Okra Fibres - Properties and Possible Applications

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RESET
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Introduction

Natural fibres:

- biodegradable;
- non toxic;
- bioaceptable;
- mostly environmental friendly;

Do not forget disadvantages.

Weak sides of natural fibres

Problems with traditional natural fibres:

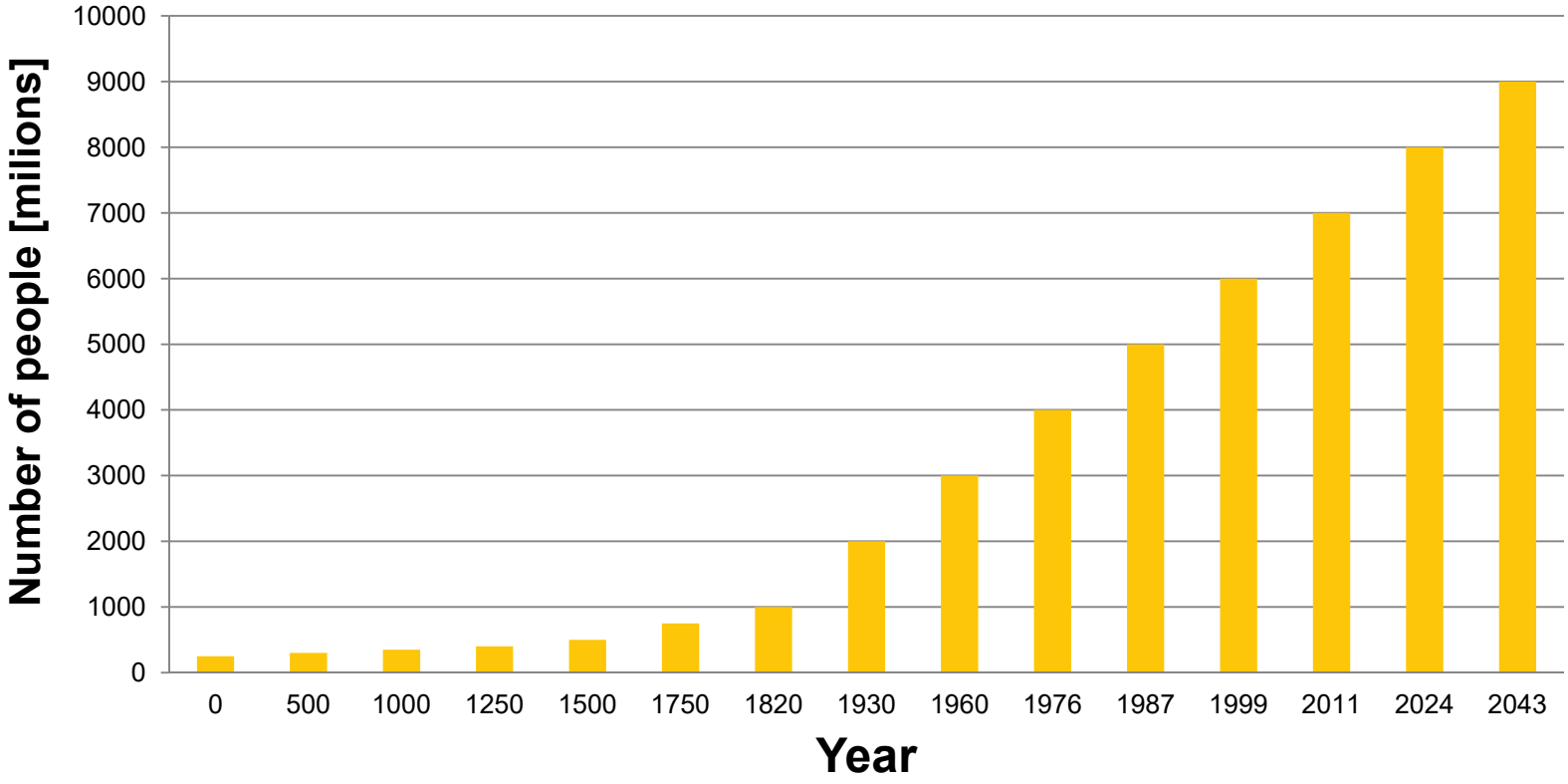
- are quite expensive;

- need large arable areas. This space can't be use for food cultivating;

- using for reinforcement mean not using in clothing industry;

What can be a solution?

Number of People on Earth



Okra fibres

Okra fibres are coming from stem

Fiber preparation – alkalization for separation

- **Removing of pectins, hemicelulose and other low molecular weight substances;**
- **Increase celulose content;**

