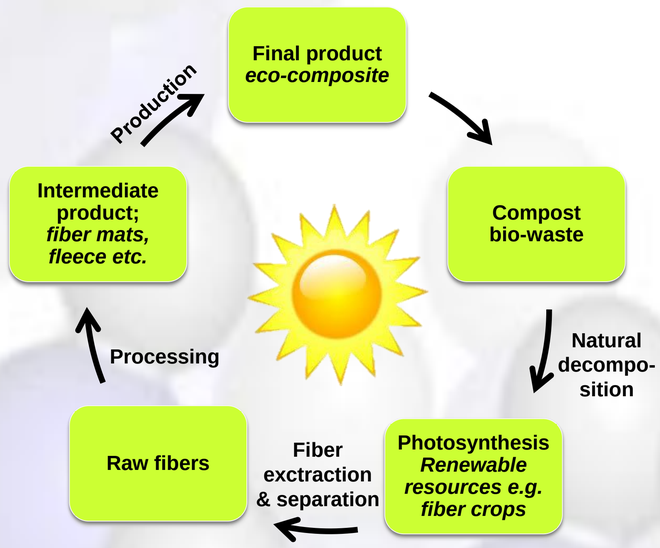
POLY(LACTIC ACID)/KENAF FIBER COMPOSITES: EFFECT OF MICRO-FIBRILLATED CELLULOSE ON INTERFACE-SENSITIVE PROPERTIES

Gordana Bogoeva-Gaceva[1], Dimko Dimeski[2], Vineta Srebrenkoska[2]
1-Faculty of Technology and Metallurgy, Ss Cyril and Methodius University, Skopje, Macedonia
2-Faculty of Technology, Goce Delcev University, Stip, Macedonia

Introduction

Ecologically friendly composites consist of a biodegradable matrix and natural fibers (such as cotton, sisal, kenaf, bamboo, etc.), which have been successfully used for reinforcing of different polymer matrices. Quite recently, poly(lactic acid) (PLA) was used as a matrix for biodegradable eco-composites. Natural fibers (NFs) offer both cost savings and a reduction in density when compared to glass fibers.

Though the strength of NFs is not as great as glass, the specific properties are comparable. According to the literature, kenaf fibers exhibit higher strength values in terms of tensile and flexural properties, as compared to other NFs, when reinforcing PLA.



Life cycle of biocomposites

Kenaf plant

Objective

The aim of this work was to study the mechanical behavior of PLLA-based composites reinforced with kenaf fibers, and the influence of micro-fibrillated cellulose (MFC) on overall composite properties.

Materials

Micro-fibrillated Cellulose()MFC) (Nanocellulose) is a material composed of nanosized cellulose fibrils with a high aspect ratio. Typical lateral dimensions are 5–20 nm and longitudinal dimension is in a wide range from tens of nanometer to several microns. Prior the use in kenaf /PLA composites, MFC was modified with nucleating agent in order to increase the rate of polymer crystallization.

Experimental

- **Composites of PLLA and kenaf fibers (Bast Fiber, LLC) were prepared by melt mixing the components in a Rheocord apparatus, and consequent compression molding at 180 ^{o}C for 3 min at 50 MPa.**
- **The amount of MFC in the mixture was varied from 5-15 %, while the content of PLLA was kept constant, 50%.**
- **Additional thermal treatment (100^{o}C, 30 min) of composite samples was tested as a means to increase the crystallinity of the matrix and to improve the mechanical properties.**

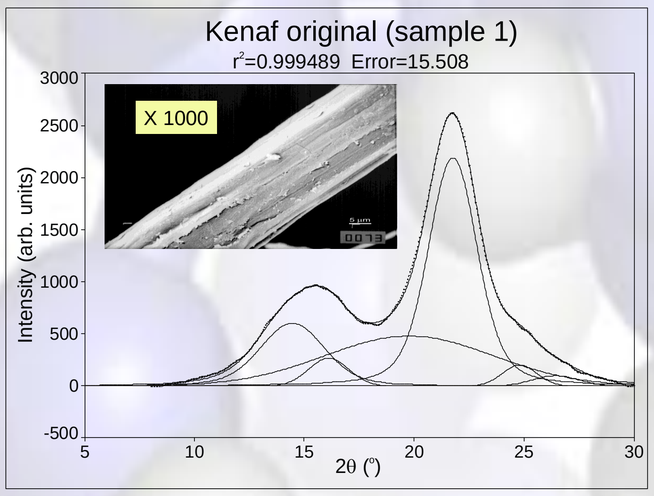


Figure 1. WAXD patterns of Kenaf fiber

The largest advantages to using natural fibers in composites are: the cost of materials, their sustainability and density.

Fracture toughness was increased by addition of MFC for cca 20% : from 2.9 KJm-2 (Kenaf/PLLA) to 3.9 KJm-2 (Kenaf/PLLA/MFC(10%)).

Influence of micro-fibrillated cellulose (MFC) on flexural strength and modulus of Kenaf/PLLA composites

MFC/ % wt.	Flexural strength/ MPa	Flexural modulus/ GPa
0	34.8	3.9
5	42.3	4.9
10	57.1	5.8
12.5	47.8	5.9
15	50.0	4.6

Glass transition temperature of Kenaf/PLLA composites containing MFC

Sample	Tg/ ^{o}C
PLLA	57.0
Kenaf/PLLA	61.2
Kenaf/PLLA/MFC(5%)	64.5
Kenaf/PLLA/MFC910%)	68.9

Conclusions

- **The results have shown that the addition of MFC influence the interface sensitive properties of PLA/kenaf fiber composites, increasing the interfacial energy release rate for about 20% at MFC loading of 10%. Flexural strength and modulus of the composites were also improved by the presence of MFC, reaching values of 57 MPa and 5.9 GPa, correspondingly.**