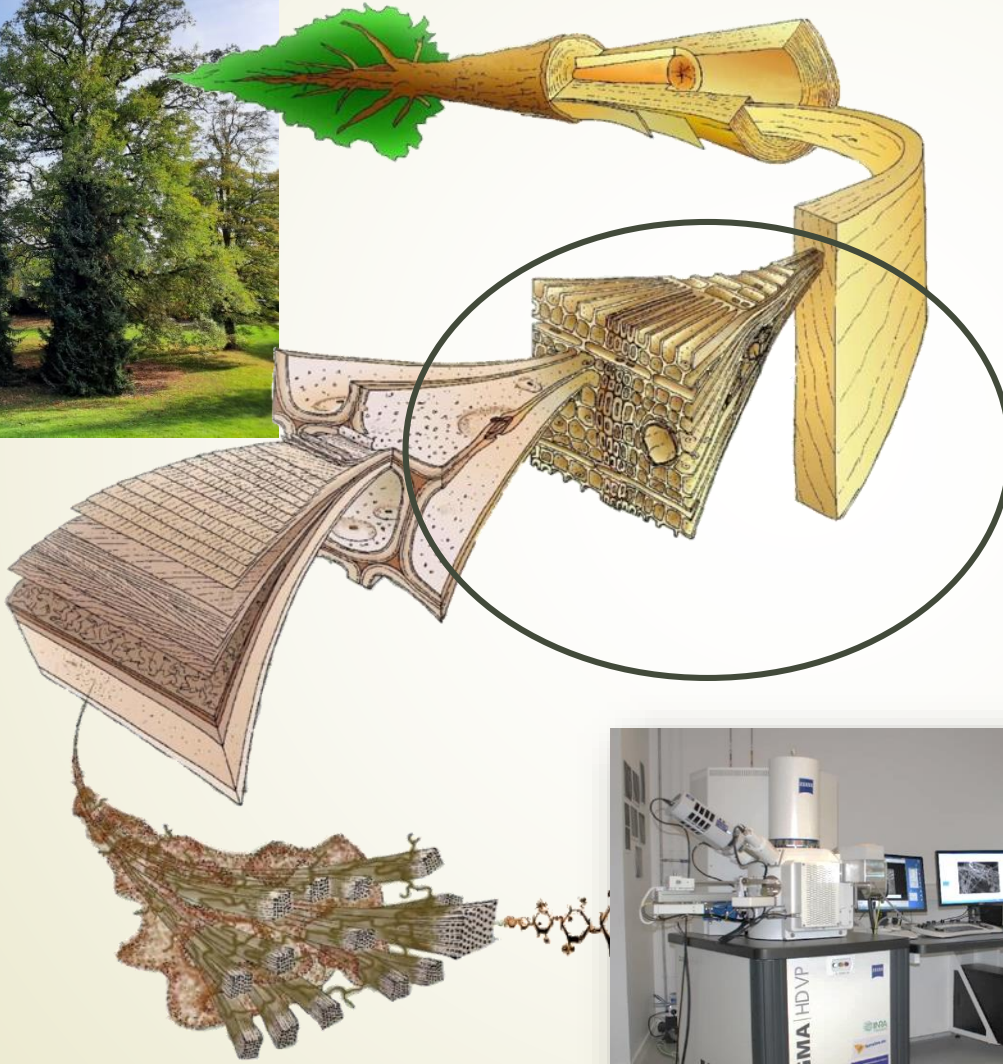


Caractérisation des effets d'un procédé expérimental d'explosion à la vapeur appliqué à des panneaux de particules

Approches par microscopie électronique à balayage ,
microscopie corrélative et
microanalyse en dispersion de longueur d'onde .

Christophe ROSE INRAE NANCY UMR SILVA- SILVATECH
Sarah Troilo–ENSTIB LERMAB, *Université de Lorraine; CF2P*
Arnaud Besserer ENSTIB LERMAB, *Université de Lorraine*

christophe.rose@inrae.fr



SILVATECH (ISC Labellisée INRAE)
<https://silvatech.isc.inrae.fr/>

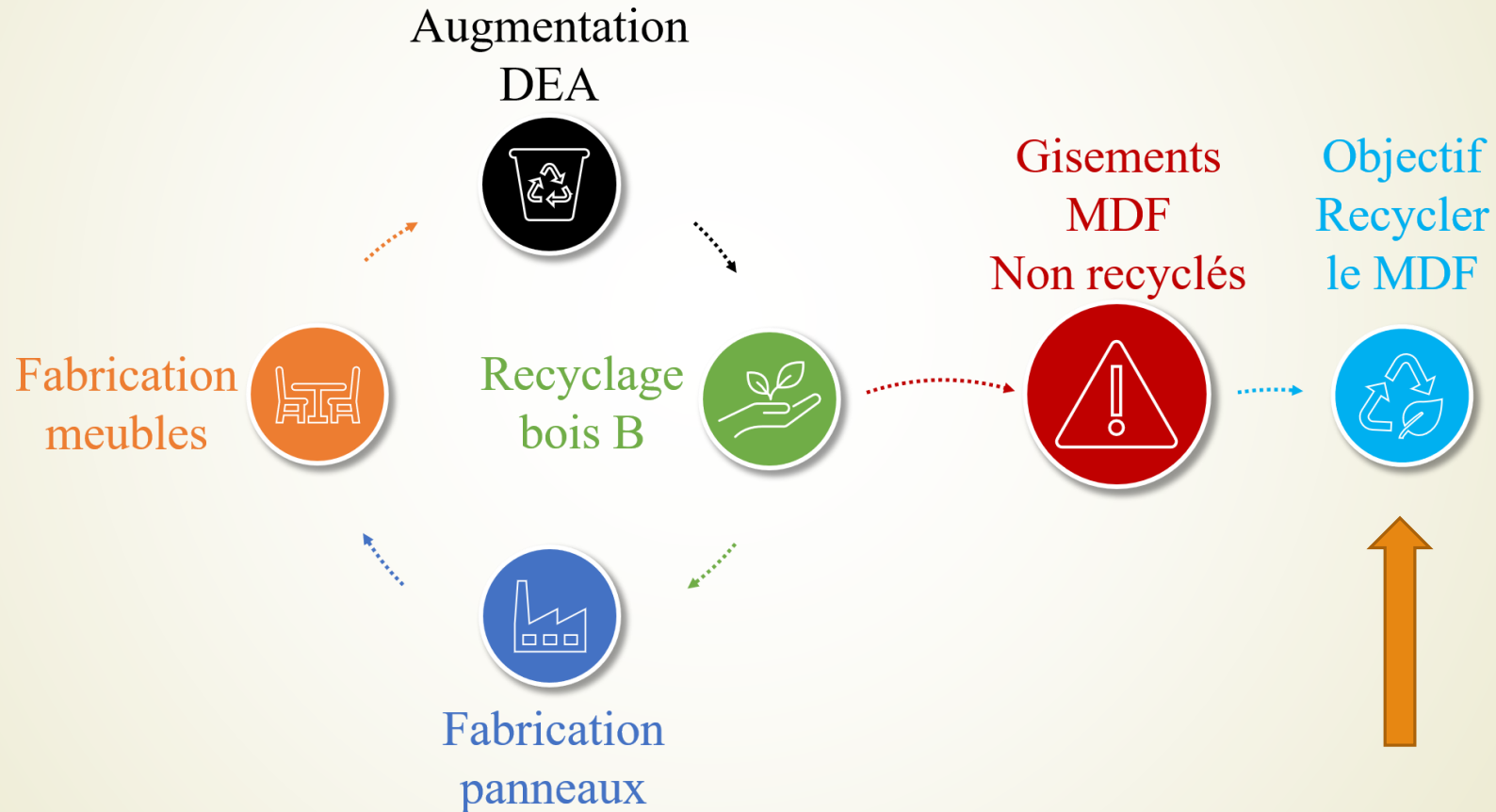
Pôle Isotopie chimie

Pôle I3M (Imagerie et Mesures Multi-Modales)



CONTEXTE

Thèse de Sarah: Cifre ENSTIB/CF2P (500 000 m³ MDF/an)



MDF :Medium Density Fiberboard

DEA: Déchets Equipements Ameublement

Enjeu scientifique

Développer un procédé de recyclage du MDF

Enjeux pour la CF2P

Augmenter le taux d'acceptation du MDF dans le bois B
Réduire le coût du bois B

Enjeu pour la filière bois


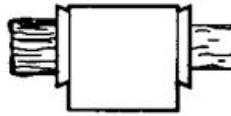
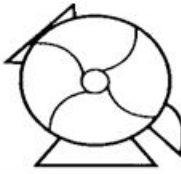

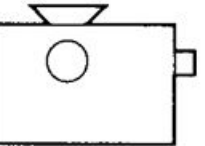
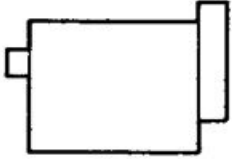
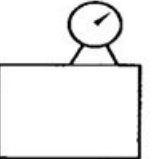
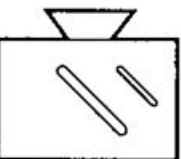
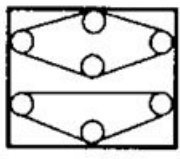



Supprimer les gisements de déchets MDF

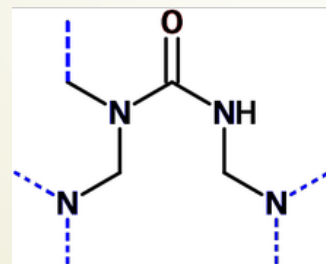
LES PANNEAUX « MDF »

DEFINITION

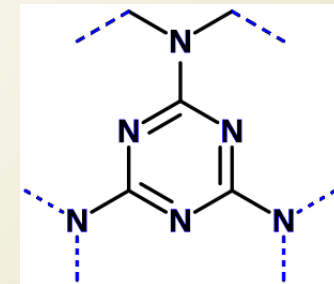
Les panneaux de fibres de moyenne densité, MDF de l'anglais Medium Density Fiberboard, sont fabriqués à partir de fibres dures additionnées à un adhésif synthétique.

