Maize – based composite films: functional group correlation to mechanical properties

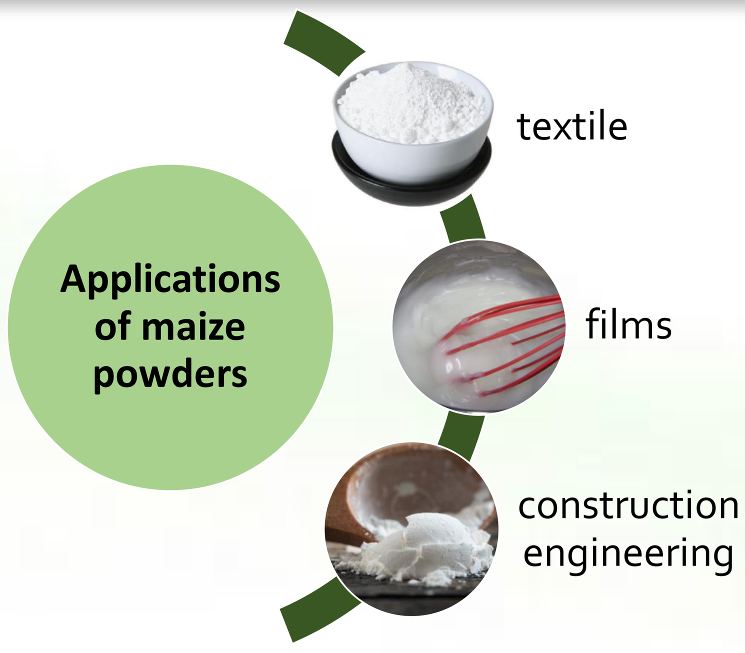
Maria Teresa A. Batocael* and Reynaldo M. Vequizo

* Materials Science Laboratory, Department of Physics, College of Science and Mathematics, Mindanao State University – Iligan Institute of Technology, A. Bonifacio Avenue, 9200 Iligan City, Philippines

Nanoscience, Premier Research Institute of Science and Mathematics (PRISM), A. Bonifacio Avenue, 9200 Iligan City, Philippines

*E-mail: mariateresa.batocael@g.msuiit.edu.ph

INTRODUCTION



Maize:

- One of the most used biopolymers worldwide
- Degrades without leaving behind any hazardous residues
- Semi-permeable to carbon dioxide while being resistive to oxygen gas [1,2]

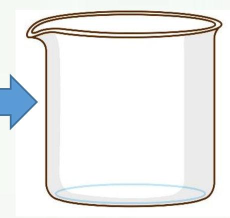
Problem: In Maize composite film (MCF) form, it has less mechanical performance compared to traditional industrial polymers [3].

Solution: In this study Incorporate spacers and/or reinforcement materials.

METHODOLOGY

Preparation of MFCs

Spacers/Reinforcement Materials + Distilled water + Maize powder →



Heated and stirred in a hot plate → Cooled and dried in room temperature

FTIR ATR | UTM (ASTM D882)

Analysis

CONCLUSION

- Increased O – H bond with the addition of spacers;
- S2 -introduced MCFs have the highest tensile strength and Young's modulus while the combination of S1+S2 improved its elongation at break;
- C – O vibration has a very high positive correlation for the tensile strength for all MCFs, and
- Spacers did not alter chemical composition of MCFs.

