Development and characterization of a new composite based on grape stalks and potato starch for building insulation

Scientific Webinar series between LUKE & URCA

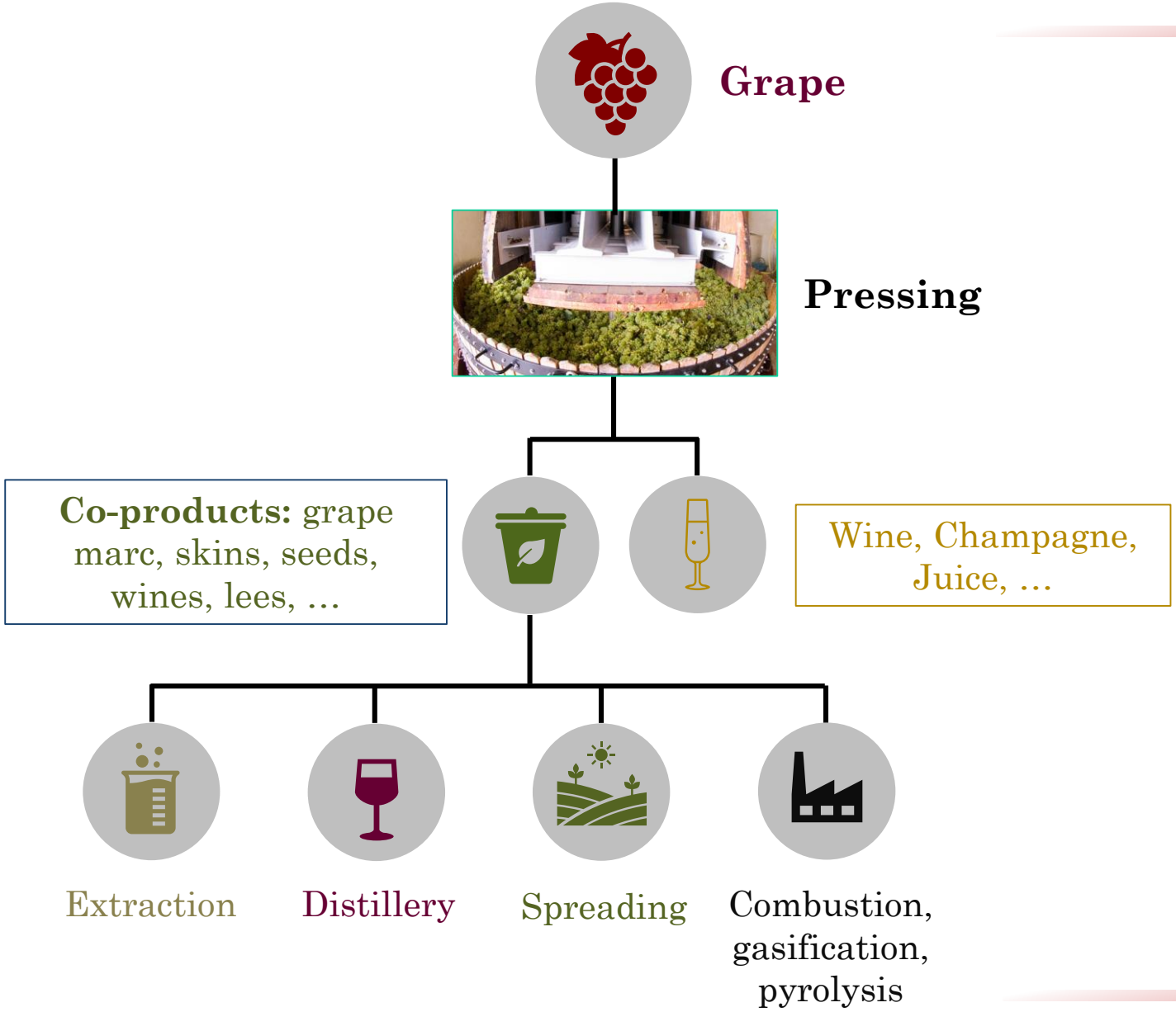
#2 « Fiber biomass valorization in soil fertilisation, materials and energy »

