



GreenGran Europe GmbH: NF/plastic granules
ready to produce and supply

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Introduction

- From oil- to bio-based economy
 - Alternative energy sources creates demand for alternative derivatives
 - Rising feedstock prices creates demand for cheaper alternatives

Introduction

- From oil- to bio-based economy
- History Natural Fibre Composites at WUR
 - Up till end 90's: extrusion compounding research → worldwide patent
 - Up till '05: technology debottle-necking
 - 2006: technology up-scaling
 - 2007: industrial production

Introduction

- From oil- to bio-based economy
- History Natural Fibre Composites at WUR
- Evolution Natural Fibre Composites technologies *worldwide* (1990-2006)
 - NMT's: compression moulding
 - WPC's: extrusion profiling
 - AFC granules: injection moulding

Introduction



NMT: compression moulded,
thick-wall
Successfully used: f.i. Mercedes
and BMW interior

WPC: profile extrusion,
thick-wall
Successfully used: Decking
(US, Japan, China)



AFC: injection moulding,
thick-wall AND thin-wall
Successfully used: NEC
mobile phone

- Difference between NMT-, WPC-, and AFC-technology

What is GreenGran Europe ('GG')?

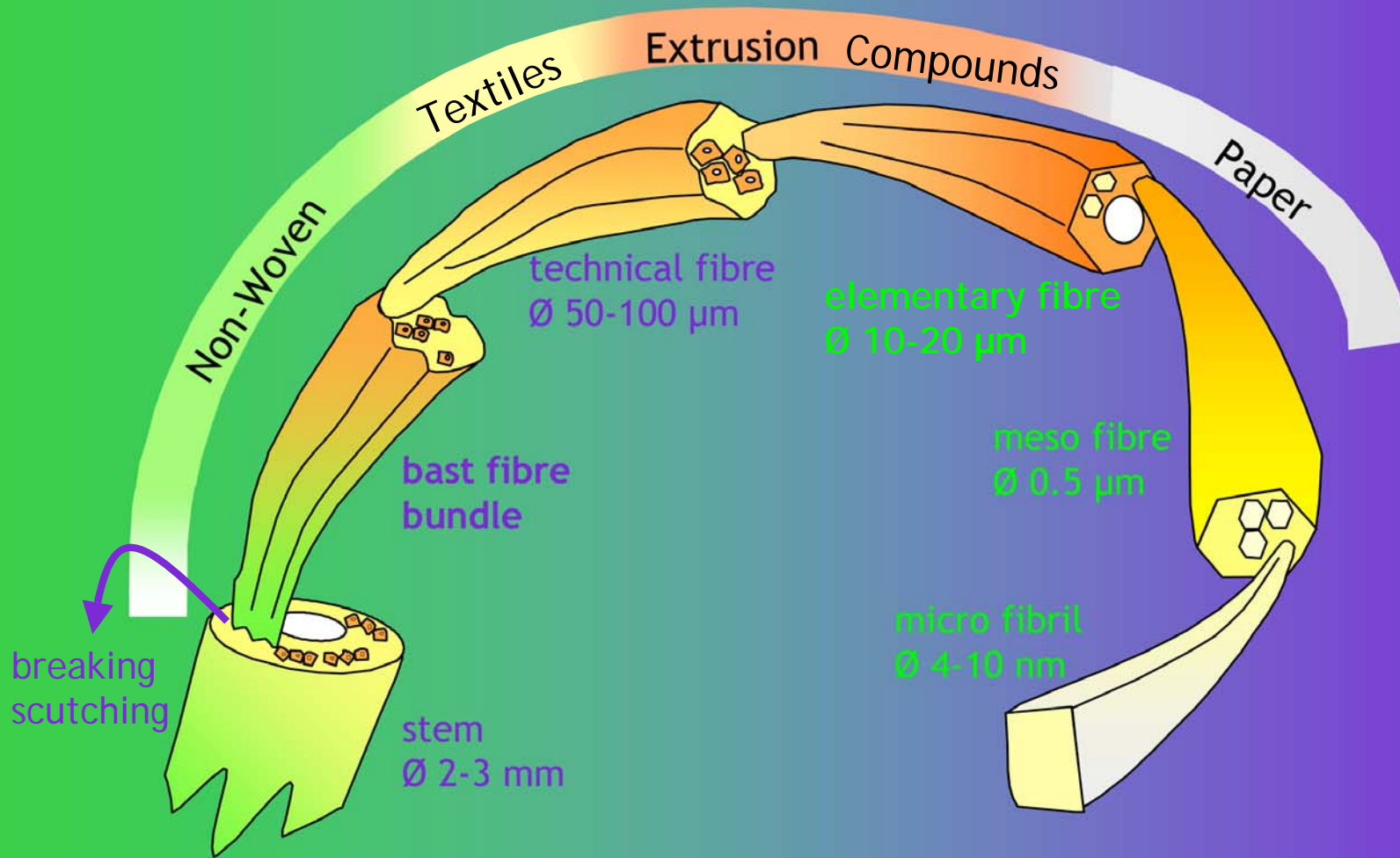
- Daughter company of GreenGran B.V. Wageningen
- Fibres used: hemp, flax, kenaf, sisal
- Co-operation with Zink
- Plastics used: PP and PLA production
- Sales natural fibre (100%) polymer granules for injection moulding applications



