Pretreatment of biomass by steam explosion for the development of biodegradable and biobased menstrual pads

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Introduction

In the context of ecological transition and the fight against period poverty, which affects more than 500 million women, the **ANR Napkins** project aims to develop **biodegradable** and **bio-sourced** menstrual pads that can be reproduced worldwide using **local biomass**. The objective is to use simple and **affordable processes** and a single biomass for the entire menstrual pad.
LERMaB aims to work on biomass **pretreatment** using **steam explosion**, a robust and scalable process requiring only **a simple equipment**. This technique allows the different components of the biomass to be fragmented and confers different **physical and mechanical properties** depending on the pretreatments and the severity of the steam explosion. This makes it possible to meet the needs of the **different layers** that make up the menstrual pad.

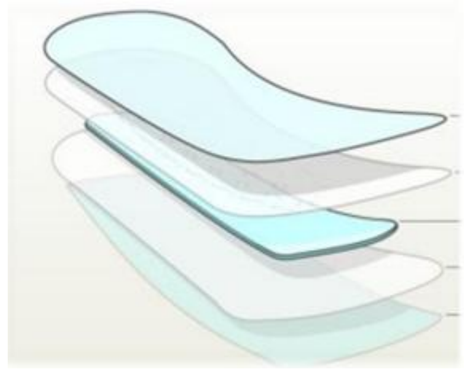


Figure 1: Multi layer structure of a sanitary napkin

Material and methods

The principle is based on a **sudden depressurization** of a reactor containing the **biomass to be fragmented** at a set temperature between 170°C and 220°C. Water vapor in the reactor causes the **swelling of the fibers** for a determined residence time and initiates the **hydrolysis and depolymerization of hemicelluloses** as well as the solubilization of extractives.

Pilot	General Parameters	Pretreatement	Concentration	Number of explosion
Semi-industrial pilot	Flax shives Impregnation 400% during 20min Explosion at 190°C after 20min	Acid - H2SO4	0,5%	1
				2
				3
		Neutral - Water	100%	1
				2
				3
		Alkali - NaOH	5%	1
				3

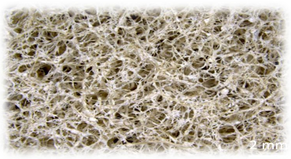
Figure 2: Parameters for the Steam explosion

Steam explosion to fibrillate biomass

Highly fibrillated pulp with a various content of lignin depending on the application

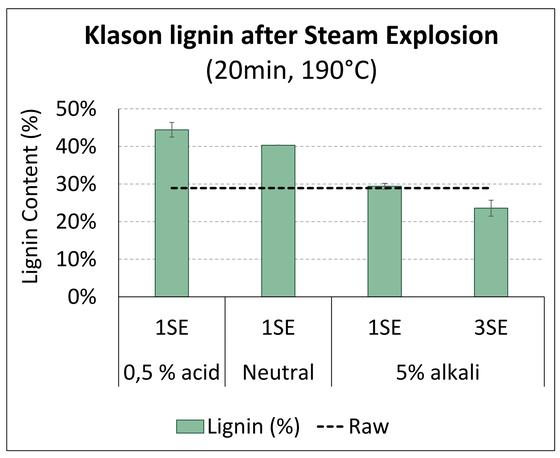
Closed paper
(short fibers and fines)

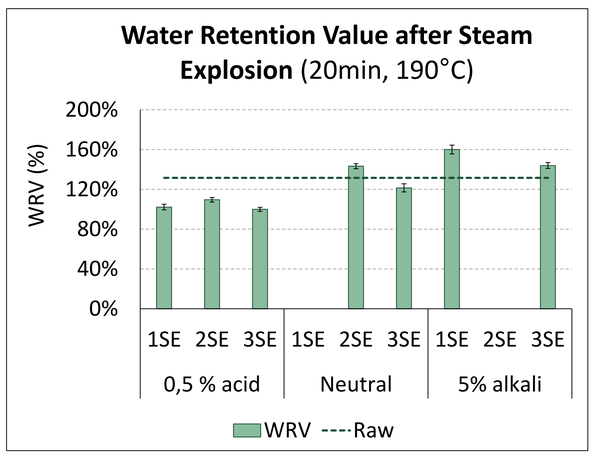
Porous paper
(less fines)