January 17, 2023

Céline Badouard,

Boussad ABBES, Christophe BLIARD, Fabien BOGARD, Mohammed LACHI, Chadi MAALOUF, Guillaume POLIDORI

Context



Grape Marc (aignes)

- **Some numbers (/year)**:
  - 100 000 t → Champagne aera
  - 850 000 t → in France

Raw materials – Grape marc

Composition :

Seeds
36,0 %

Grape pomace

82 % water

Stalks
12,7%

Skins
51,3 %

Materials :

Stalks (S)

Crushed stalks (CS)

Starch (A) 10, 20 and 30%

	Stalks	Crushed stalks	Starch
10%	**S/A-0.1**	**CS/A-0.1**	***
20%	**S/A-0.3**	**CS/A-0.2**	***
30%	**S/A-0.3**	**CS/A-0.3**	***
100%	***	***	**A-1**

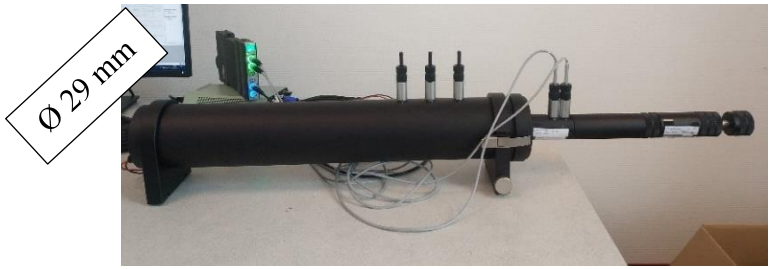
Thermal – Thermal conductivity

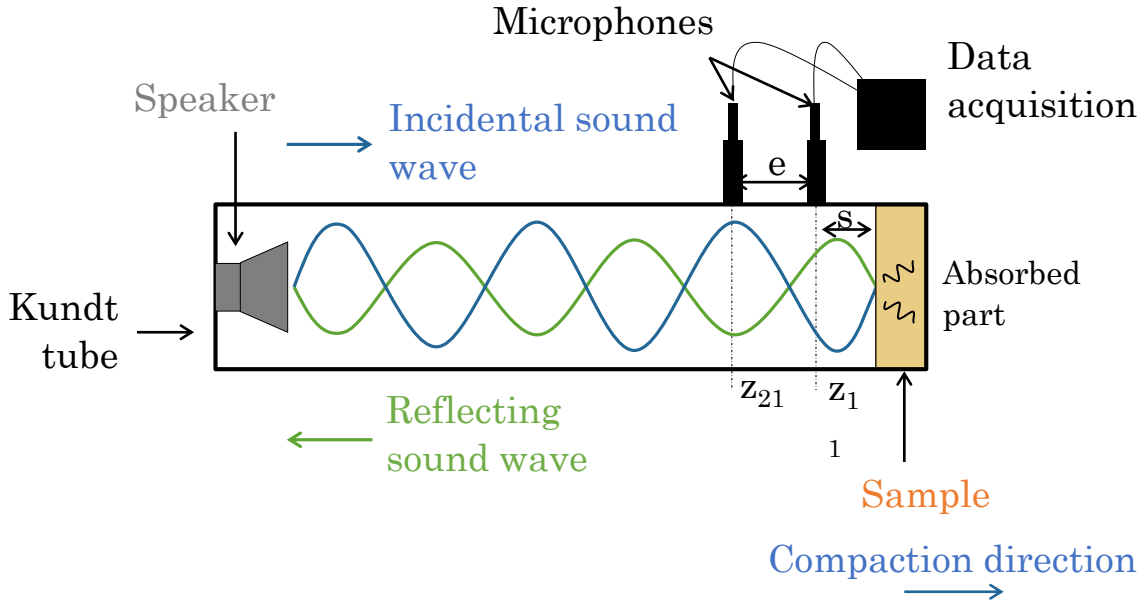
Measurement of thermal conductivity **λ** (W/m.K) → Good insulator > 0,065 W/(m.K)