PRINCIPE DE FABRICATION

Matière première→	Ecorçage→	Coupeuse déchiqueteuse→	Copeaux de bois→	Tamis→
				
→Défibreur→	Addition de résine→	Conformation du mat→	Pré-pressage→	Pressage→
				Statique  Continu  Mende 



Uree-formaldéhyde
Melamine-formaldéhyde



CONTEXTE process industriel/pilote

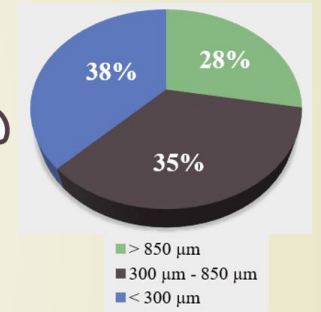
Pilote d'explosion à la vapeur
échelle laboratoire 100g/explosion



Vapeur surchauffée
220°C-2.5 bars 15mn



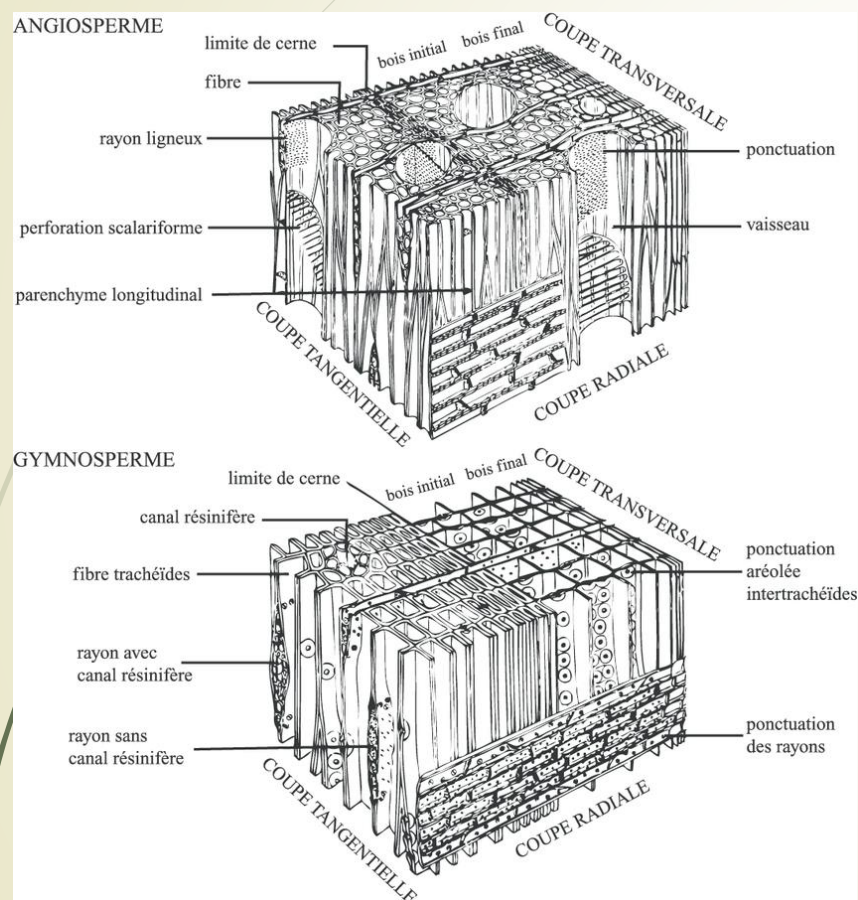
Explosion vapeur



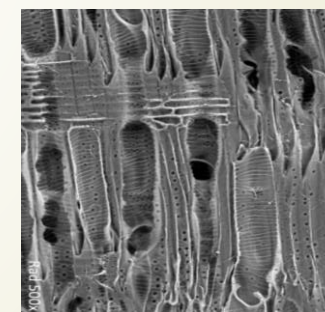
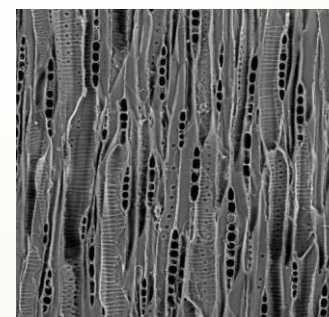
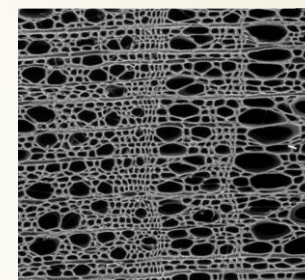
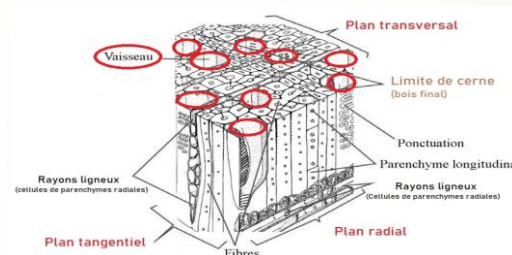
Décompression 2.5bars->1bar en 1seconde

- Fragmentation du MDF.
- Suppression des émissions de formaldéhyde.
- Elimination de la résine jusqu'à 86%.
- Fibres de bonne qualité.

IMAGERIE



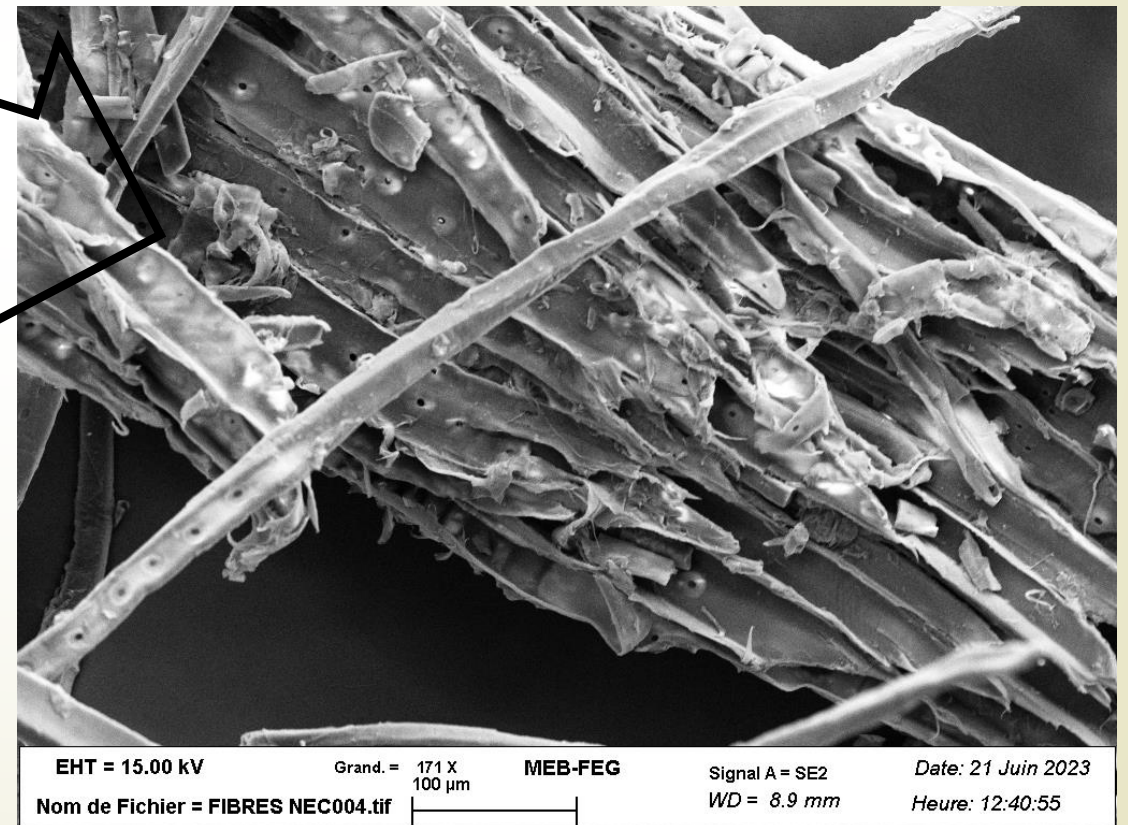
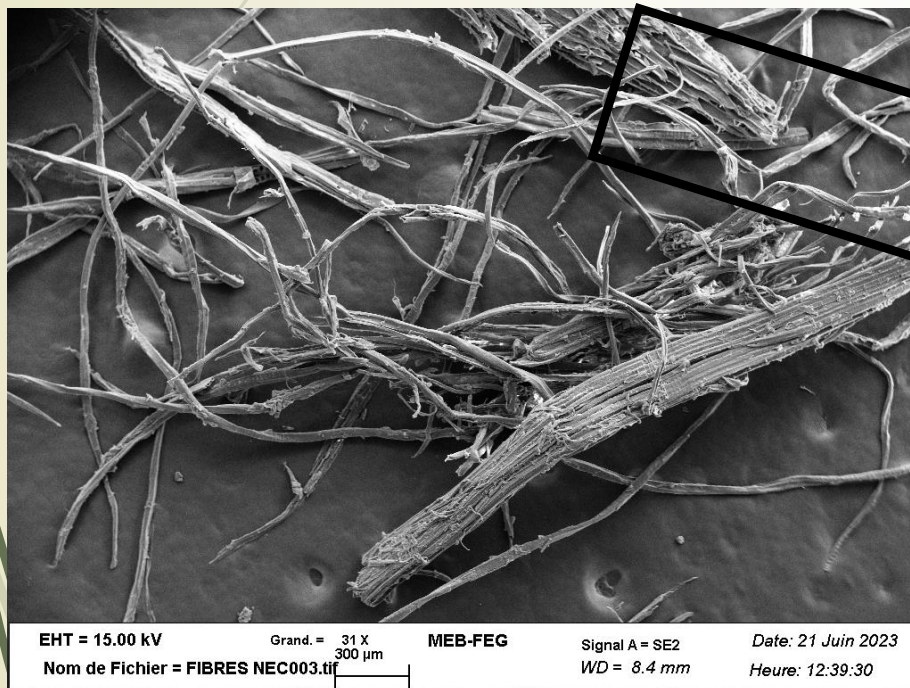
Fusain du japon
(*Euonymus japonicus*)