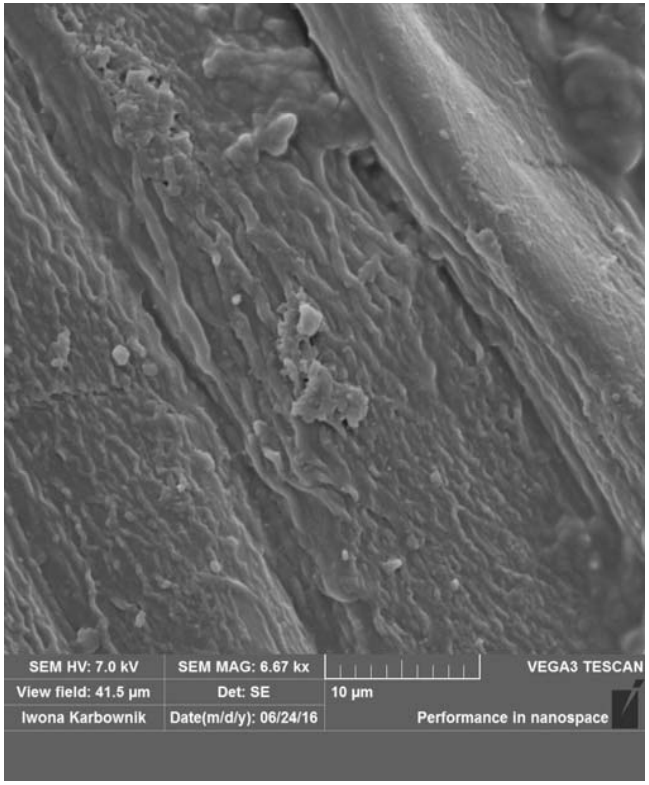
Fiber preparation - retting

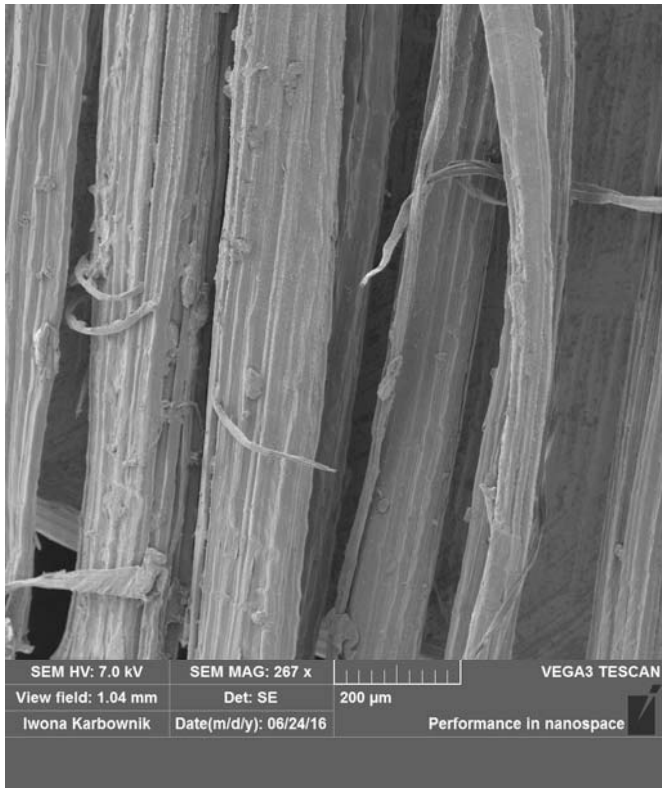
The aim of the procedure is to remove pectins and other cellular tissues and obtain fiber separation from the steam.

- **Water retting;**
- **(Natural retting in stagnant or slowly moving water);**
- **Dew retting in areas with limited water resources.**

Combined action of sun, air, bacteria, dew fermentation.