λ W/(m.K)		Stalks (S)	Crushed stalks (CS)	Starch (A)
Starch Ratio	**0.1**	0,0651 ± 0,0005	0,0656 ± 0,0004	***
	0.2	0,0693 ± 0,0039	0,0771 ± 0,0015	***
	0.3	**0,0590 ± 0,0015**	0,0617 ± 0,0006	***
	1	***	***	0,0658 ± 0,0042

- Kundt tube
  - Measurment of the acoustic coefficient **α**
  - 2 frequency ranges :
    - Low frequencies (50-1 600 Hz)

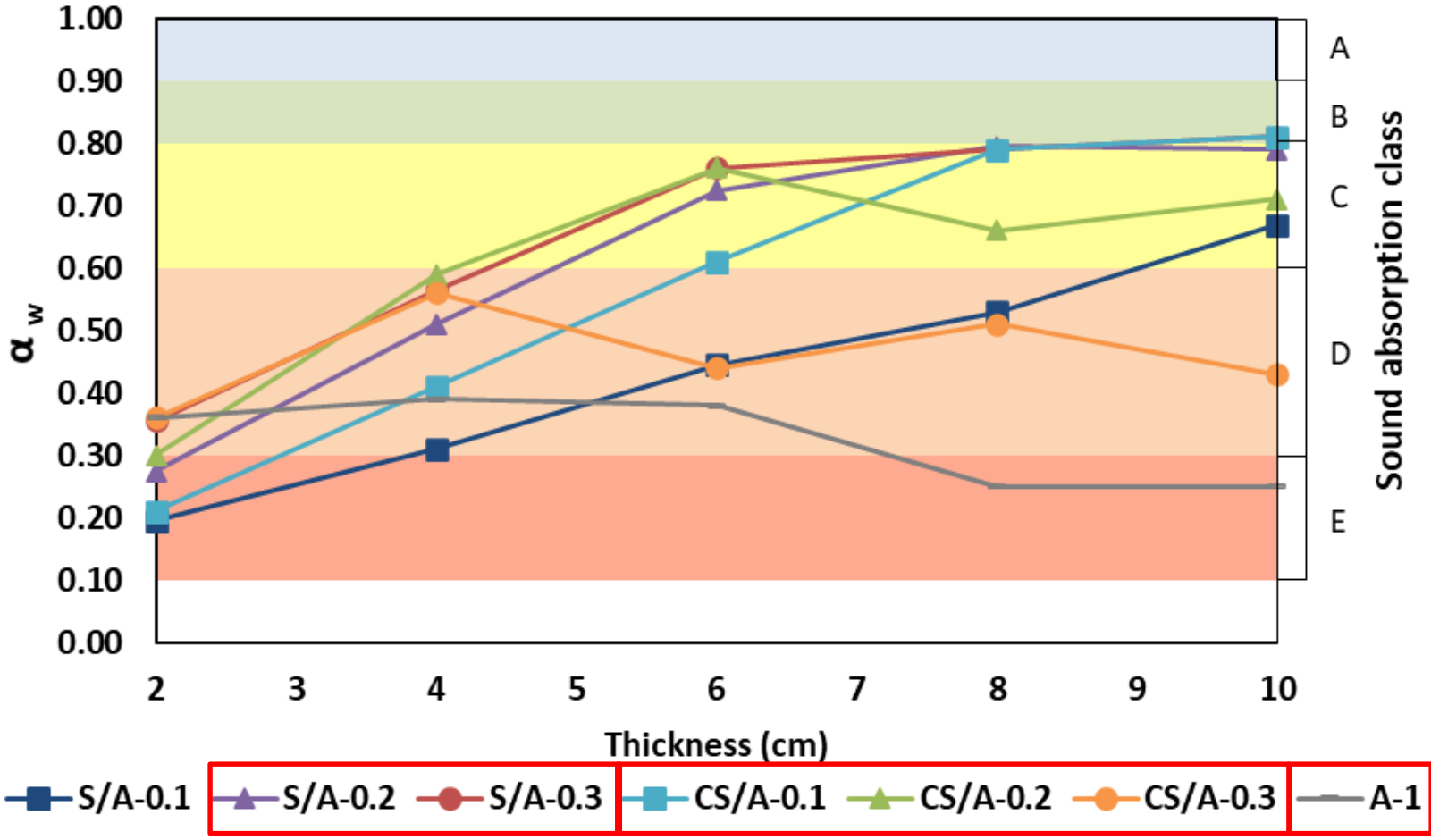
    - High frequencies (500-6 400 Hz)