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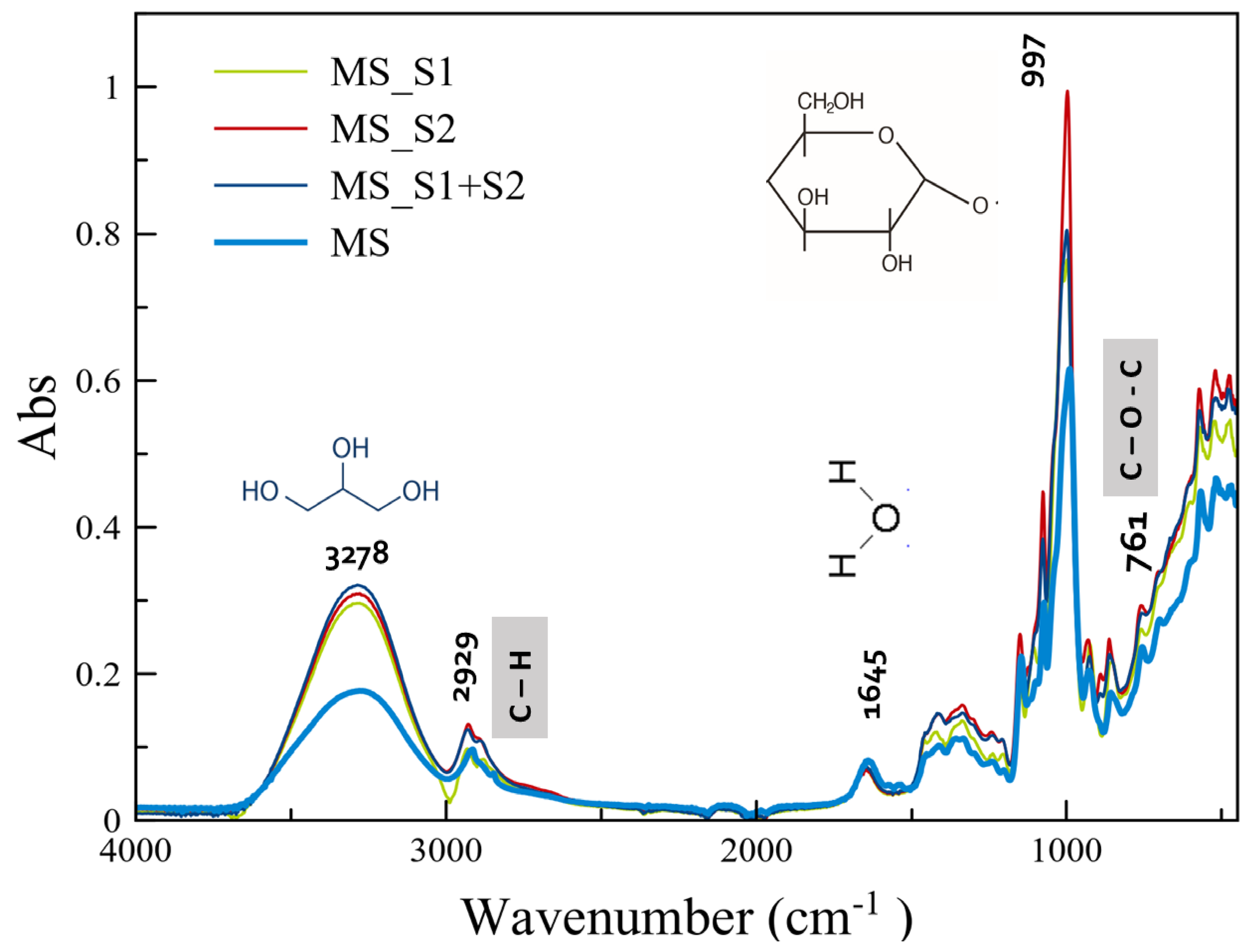
- *Source of images: Google images*