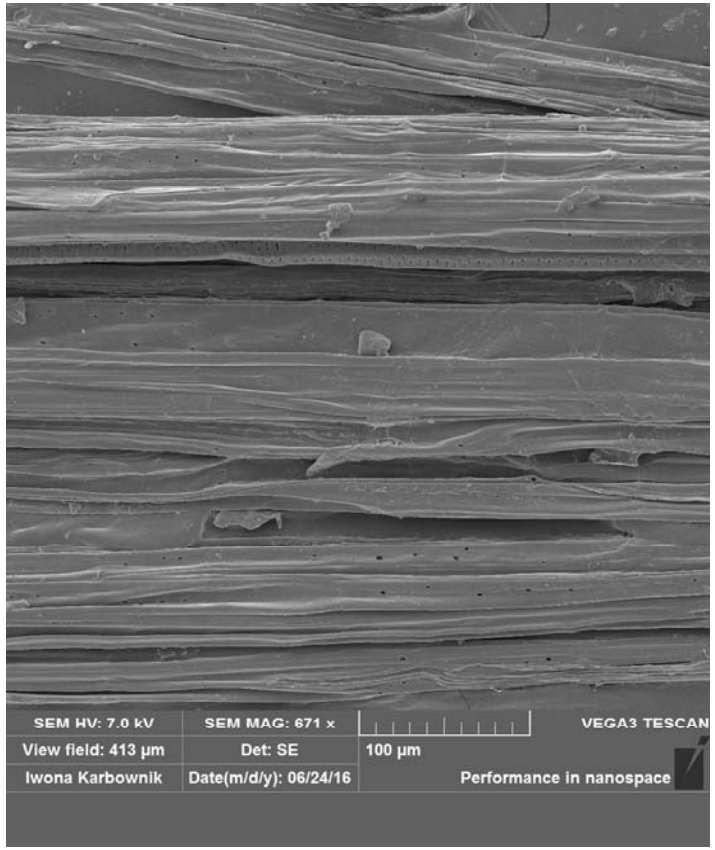
SEM images alkalized okra

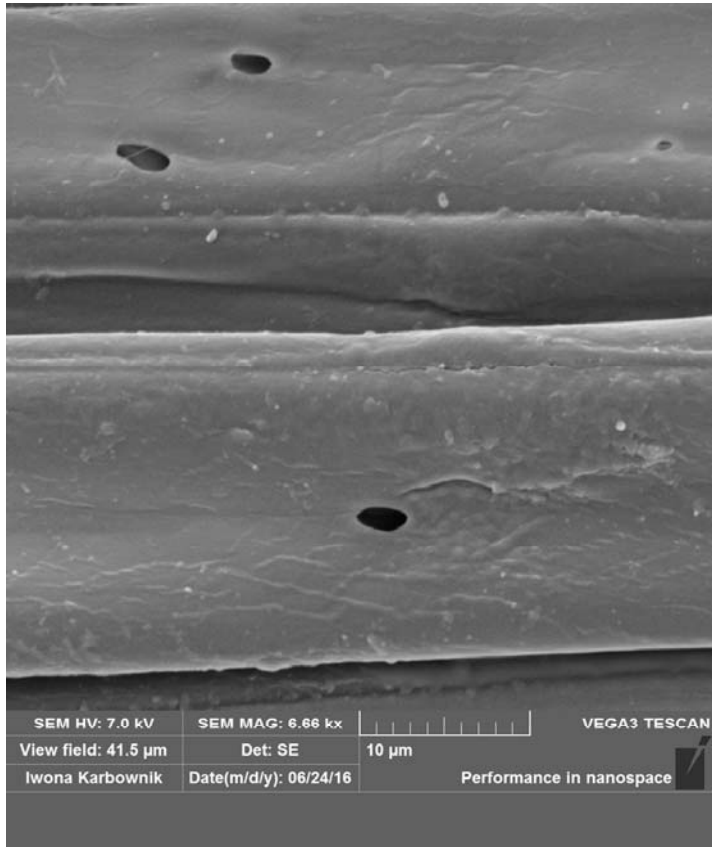




Courtesy dr Iwona Karbownik

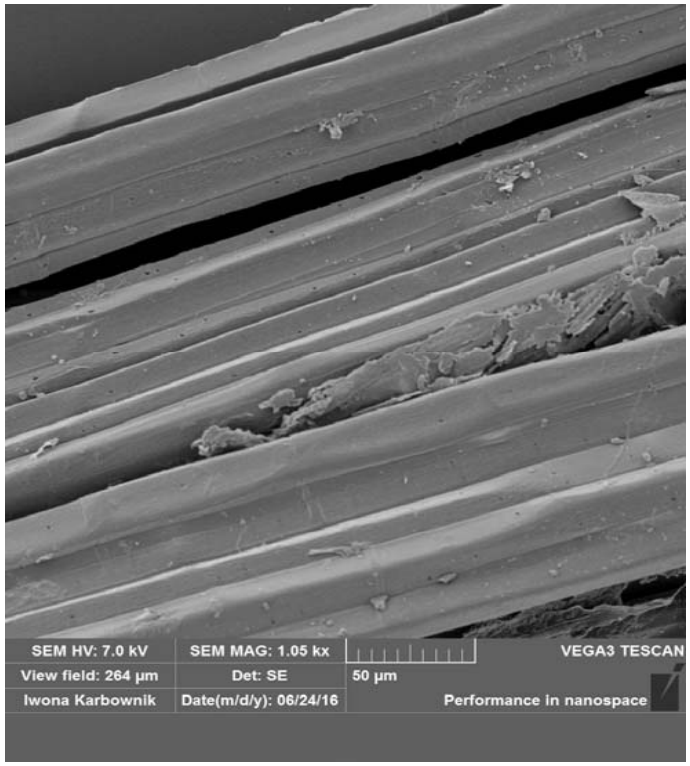
SEM images water retted okra

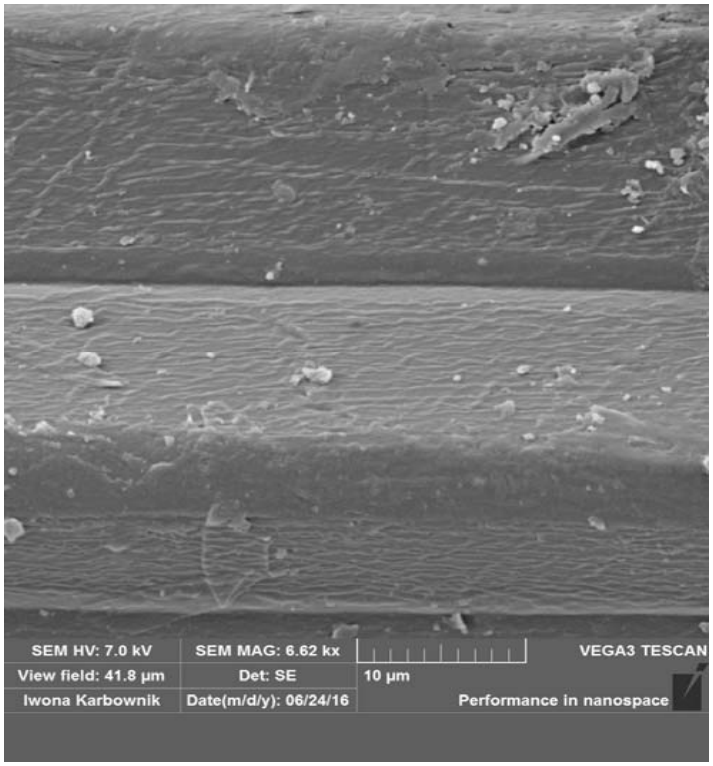




Courtesy dr Iwona Karbownik

SEM images dew retted okra





Courtesy dr Iwona Karbownik

Linear density

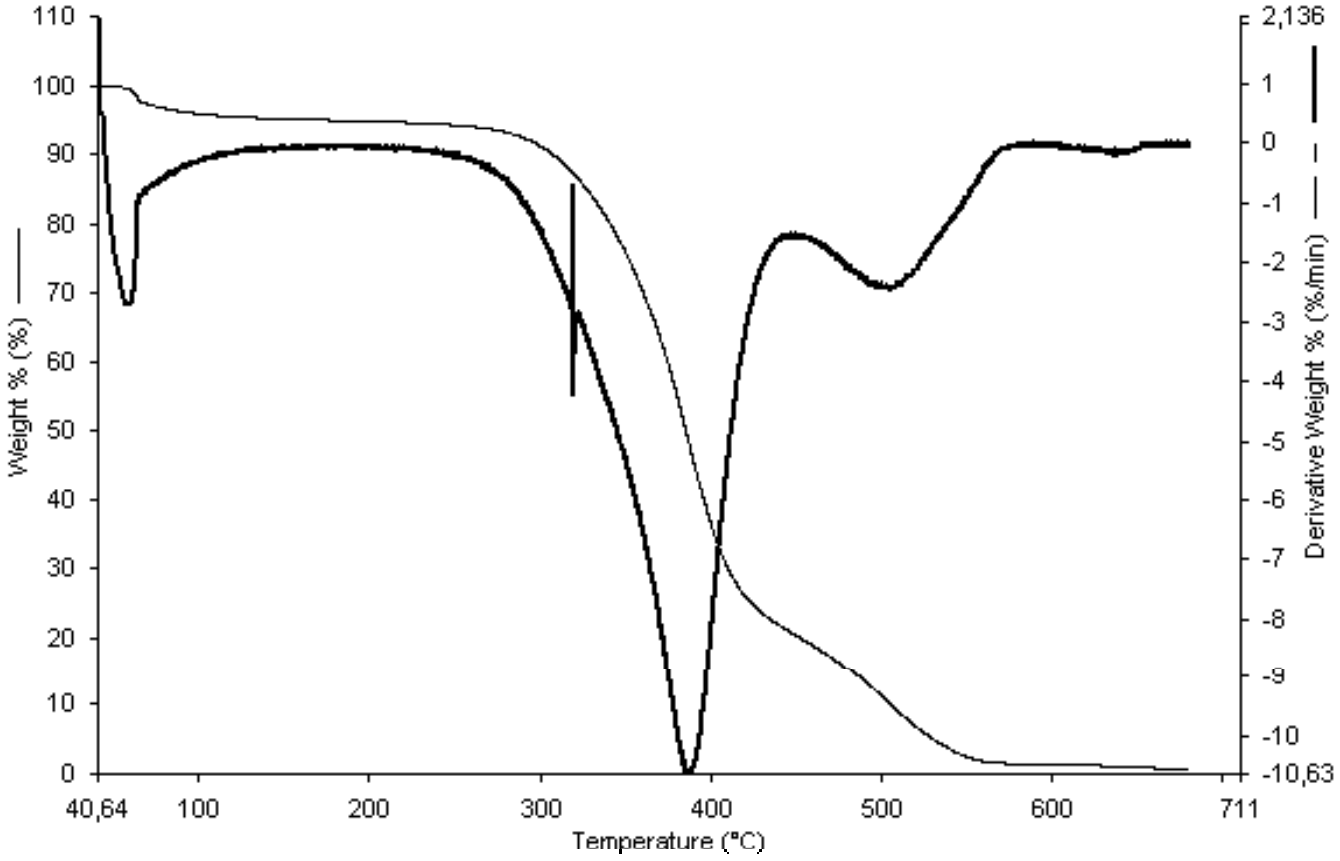
Fiber	Lineer Density - tex
Alkalized okra bast fiber (OA)	12.5
Water retted bottom okra bast fiber (OWB)	11.9
Water retted middle okra bast fiber (OWM)	10.3
Water retted upper okra bast fiber (OWU)	10.9
Dew retted bottom okra bast fiber (ODB)	17.1
Dew retted middle okra bast fiber (ODM)	13.1
Dew retted upper okra bast fiber (ODU)	11.2