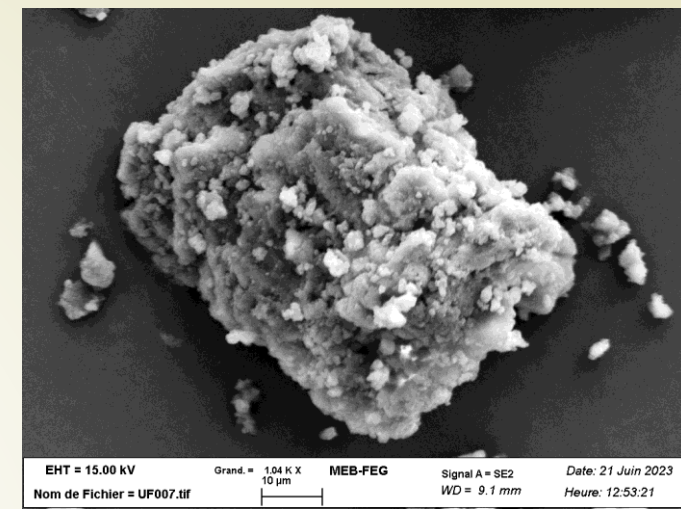
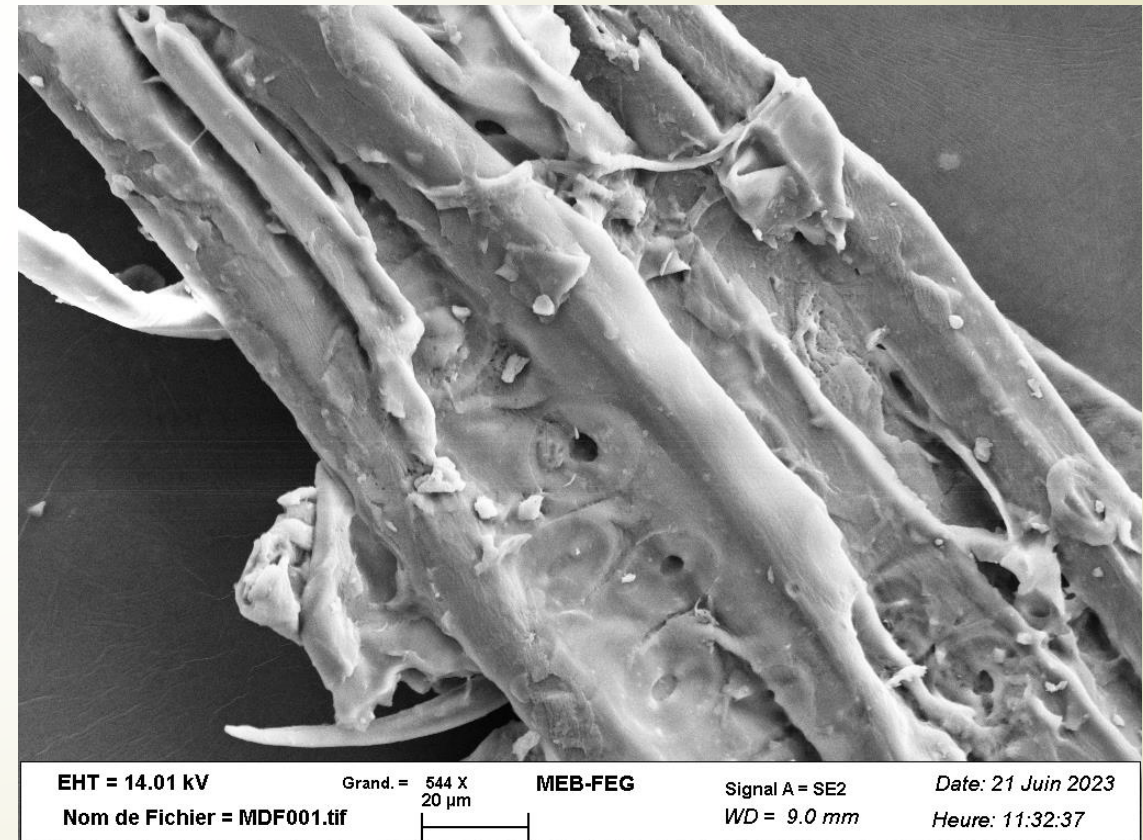
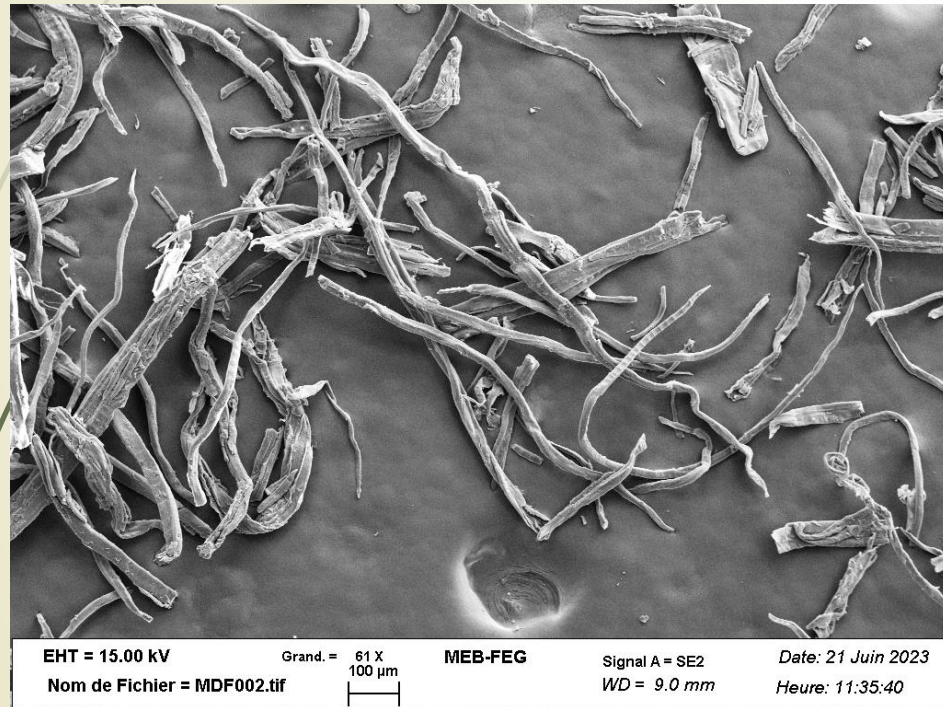
Detecteur BSD
Mosaïque
d'images 1cm²

Les plans ligneux

OBSERVATIONS MEB DES DIFFERENTS ETATS FIBREUX: FIBRES BRUTES NON ENCOLLEES

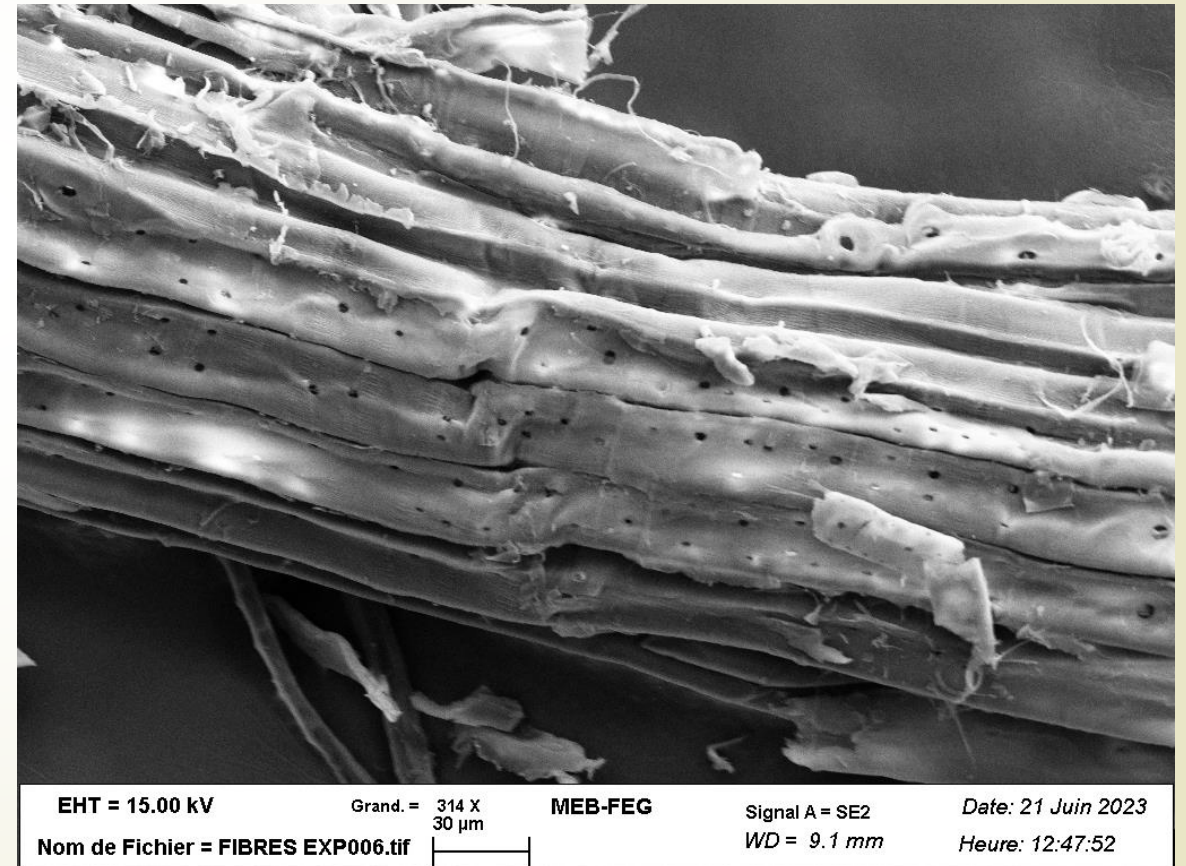
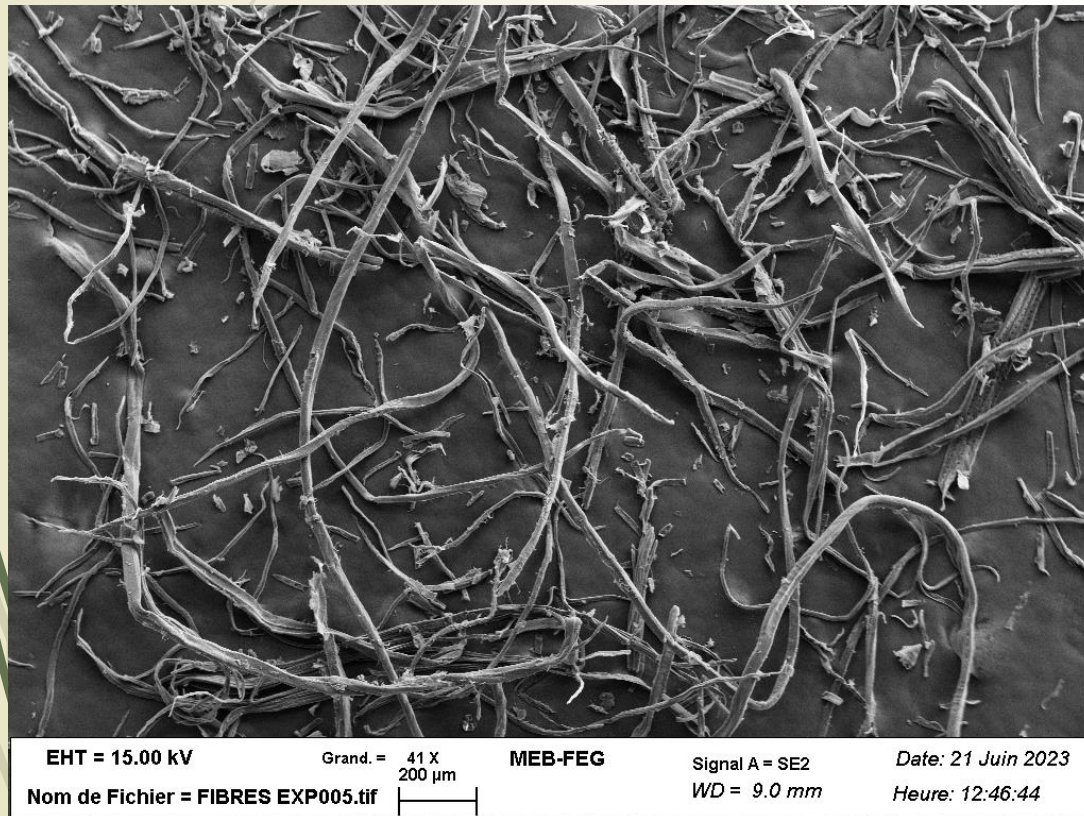


