Multiscale nanoparticles from sisal and compatibilization techniques to reinforce polycaprolactone

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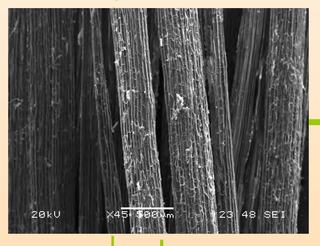
Objective



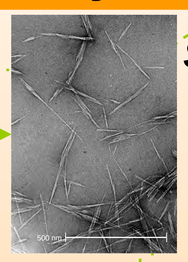
Sisal fibers

1- Production

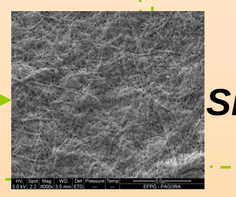
Key Steps:

Material Selection
Process Optimization
Scaling up

SUGARS



Sisal Whiskers



Sisal MFC

2 – Compatibilization

Key Steps:

Dispersion
Formulation
Grafting

PCL Reinforced Films

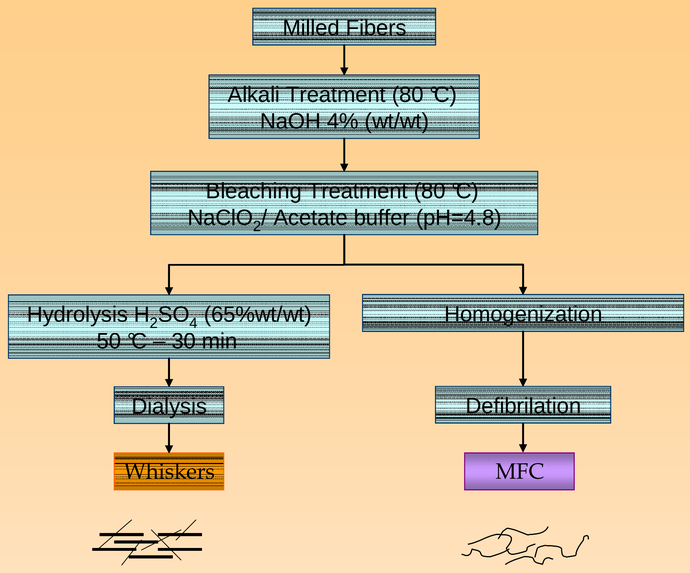
Current work

Introduction

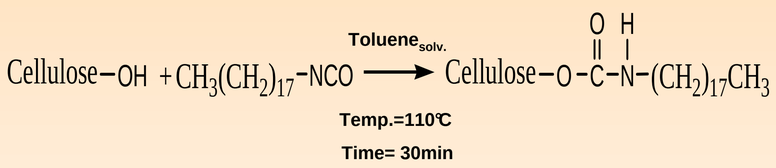
In the present work, nanowhiskers and microfibrillated cellulose (MFC) from sisal (Agave sisalana) were used to reinforce polycaprolactone (PCL) composites. We report the influence of the nanoelements' size in the mechanical and thermal properties of the composites. Chemical modifications were performed on the surface of the nanowhiskers and MFC in order to improve the compatibilization. n-Octadecyl isocyanate was used as grafting agent.