Breaking force and specific strength

Fiber	Fmax cN	Fmax (cN)/tex)
Alkalized okra bast fiber (OA)	407.0	64.0
Water retted bottom okra bast fiber (OWB)	500.0	42.0
Water retted middle okra bast fiber (OWM)	469.8	45.8
Water retted upper okra bast fiber (OWU)	489.6	45.1
Dew retted bottom okra bast fiber (ODB)	579.8	33.9
Dew retted middle okra bast fiber (ODM)	427.2	32.5
Dew retted upper okra bast fiber (ODU)	414.5	37.1

Cotton: 23-36 cN/tex;
Linen: 30-60 cN/tex

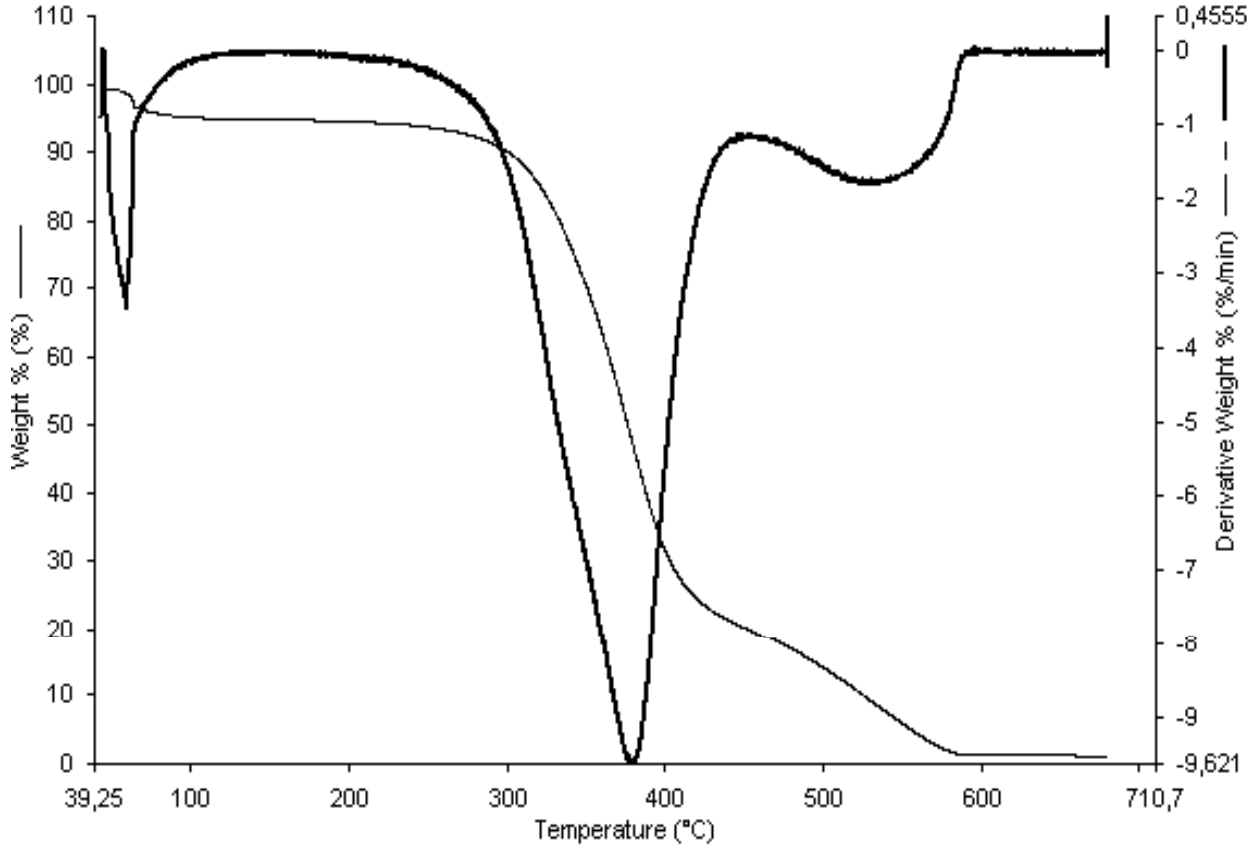
Thermal analysis
Alkalized okra bast fiber