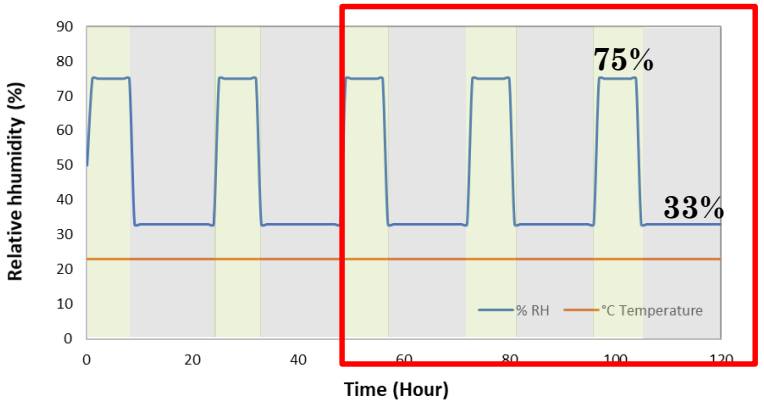
- Weighted absorption coefficient α_w
  - ISO 11654 Standard
  - Practical absorption coefficient α_p at center frequencies
  - Define a reference curve: value at 500 Hz

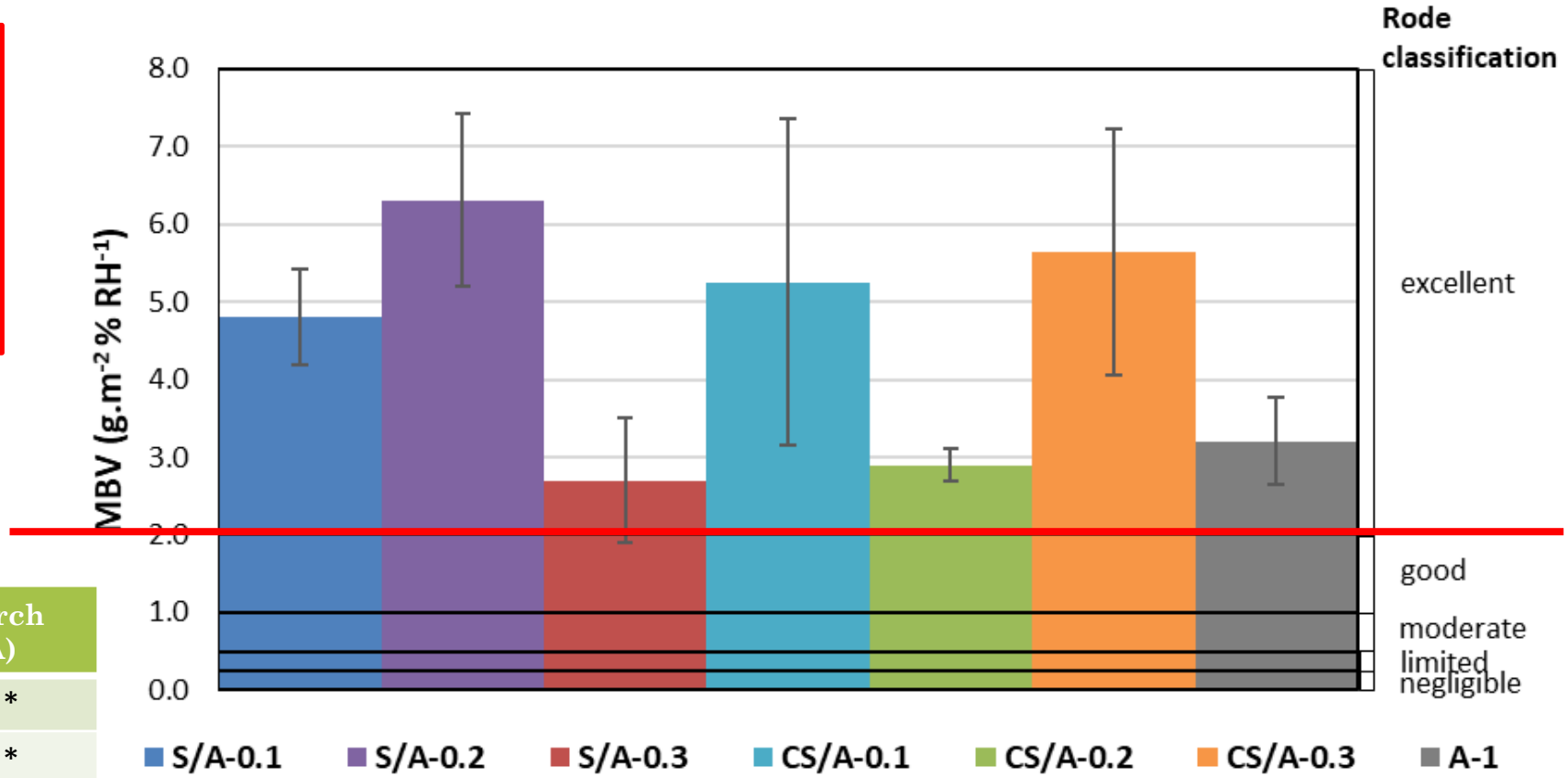
- Evolution of α_w as a function of composite thickness