For making high quality granules it is essential to understand that, *in processing*:

Natural fibres do NOT behave like glass fibres
(but *in properties* they do!)

Agrofibre structure



GreenGran comparison chart

| Granule type/ Property | Glass fibre filled PC/ABS composite | Glass fibre filled PP homopolymer composite | Glass fibre filled PP copolymer composite | GG Natural-fibre filled PP homopolymer composite |
|--|--|--|--|--|
| Fibre content [wt.%] | 10 | 20 | 30 | 50 |
| Density [kg/m ³] | 1,220 | 1,050 | 1,140 | 1,080 |
| Flexural modulus [MPa] | 3,650 | 3,870 | 4,500 | 4,900 |
| Flexural strength [MPa] | 99 | 102 | 100 | 91 |
| Tensile Modulus [MPa] | 3,800 | 4,600 | 4,500 | 6,750 |
| Tensile strength [MPa] | 50 | 68 | 55 | 60 |
| Charpy Impact [kJ/m ²], unnotched | | 30 | 45 | 22 |
| HDT A [°C] | 115 | 136 | | 132 |
| HDT B [°C] | 132 | 153 | 142 | 156 |
| Vicat Softening B50 [°C] | | | 120 | 132 |

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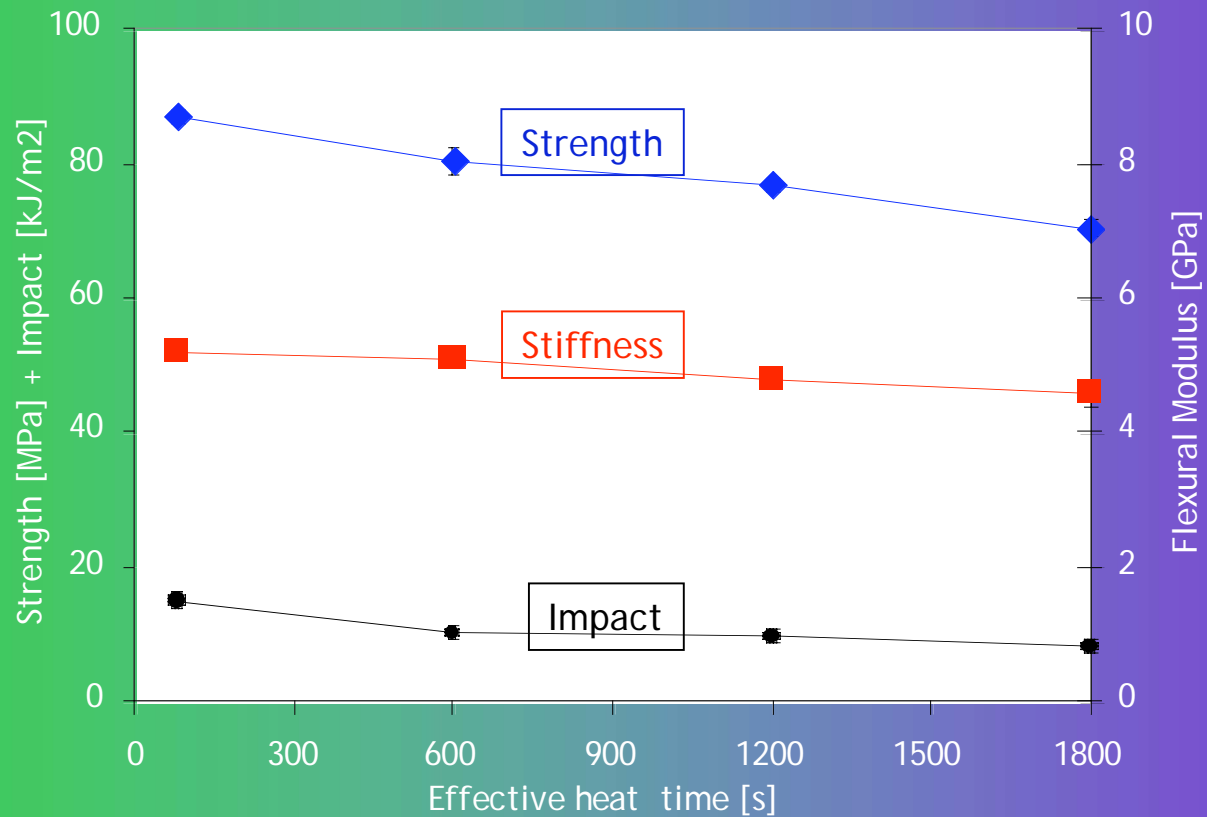
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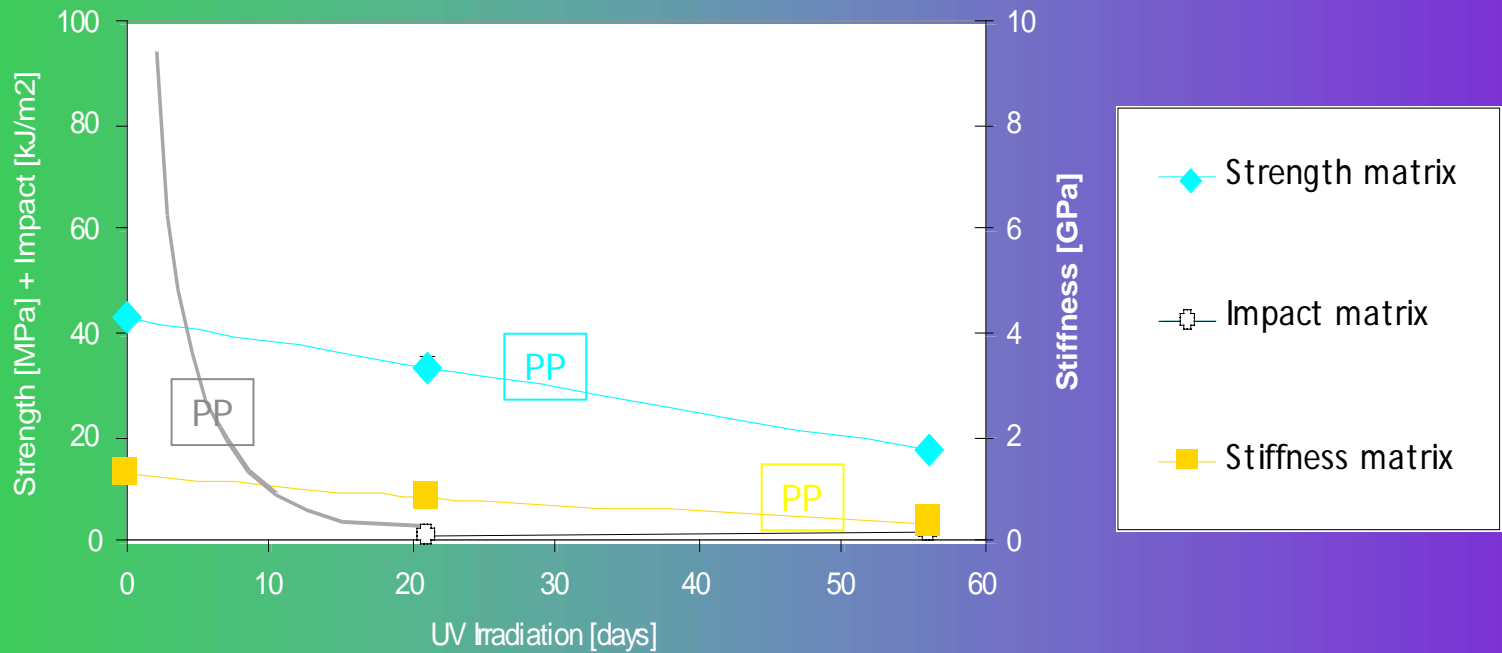
GG Granules' performance: machine residence time

- Hot melt in injection moulder at 200°C and up to 30 min.