Material & Methods

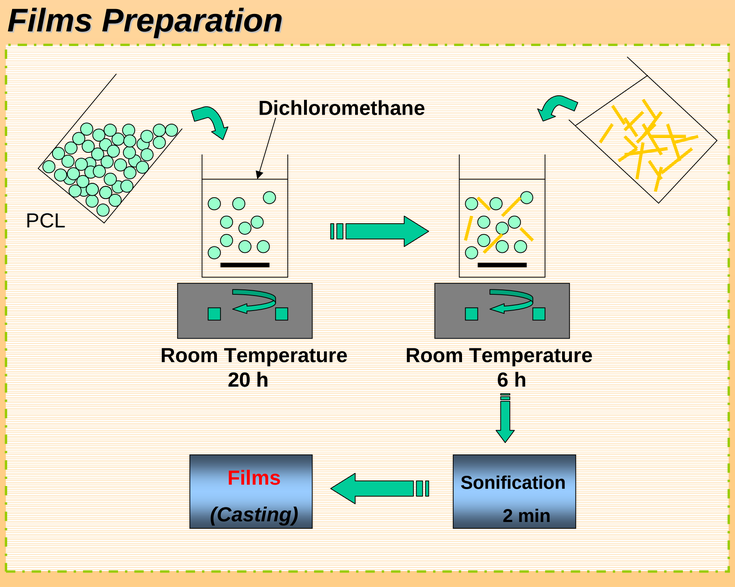
Nanoparticules Obtention



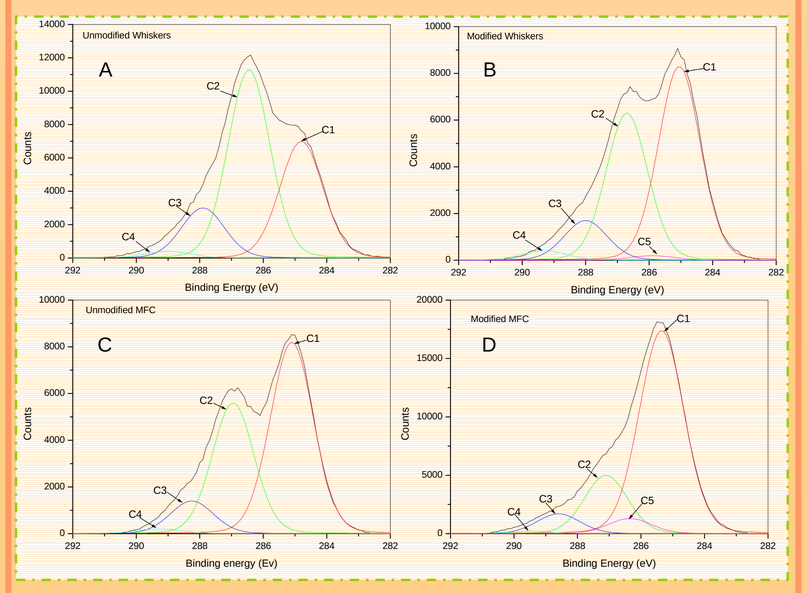
Grafting Scheme



Films Preparation



XPS Analyses



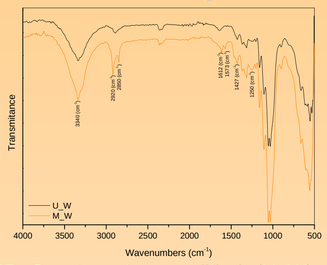
C1: C-C/C-H; C2: O-C-O/C=O; C3: C-O; C4: O-C=O and C5: C-N

More C1 and C5 in modified fillers prove **grafting**. MFC have more efficient chemical grafting process.

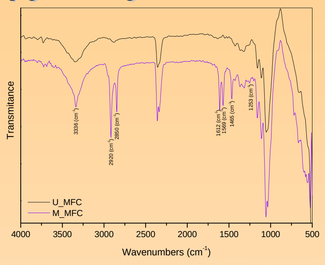
Results & Discussion

Chemical modification

Infrared Spectrsocopy Analyses



IR Spectra of unmodified (U_W) and modified (M_W) sisal whiskers after whashing.

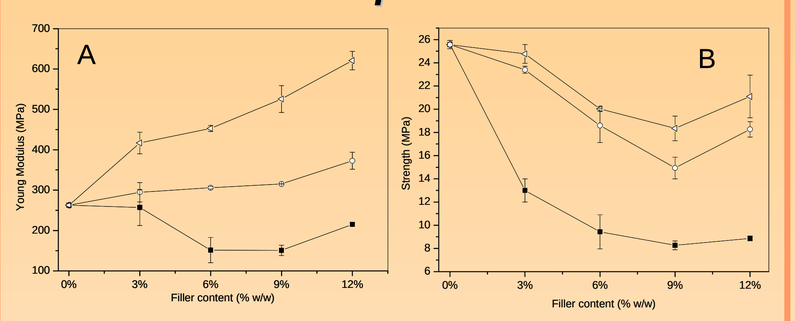


IR Spectra of unmodified (U_MFC) and modified (M_MFC) sisal MFC after washing.

➢Differences in the IR spectra indicate chemical modification.

Agave Sisalana (Sisal Plant)

Mechanical Properties



Evolution of the Young's modulus (A), strength (B) and strain at break (C) for PCL-based nanocomposites vs. filler (whisker or MFC) content: unmodified (■) and chemically modified whiskers (○), and MFC (Δ).

➢Influence of fillers' morphology & chemical grafting on the mechanical properties of nanocomposites.

Conclusion & Perspectives

Nanoparticles grafting have been proved by XPS and IR analyses. Nanofillers and matrix compatibilization was achieved by chemical surface modification which allow films formation for further analysis.
Results have shown great differences between the two kinds of nanoparticules, Whiskers and MFC.
Microfibrillated celluloses are bigger and allowed important network and increasing crystallinity rate.

Acknowledgements

The authors gratefully acknowledge ALBAN Program for the financial support (PhD fellowship of G. S.), Y. Habibi and FCBA for the support in MFC production.

References

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[3] W. THIELEMANS, M. LABET, A. DUFRESNE, *Biomacromolecules*, ***8***, *2916 (2007).*

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