Nitrogen

Thermal analysis

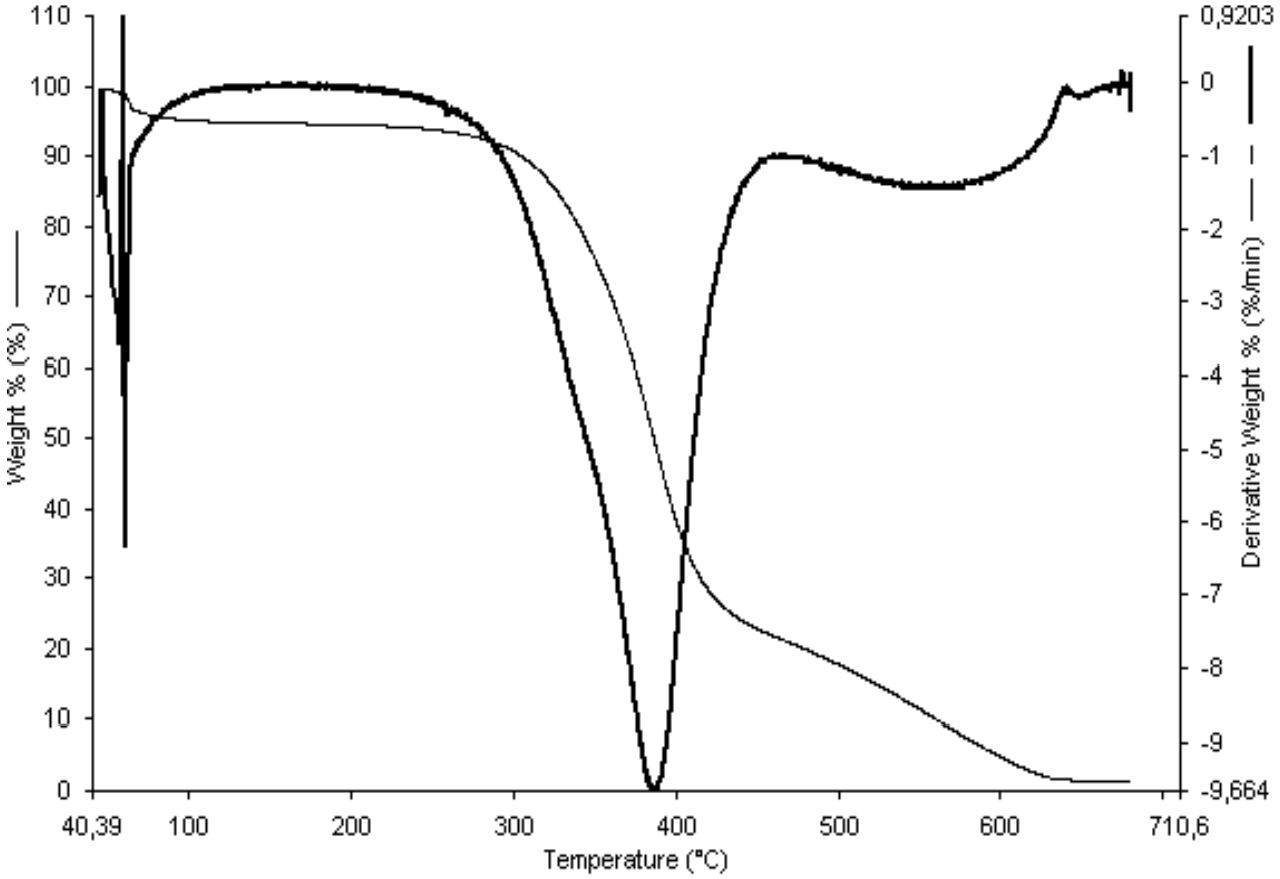
Water retted bottom okra bast fiber



Nitrogen

Thermal analysis

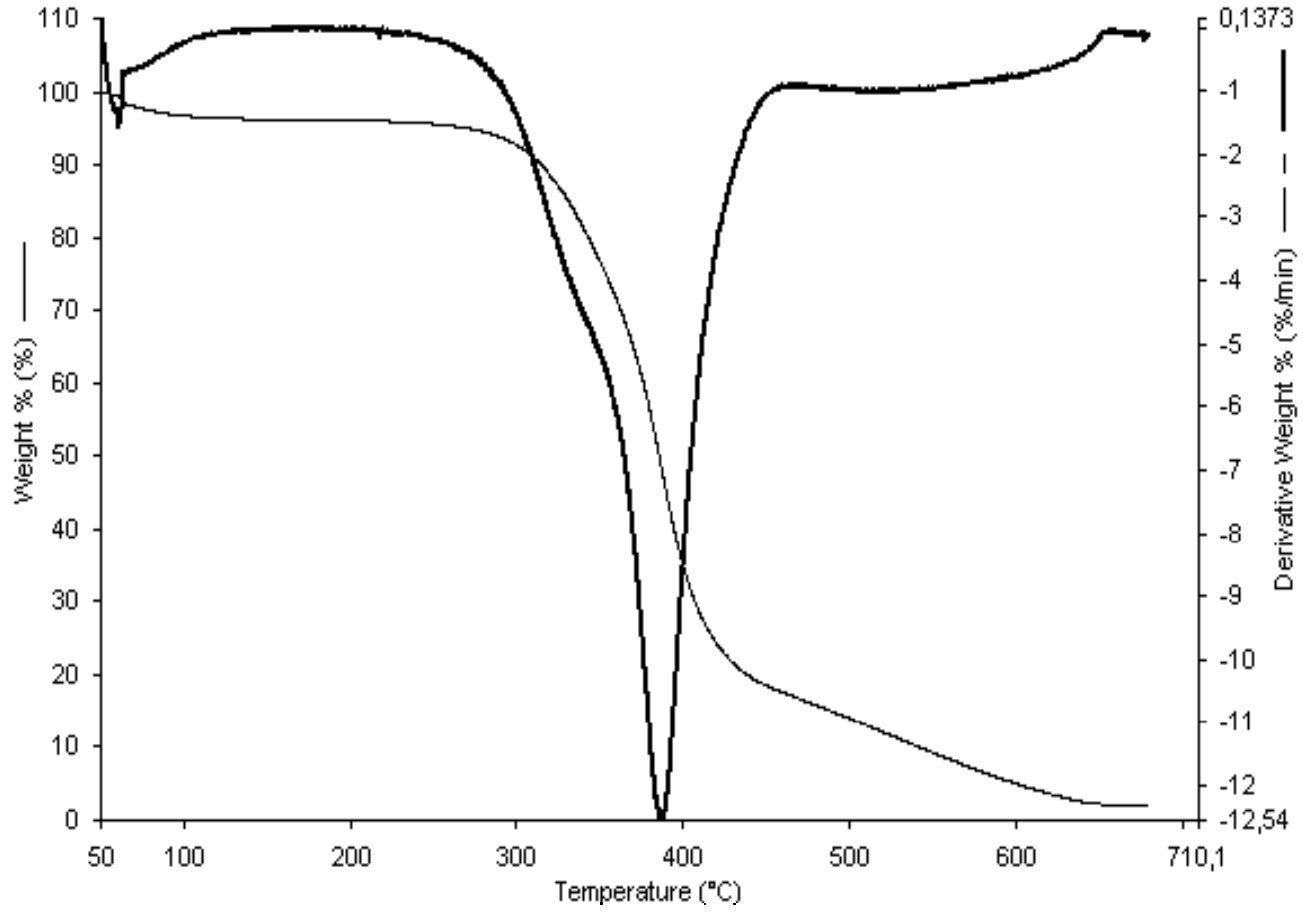
Water retted middle okra bast fiber



Nitrogen

Thermal analysis

Dew retted upper okra bast fiber



Nitrogen

Thermal analysis

Activation energy – Coats and Redfern method

Fiber	Activation energy (kJ/mol)
Alkalized okra bast fiber (OA)	58.8
Water retted bottom okra bast fiber (OWB)	60.4
Water retted middle okra bast fiber (OWM)	50.9
Water retted upper okra bast fiber (OWU)	50.4
Dew retted bottom okra bast fiber (ODB)	42.8
Dew retted middle okra bast fiber (ODM)	54.4
Dew retted upper okra bast fiber (ODU)	62.1