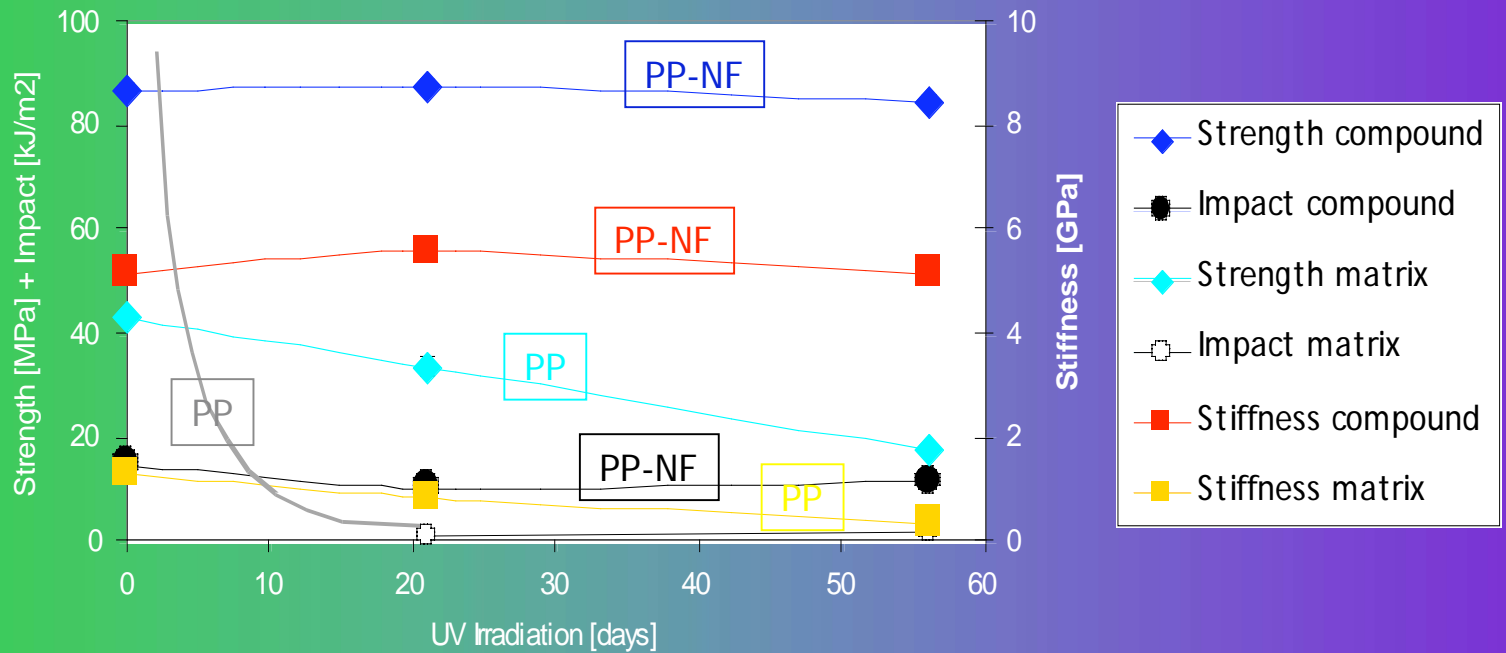
GG Granules' performance: UV radiation

- Irradiation vs mechanical properties in time (up to 56 days)



GG Granules' performance: UV radiation

- Irradiation vs mechanical properties in time (up to 56 days)



Highlighting GG's PP-NF quality

■ Our granules compete with GF compounds:



- lighter, stiffer, equally strong
- Masterbatches!
- normal flow behaviour
- withstands long machine residence time
- water absorption within accepted limits
- better resistance against UV radiation

Highlighting GG's PP-NF quality

■ Additional USP's:

- Insulation (heat and sounds)
- Flame retardancy, no-drops
- Increased HDT
- Improved dimension stability at higher temperatures
- No sharp edges f.i. after car crash
- 'Pro-Kyoto': recycle-able, fuel-pellets



End of presentation

- Thank you for your attention!
- For more info:
 - Contact us, f.i. via info@greengran.com
 - Through our websites:
 - www.agrofibrecomposites.com
(Wageningen UR)
 - www.greengran.com
(under construction)