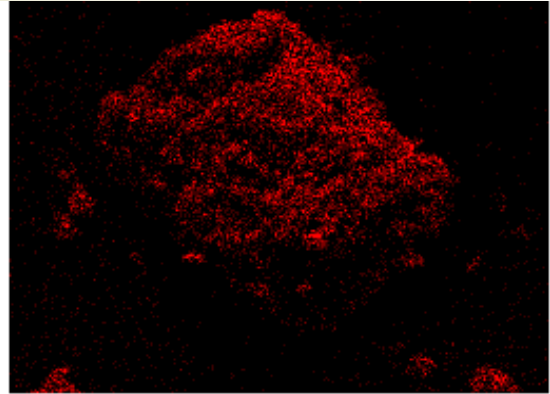
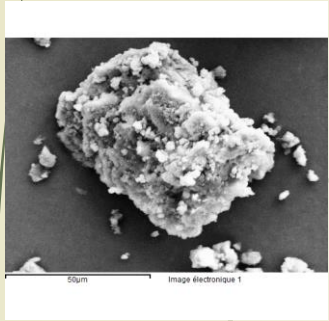
OBSERVATIONS MEB DES DIFFERENTS ETATS FIBREUX: FIBRES MDF



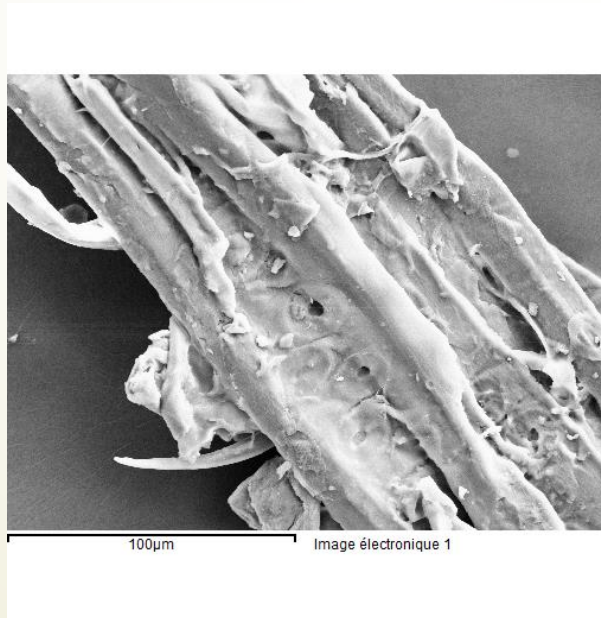
IMAGERIE

OBSERVATIONS MEB DES DIFFERENTS ETATS FIBREUX: FIBRES APRES EXPLOSION A LA VAPEUR

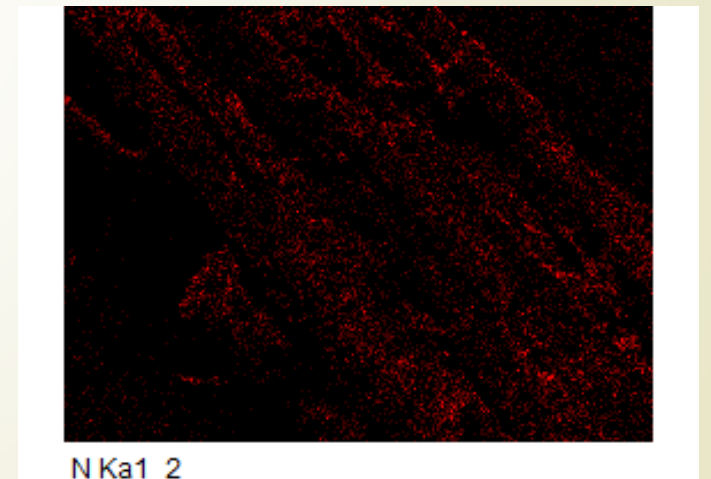


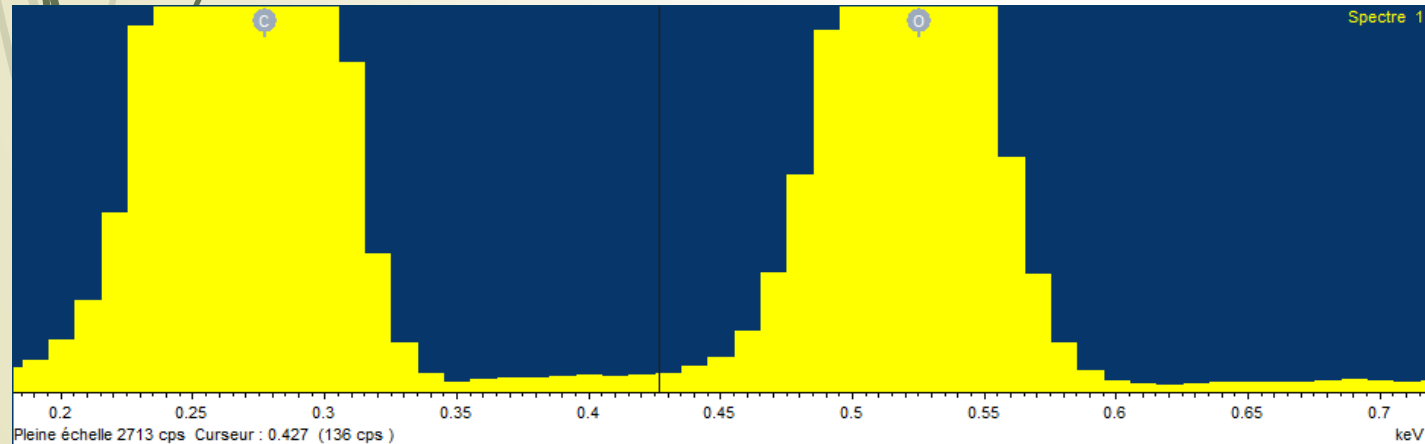
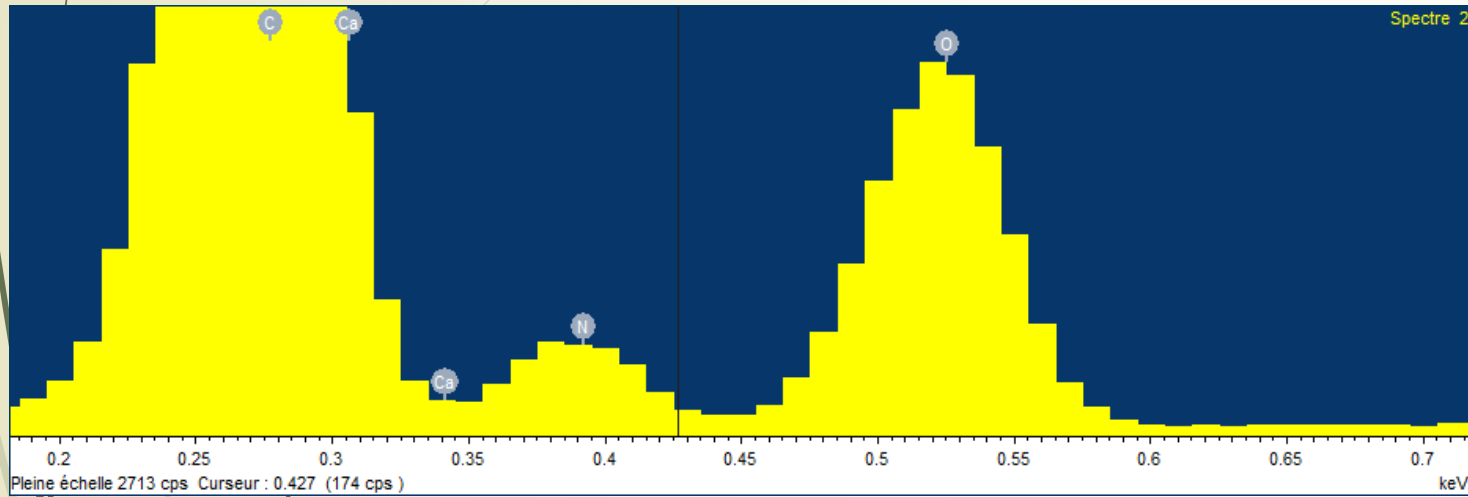
CARACTERISATION DE LA RESINE : μ -ANALYSE EDS DE L'AZOTE