Nitrogen

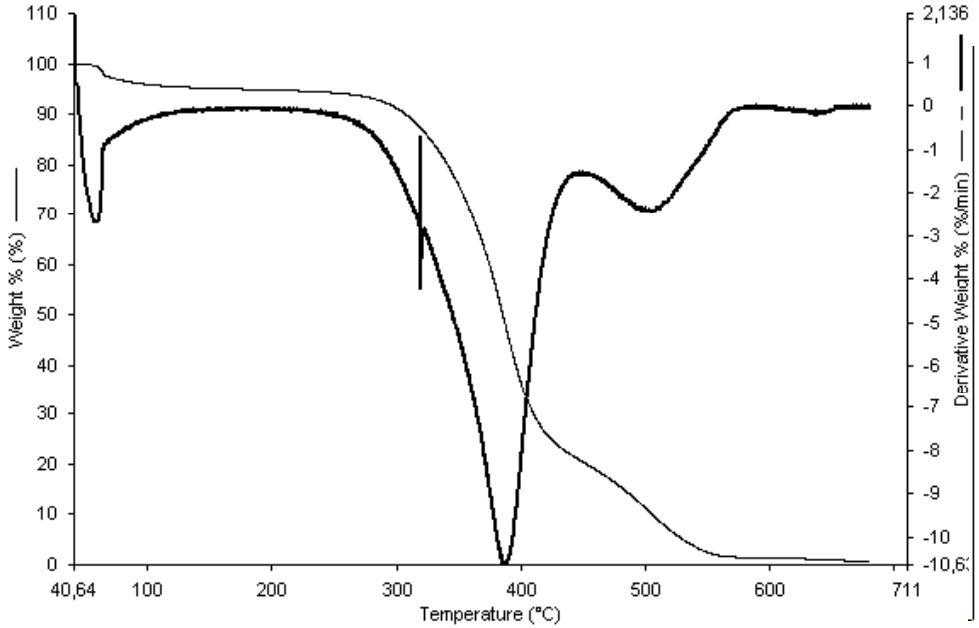
Thermal analysis

Activation energy – Van Krevelen method

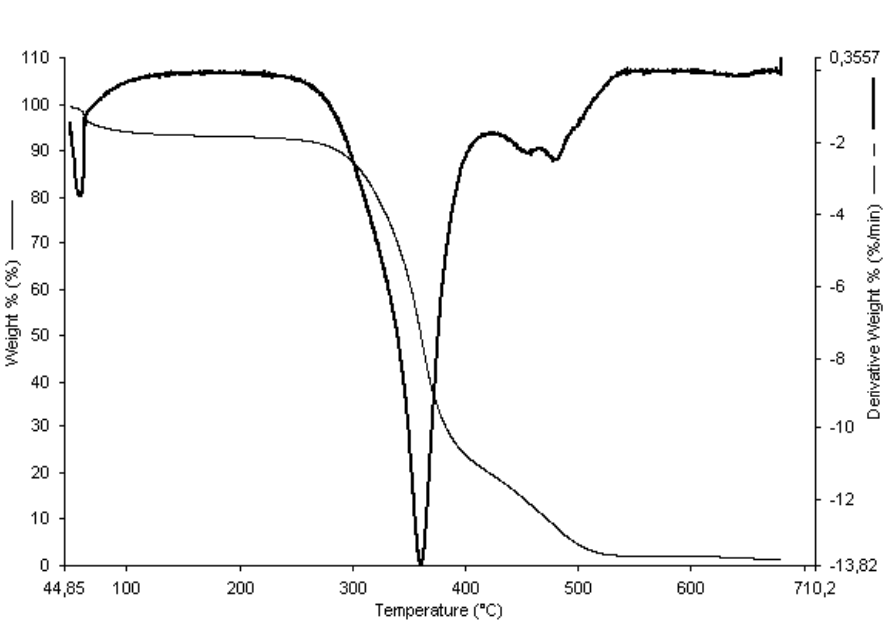
Fiber	Activation energy (kJ/mol)
Alkalized okra bast fiber (OA)	65.8
Water retted bottom okra bast fiber (OWB)	35.7
Water retted middle okra bast fiber (OWM)	64.1
Water retted upper okra bast fiber (OWU)	63.8
Dew retted bottom okra bast fiber (ODB)	72.3
Dew retted middle okra bast fiber (ODM)	73.6
Dew retted upper okra bast fiber (ODU)	78.9

Nitrogen

Thermal analysis
Alkalized okra bast fiber



Nitrogen



Oxygen

Thermal analysis

Activation energy – Coats and Redfern method

Fiber	Activation energy (kJ/mol)
Alkalized okra bast fiber (OA)	49.3
Water retted bottom okra bast fiber (OWB)	84.1 (?)
Water retted middle okra bast fiber (OWM)	69.9
Water retted upper okra bast fiber (OWU)	41.9
Dew retted bottom okra bast fiber (ODB)	46.7
Dew retted middle okra bast fiber (ODM)	36.4
Dew retted upper okra bast fiber (ODU)	39.3