RESULTS AND DISCUSSION

FTIR Spectroscopy

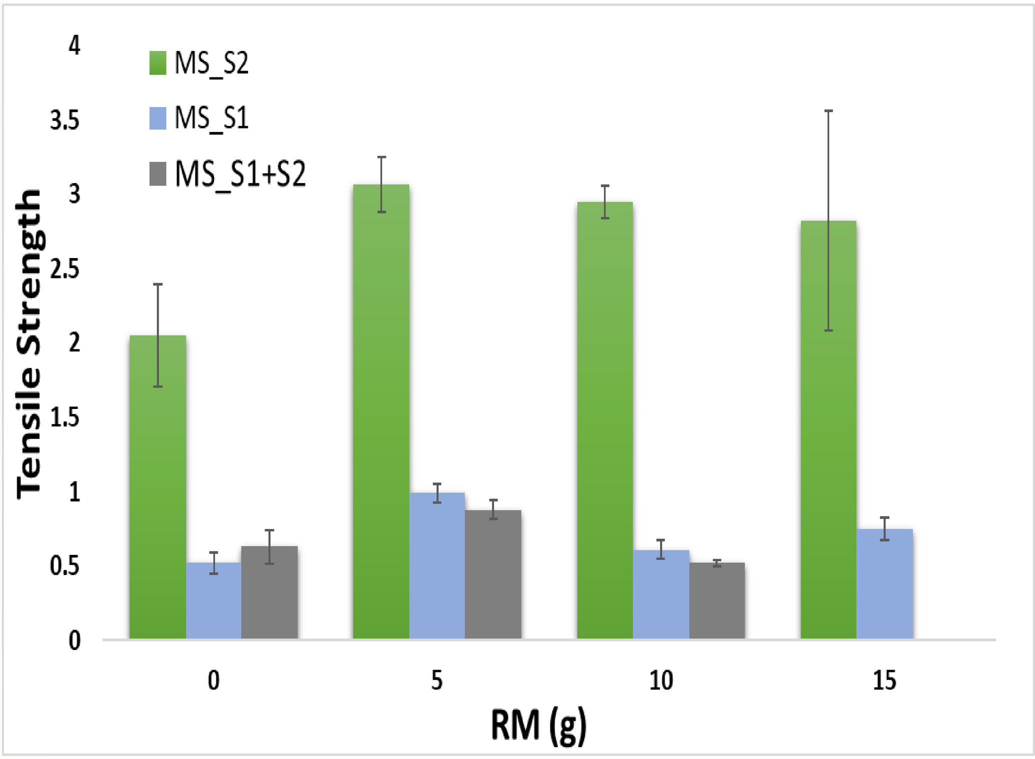
Functional Groups:

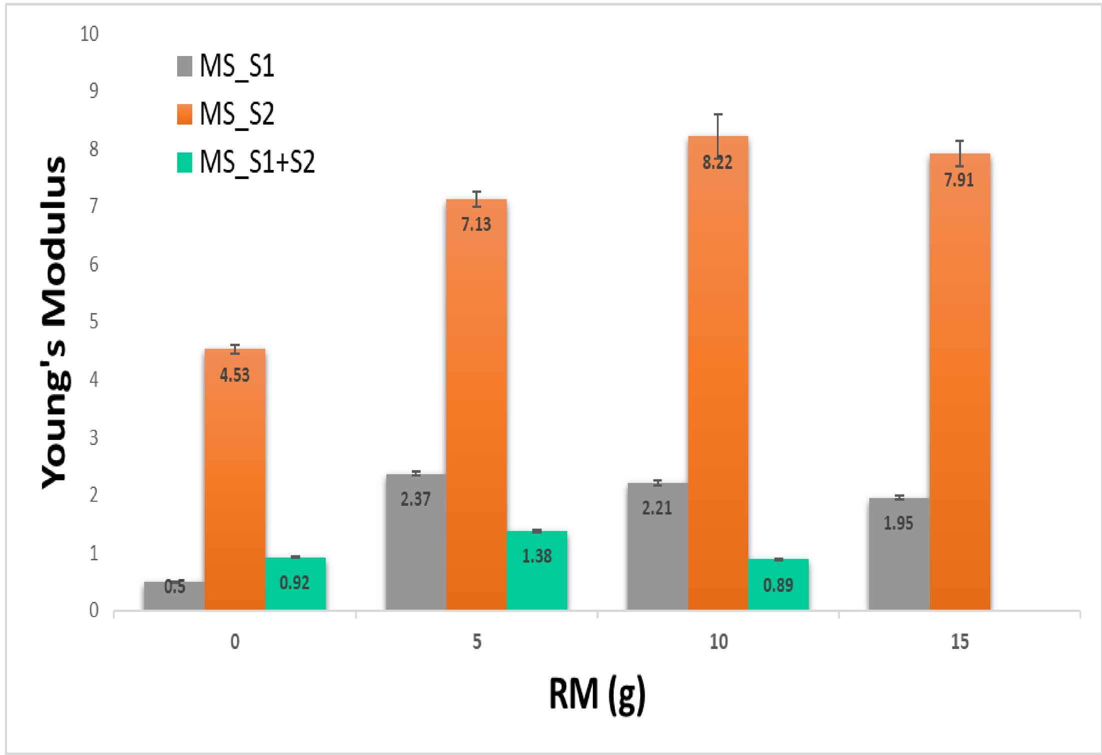
- $3278\ cm^{-1}$ = O-H stretching (water, starch, spacer)
- $1645\ cm^{-1}$ = O – H scissoring (water)
- $2929\ cm^{-1}$ = C–H stretching (starch)
- $761\ cm^{-1}$ = C – O – C carbohydrate ring – glucose pyranose
- $997\ cm^{-1}$ = C– O (index of crystallinity)