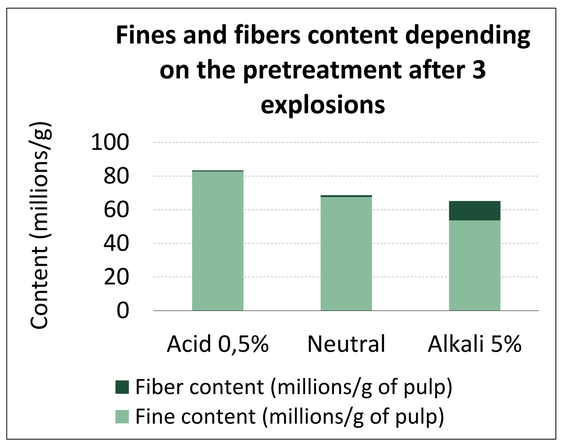


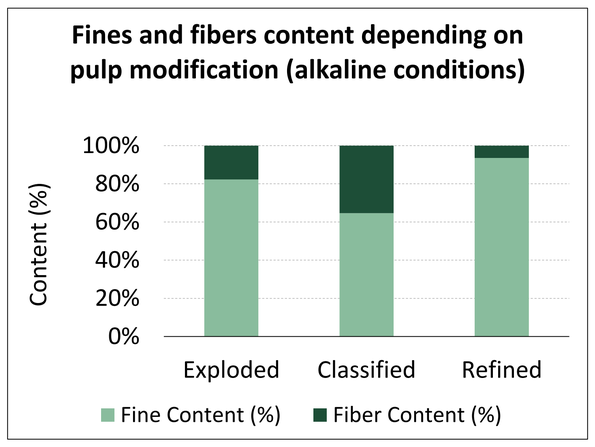
Foam

Results









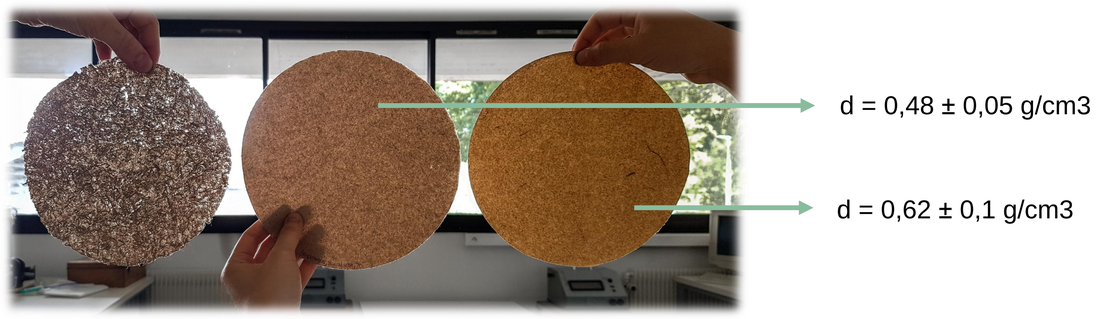


Figure 3: Sheet-former with the only **exploded** biomass (left), after **classification** with a Somerville 150µm (middle), after **refining** with the Pile Valley until 87°SR (right). Alkali conditions 5% NaOH and 3 explosions (20min, 190°C)

	Permeability (m^2)	Cobb water (g/m^2)	Cobb oil (g/m^2)
Classified fibers	$1,89 \pm 0,2.10^{-14}$	134,15 ± 1,06	55,17 ± 5,01
Refined fibers	$6,99 \pm 2,1.10^{-16}$	59,70 ± 0,71	8,635 ± 1,85

Discussion

- **Lignin** is more degraded in **alkaline** conditions.
- **Polysaccharides** are better hydrolyzed in **acidic** conditions.
- **Alkaline** conditions allow to obtain **longer and more numerous fibers**. The acidic conditions does not allow to make **sheet-former** probably due to lignin content.
- The **classification** allows to keep small particles and short fibers allowing to get a **dense fibrous mattress**.
- **Harsh refining** allows to **fibrillate the individual fibers** allowing a better **entanglement** of them with a large number of fines that make a **closed paper** more suitable for the **waterproof veil**.

Conclusion

The optimization of **pretreatment** conditions for flax shives allows to **modify the morphology and quality** of the fibrous mattress, in order to obtain **veils** with properties adapted to the different layers of the napkin. Diversification of **biomass** will be considered.

References

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Acknowledgement

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