UREE FORMALDEHYDE

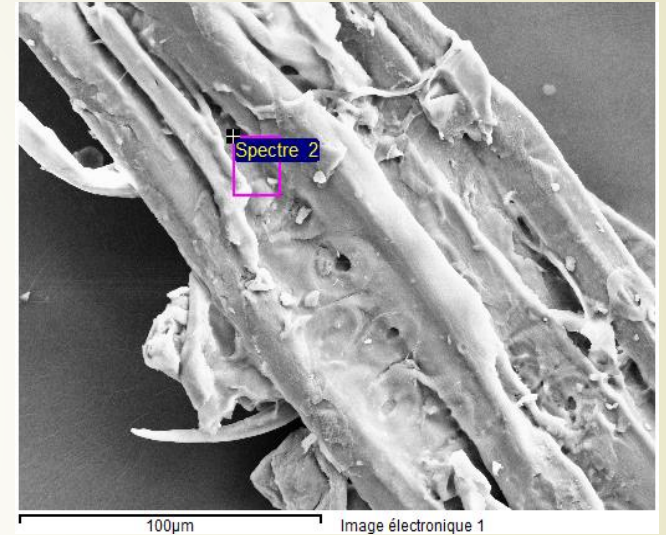


MDF

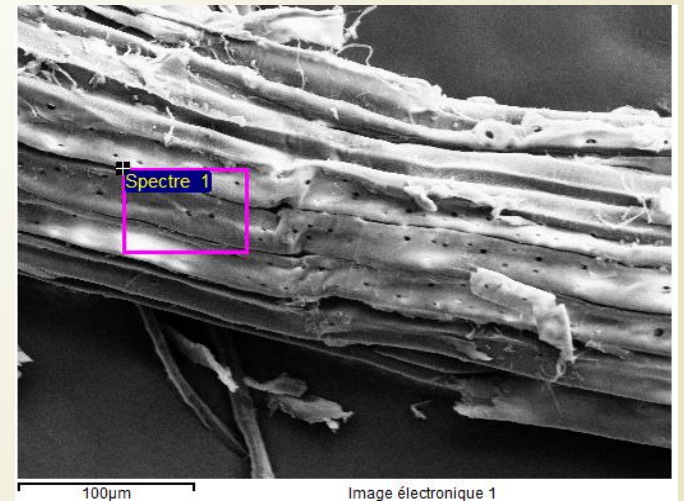


CARACTERISATION DE LA RESINE : μ -ANALYSE EDS DE L'AZOTE

MDF

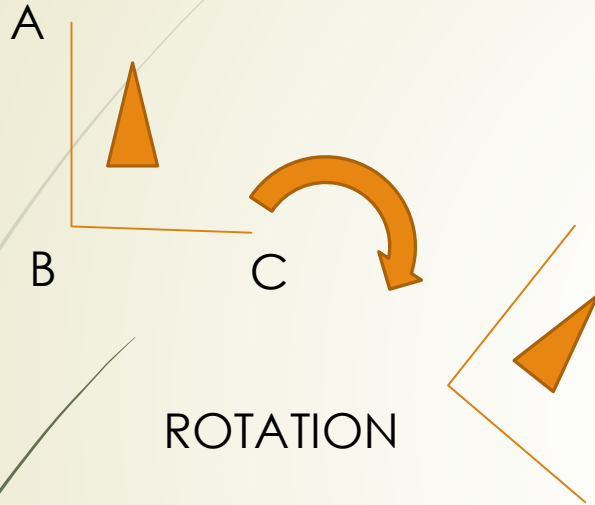


FIBRES EXPLOSION VAPEUR



UTILISATION DE LA MICROSCOPIE CORRELATIVE CONFOCAL- MEB

APPAREIL 1:



TRANSLATION

APPAREIL 2:

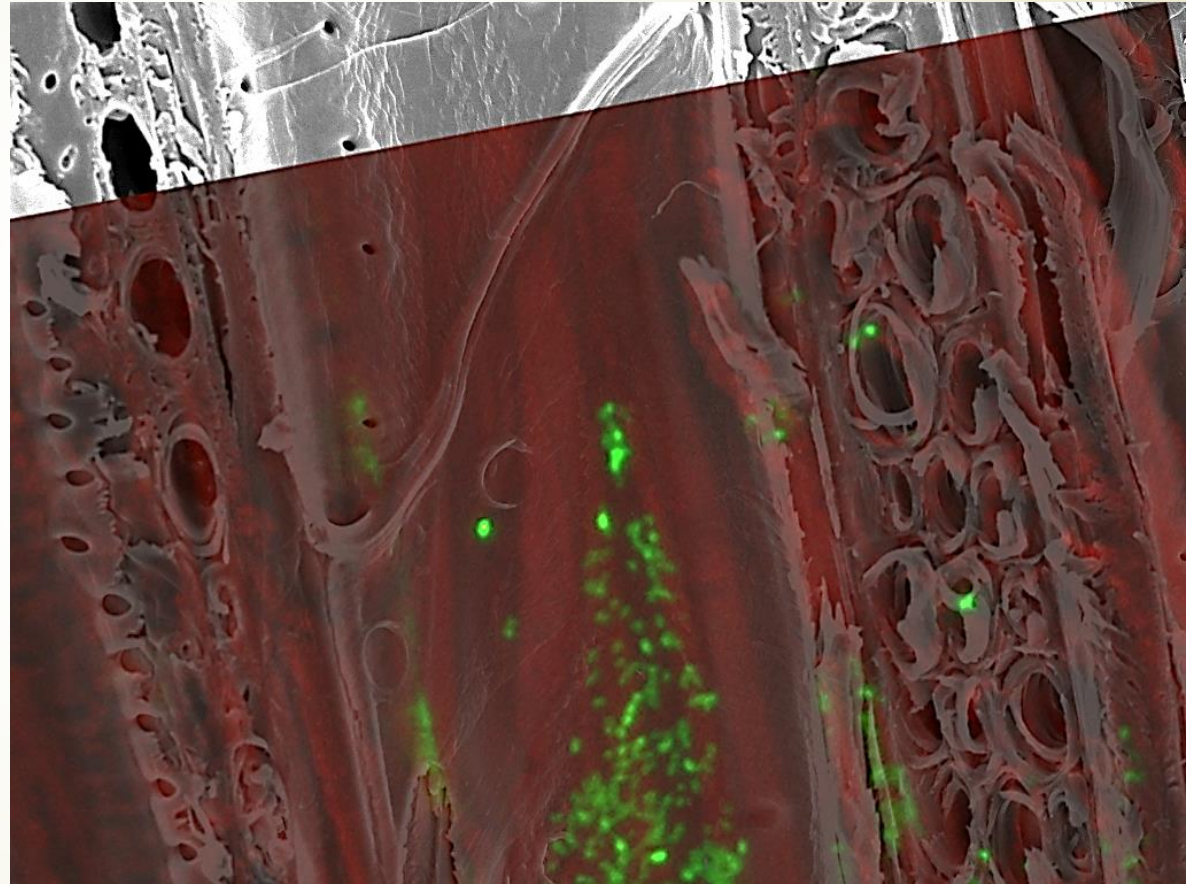
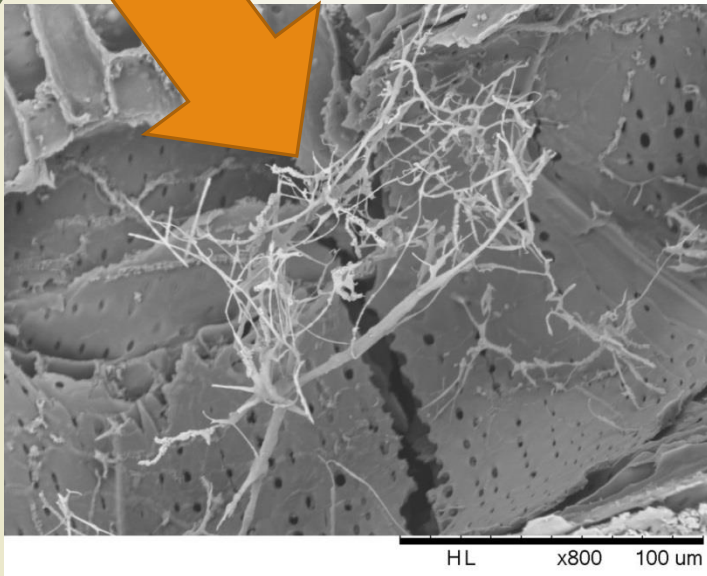
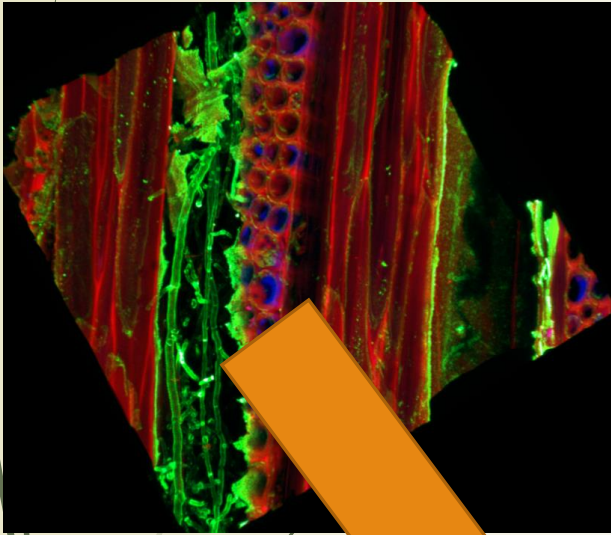
RELOCALISATION



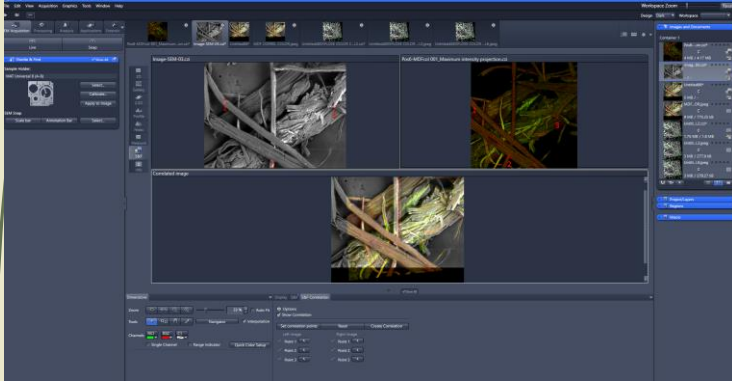
UTILISATION DE LA MICROSCOPIE CORRELATIVE

ec-CLEM (ICY)
Shuttle and find
Atlas5,

...