Hydric – Moisture Buffer Value (MBV)

Water absorption and desorption capacity (33% - 75% RH)





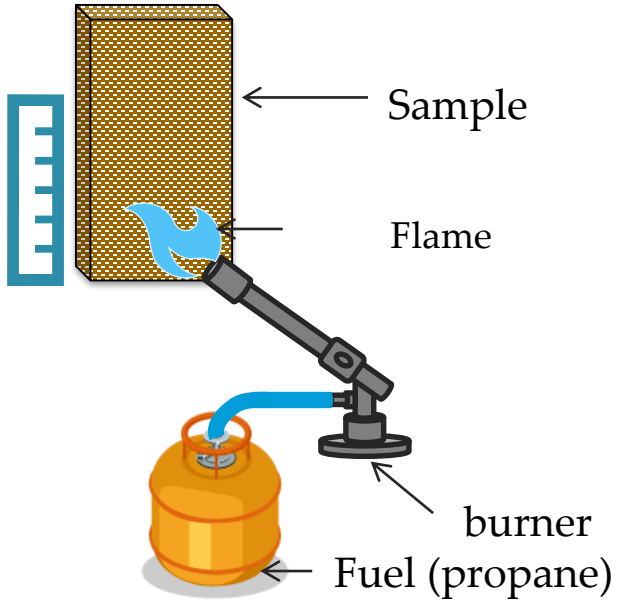
MBV g/(m².%RH)		Stalks (S)	Crushed stalks (CS)	Starch (A)
Starch Ratio	**0.1**	4.81 ± 1.11	5.25 ± 2.10	***
	0.2	6.31 ± 0.62	2.90 ± 0.21	***
	0.3	2.70 ± 0.81	5.64 ± 1.59	***
	1	***	***	3.20 ± 0.56

C. Rode, R. H. Peuhkuri, L. H. Mortensen, K. K. Hansen, B. Times, A. Gustavsen, T. Ojanen, J. Ahonen, K. Svennberg, J. Arfvidsson, L-E. Harderup, BYG Report No. R-127 (2005).

Durability

- Evolution of thermal and acoustic properties after the test :
  - Resistance to fungal growth at high humidity
  - Resistance to water immersion

- Fire test via reaction to fire



Conclusion ✓

Objectif

- Valorization of agro-waste into a useful product or added value
- Alternative insulating material to current products (petroleum or fossil fuels)

Results

- Promising composite materials
- Relatively low thermal conductivity
- Reasonable sound absorbers
- Good moisture regulator
- The best compromise
- $Stalks_{70\%}$ - $Starch_{30\%}$

Next steps in the project

- Life cycle analysis
- Wall

Thanks for you attention

Céline Badouard

PhD Student - MATIM-ICMR

celine.badouard@univ-reims.fr

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