K. Burianová, S. Ballas, T. Véronèse, O. Merah, T. Talou, C.V. Stevens, Ph. Evon, V. Simon, 2018, Characterization of volatile organic compound emissions from self-bonded boards resulting from a coriander biorefinery, *Industrial Crops and Products*, under press.

[3] AFNOR. *Air intérieur – Partie 6 : Dosage des composés organiques volatils dans l'air intérieur des locaux et enceintes d'essai par échantillonnage actif sur le sorbant Tenax TA®, désorption thermique et chromatographie en phase gazeuse utilisant MS/FID.* NF ISO 16000-6, Juin 2005 : indice de classement X 43-404-6. 30p.

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