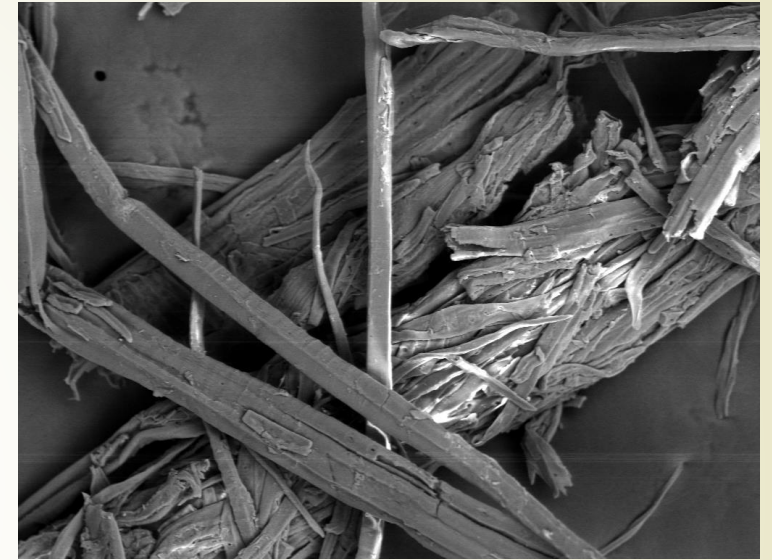
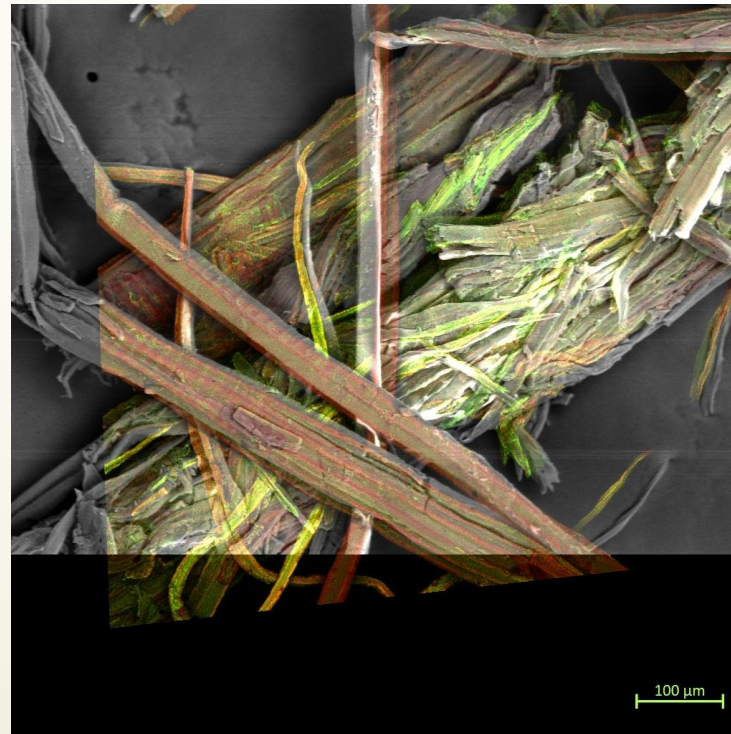


REPOSITIONNEMENT CORRELATIF



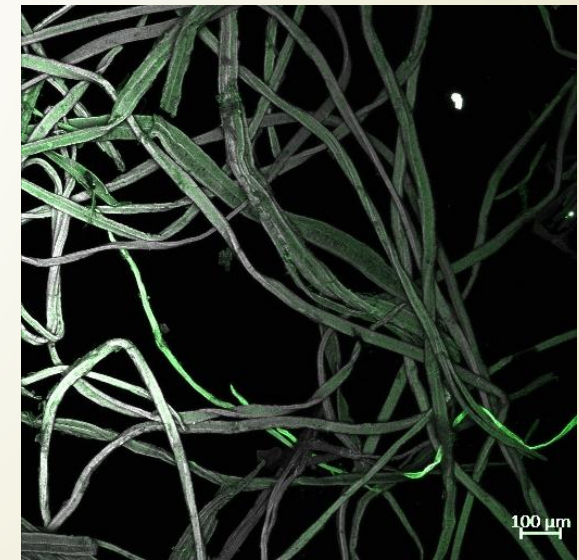
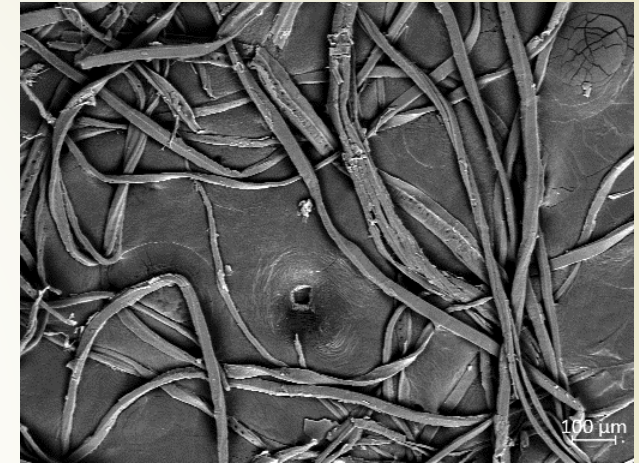
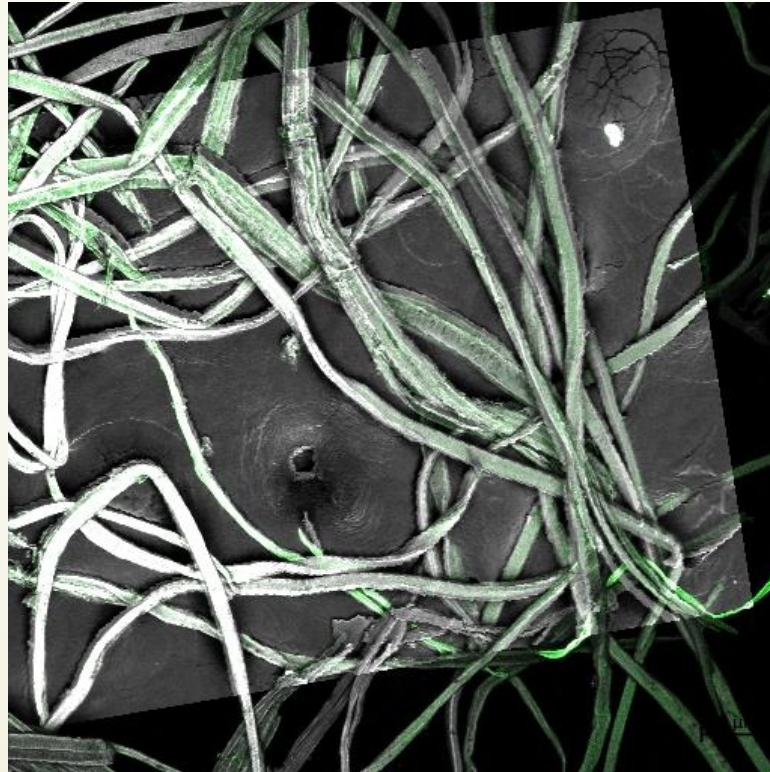
MDF
Coloration safranine

Excitation
488 nm
Couleurs virtuelles:
Rouge: autofluo bois
Vert: colle+autofluo



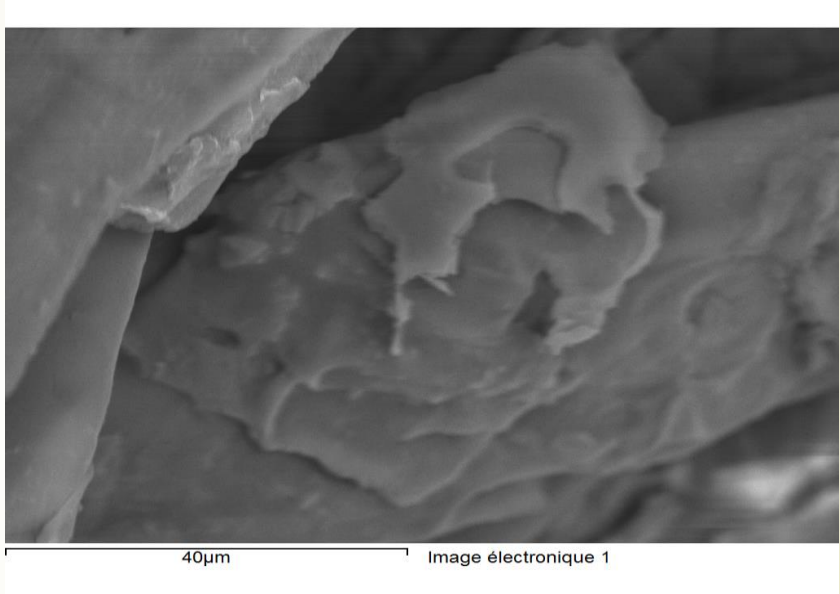
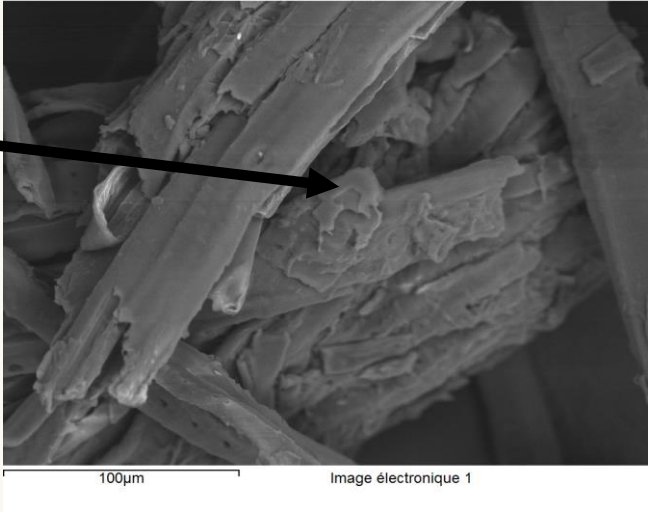
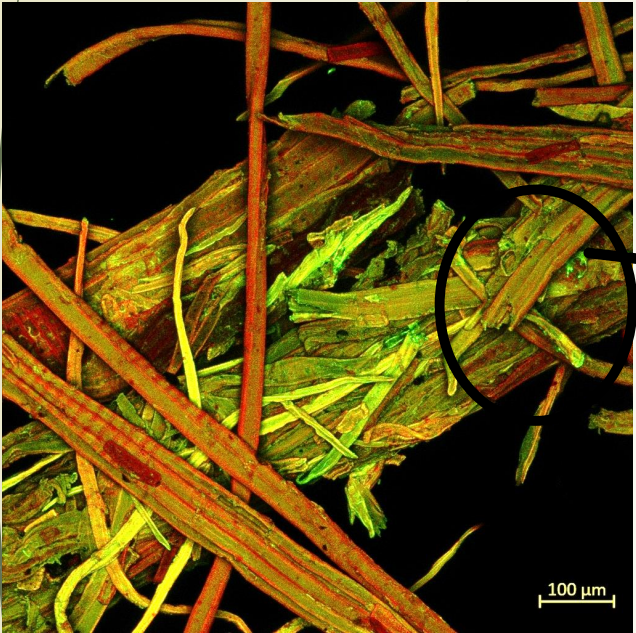
APPROCHES CORRELATIVES AVEC LES FIBRES (utilisation de shuttle and find dans ZEN)**Fibres Explosion à la vapeur
Coloration safranine**