Oxygen

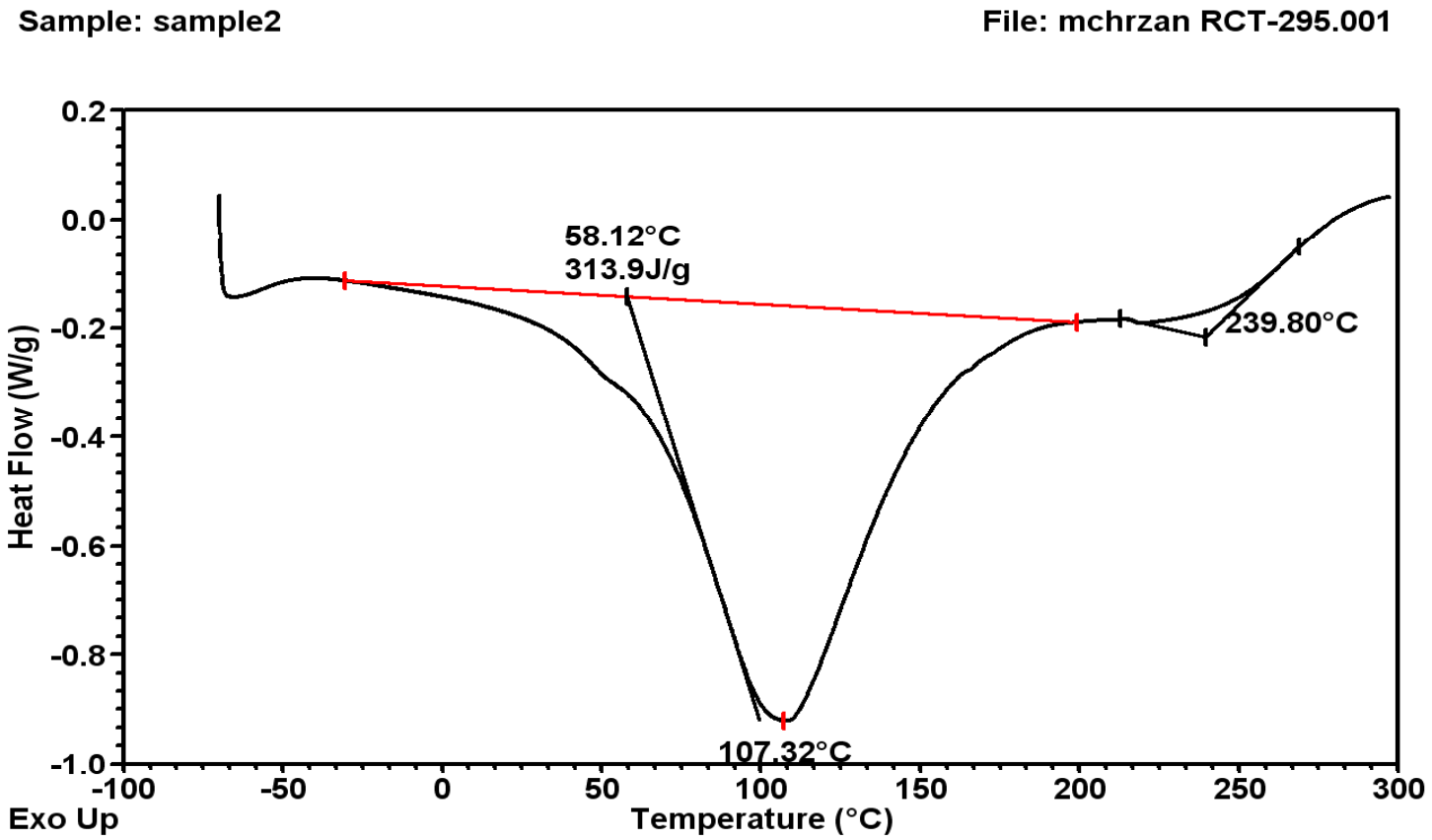
Thermal analysis

Activation energy

Coats and Redfern method

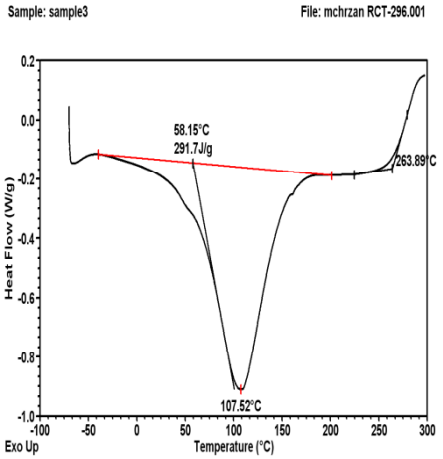
Fiber	At ambient conditions Activation energy (kJ/mol)	Thermooxidation Activation energy (kJ/mol)
Alkalized okra bast fiber (OA)	65.8	49.3
Water retted bottom okra bast fiber (OWB)	35.7	84.1 (?)
Water retted middle okra bast fiber (OWM)	64.1	69.9
Water retted upper okra bast fiber (OWU)	63.8	41.9
Dew retted bottom okra bast fiber (ODB)	72.3	46.7
Dew retted middle okra bast fiber (ODM)	73.6	36.4
Dew retted upper okra bast fiber (ODU)	78.9	39.3