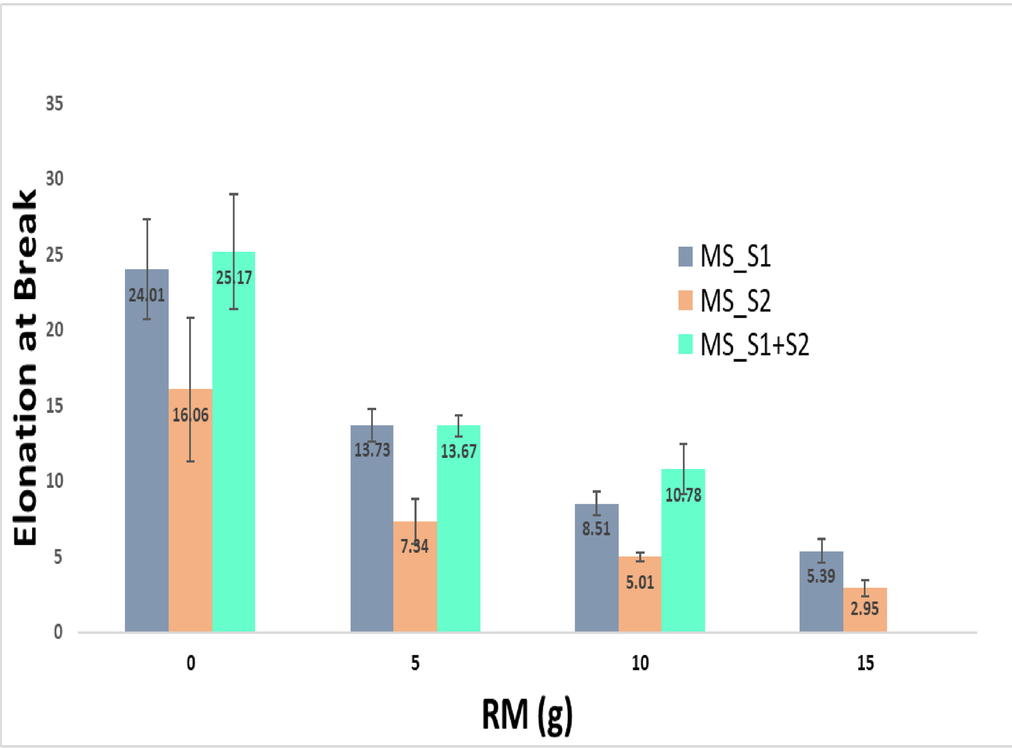
FTIR Spectra of MCFs with different spacers

Mechanical Properties





- **S2** - highest tensile strength
  - highest Young's Modulus



- **S1+S2** – improved elongation at break

Correlation Properties

Wavenumber	Assignment	Correlation Value
$761\ cm^{-1}$	Glucose pyranose units	0.8524
$997\ cm^{-1}$ (crystallinity)	C – O	0.9968

$$r = \frac{n(\sum xy)-(\sum x)(\sum y)}{\sqrt{[n\sum x^2-(\sum x)^2][n\sum y^2-(\sum y)^2]}}$$

r = +1 (total positive linear correlation)

r = -1 (total negative linear correlation)

r = 0 (no correlation at all)

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