Excitation laser
488 nm
Couleurs virtuelles:
Rouge: autofluo bois
Vert: colle+autofluo

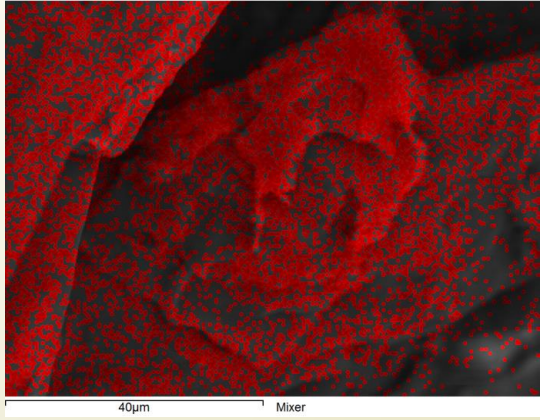
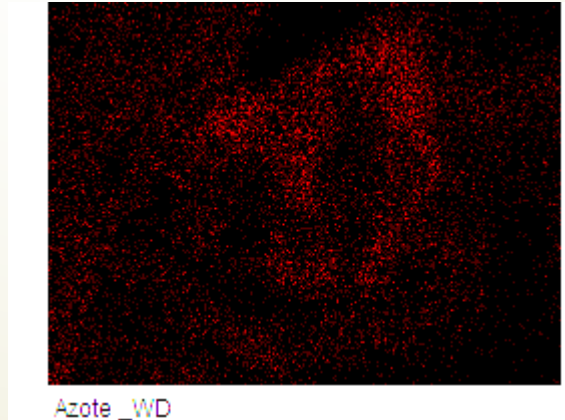
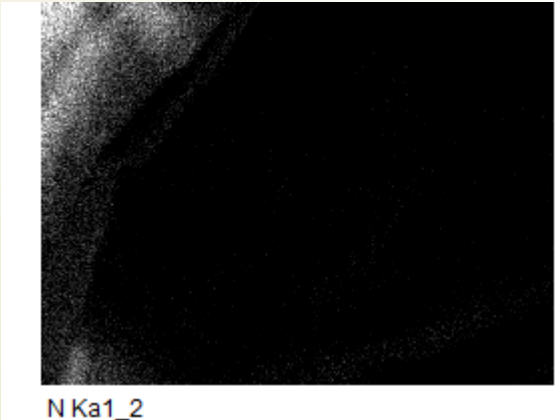


Micro-analyses X de l'azote à partir des corrélations d'images

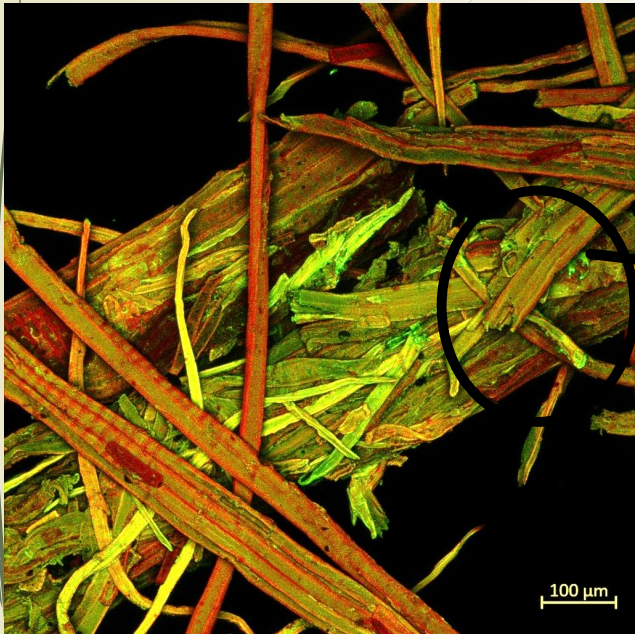
MDF



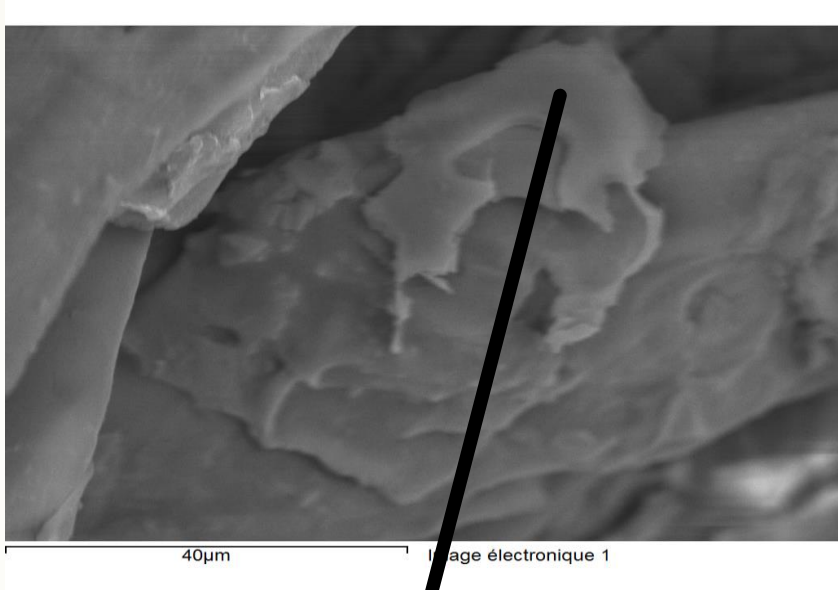
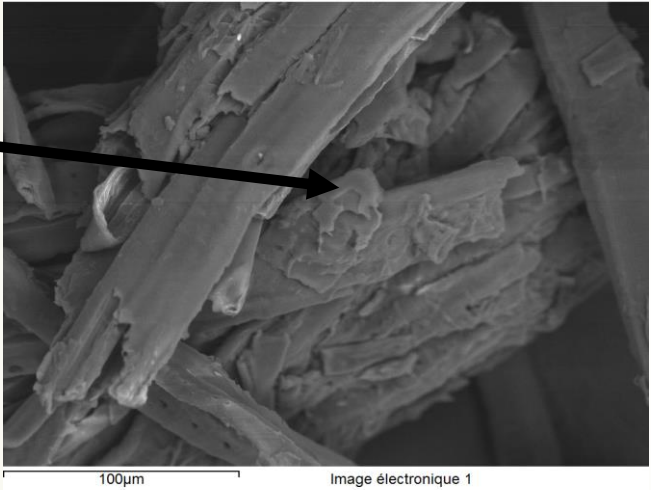
CARTOGRAPHIES



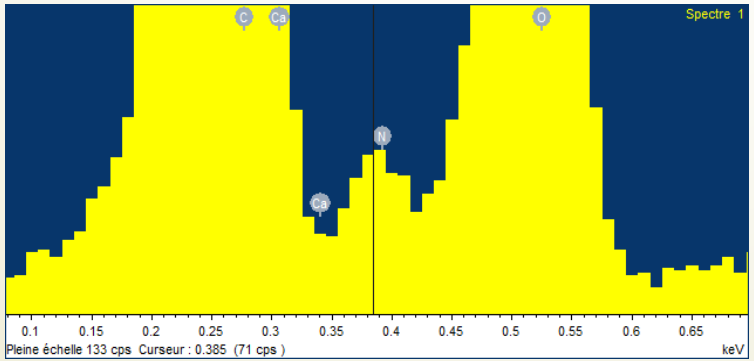
Micro-analyses X de l'azote à partir des corrélations d'images



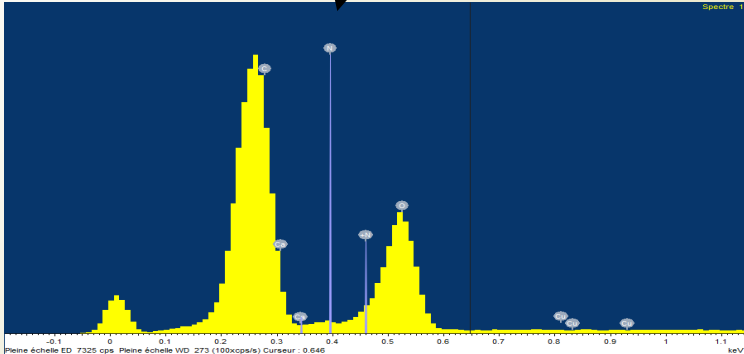
MDF



EDS



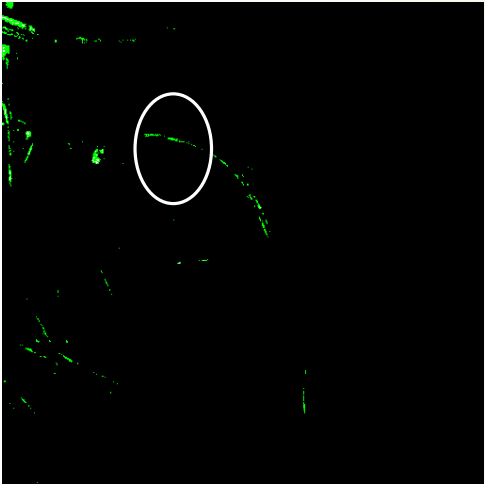
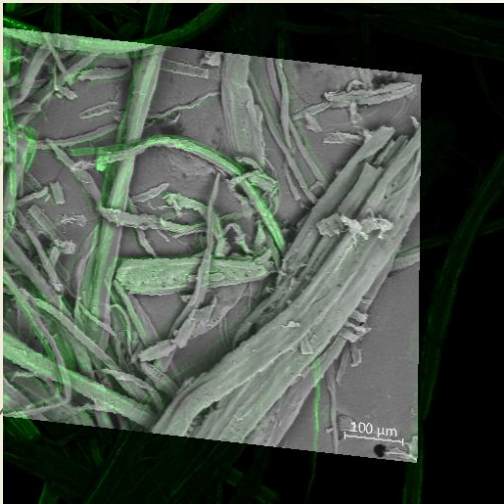
WDS