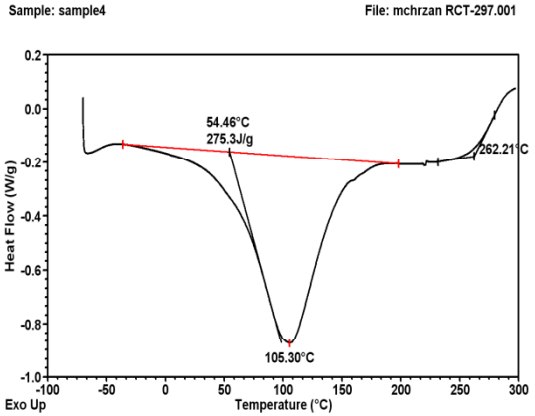
Thermal analysis
DSC

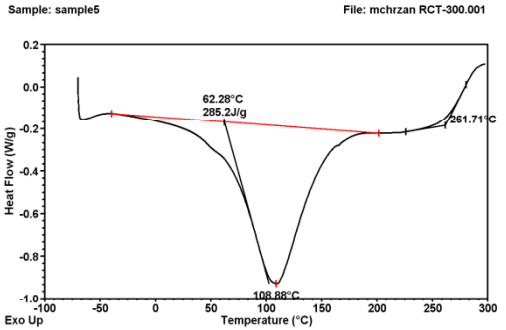


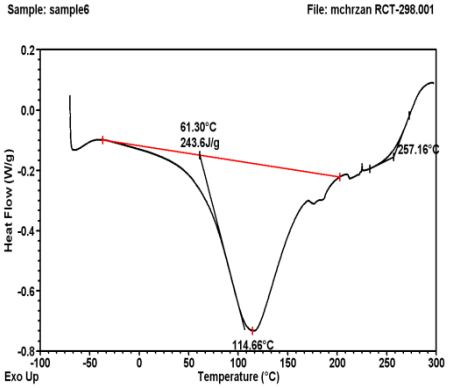
Courtesy dr Michał Chrzanowski

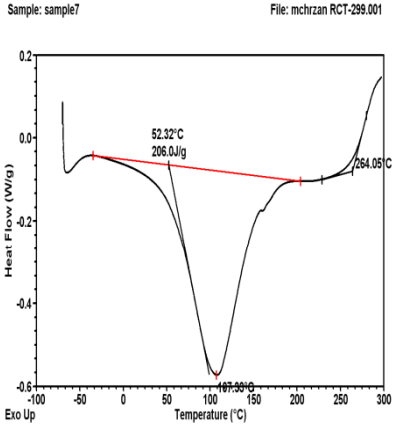
Thermal analysis
DSC

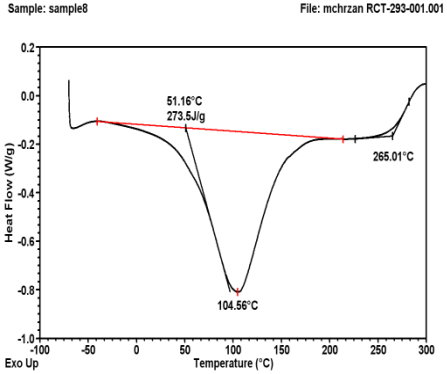












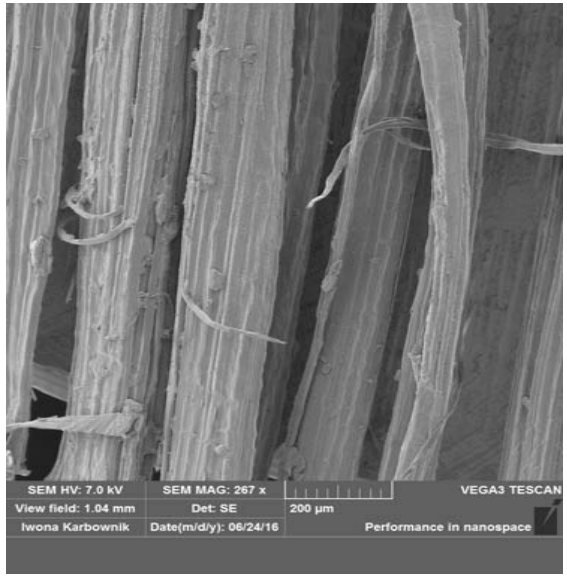
Courtesy dr Michał Chrzanowski

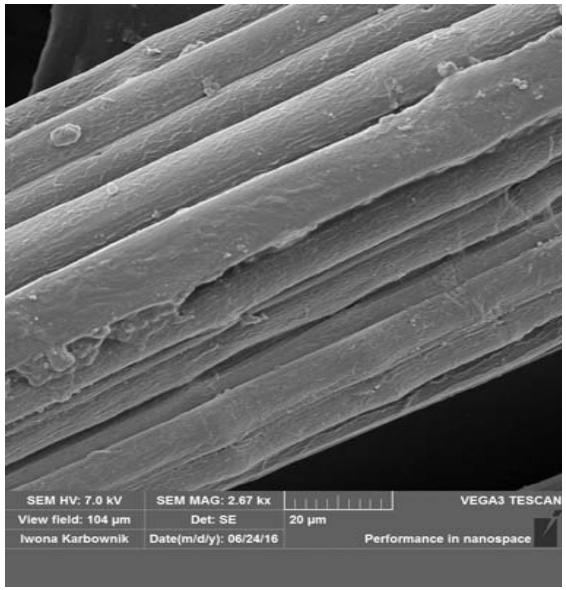
UV stability

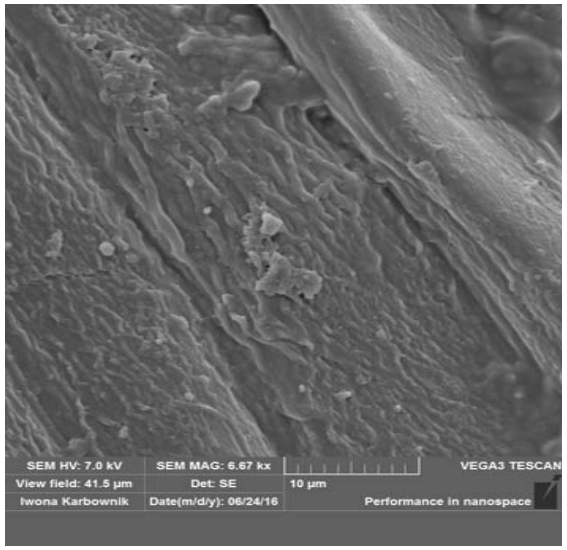
Fiber	After UV radiation		Before UV radiation	
	Fmax cN	Fmax(cN/ex)	Fmax cN	Fmax (cN/tex)
Alkalized okra bast fiber (OA)	328.7	25.3	407.0	64.0
Water retted bottom okra bast fiber (OWB)	312.0	26.2	499.8	42.0
Water retted middle okra bast fiber (OWM)	411.6	40.2	469.8	45.8
Water retted upper okra bast fiber (OWU)	305.7	27.9	490.0	45.1
Dew retted bottom okra bast fiber (ODB)	406.3	23.9	579.8	33.9
Dew retted middle okra bast fiber (ODM)	409.7	94.00	427.2	32.5
Dew retted upper okra bast fiber (ODU)	395.7	34.0	414.5	37.1

UV lamp, 1h

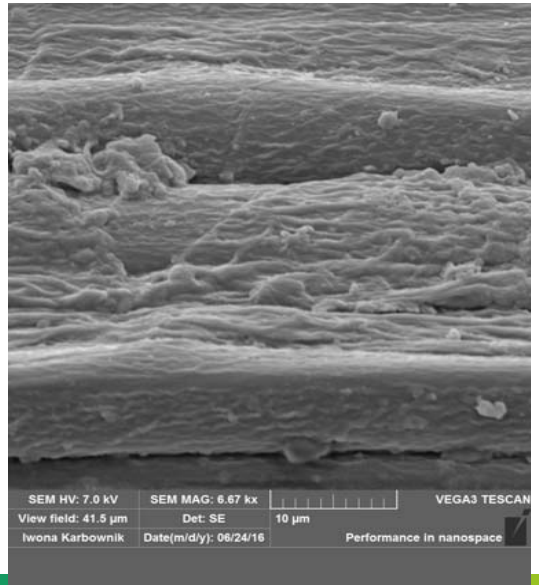
UV stability







UV lamp, 1h



Conclusions:

- **Okra fibres have good mechanical and thermal properties;**
- **Those properties are independent of the plant part they come from;**
- **Okra fibres have quite good stability against UV radiation;**
- **Such type of fibres can be used as an natural reinforcement in composites and other multi component systems.**

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Thank you!

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