μanalyses spectrales

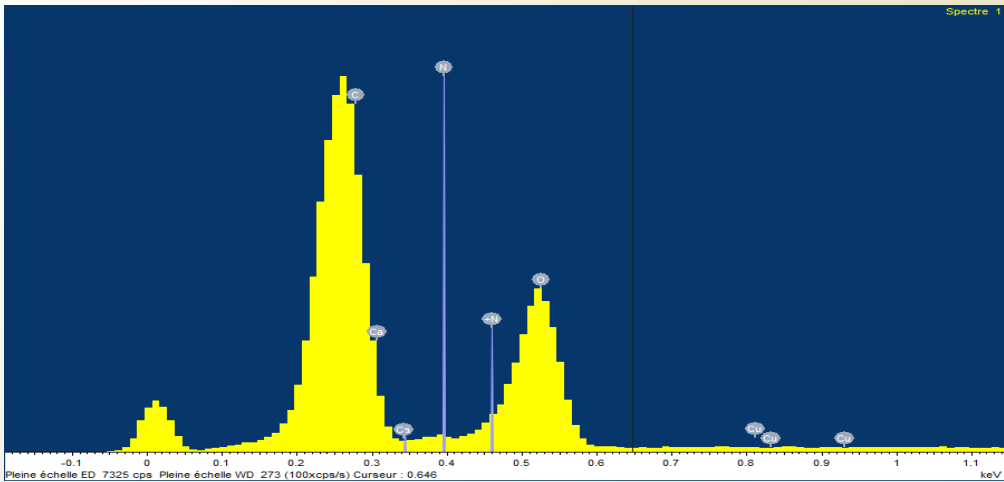
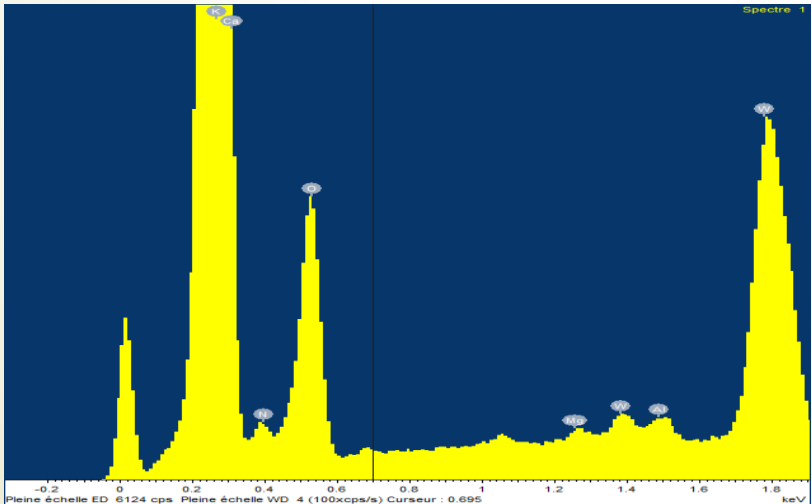
Micro-analyses X de l'azote à partir des corrélations d'images

FIBRES EXPLOSION VAPEUR (sans coloration)



EDS

WDS



μanalyses spectrales

CONCLUSION- PERSPECTIVES

Validation du process d'extraction des résines du MDF par explosion à la vapeur

¹ Urea-Formaldehyde Resin Removal in Medium-Density Fiberboards

² by Steam Explosion: Developing Nondestructive Analytical Tools

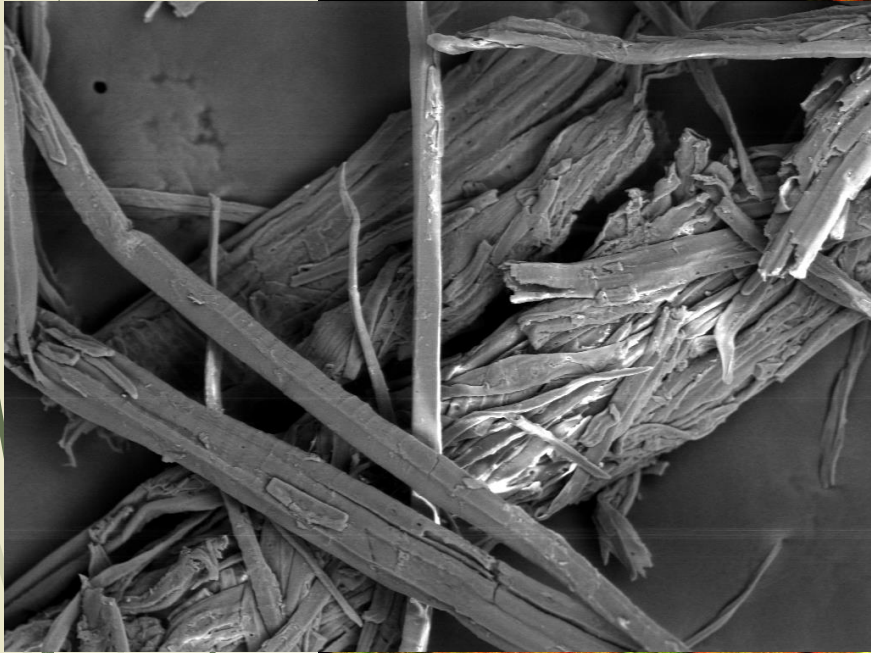
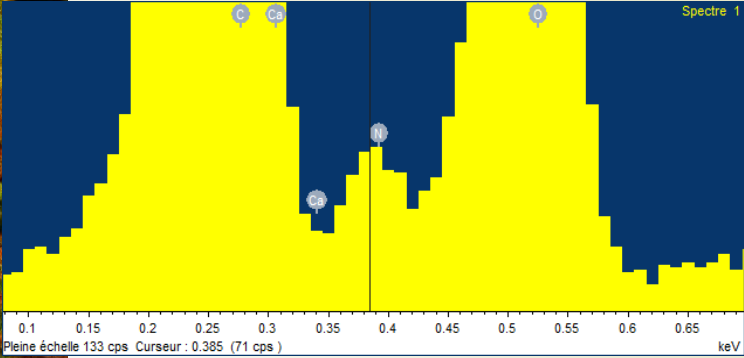
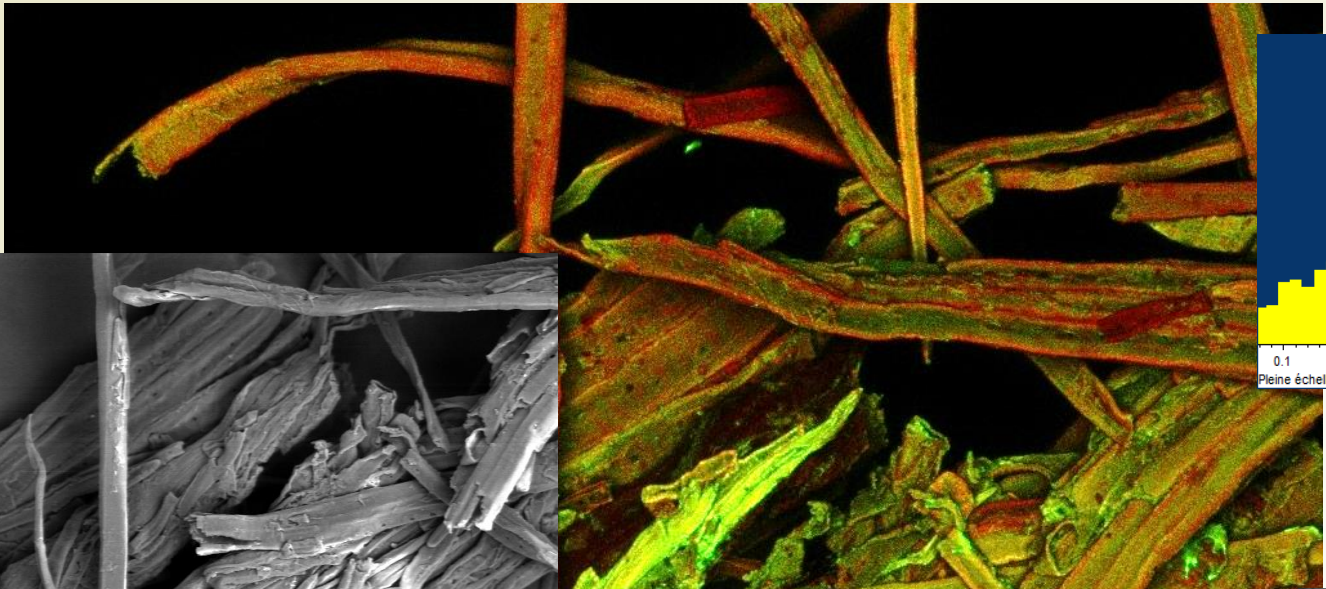
³ Sarah Troilo, Arnaud Besserer, Christophe Rose, Safwan Saker, Lucas Soufflet, and Nicolas Brosse*

Cite This: <https://doi.org/10.1021/acssuschemeng.2c05686> Read Online

ACS Sustainable Chem. Eng. XXXX American Chemical Society

Mise en œuvre nécessaire d'approches corrélatives confocal-meb et de μ analyses X EDS et WDS pour co-localiser les zones d'accumulation et de persistance des résines avant et après extraction .

**Développer les études multispectrales et semi-quantitatives (calibration des mesures d'azote /analyses élémentaires)
Evaluer le contenu en résine dans les fibres**



MERCI POUR VOTRE ATTENTION



100 µm