Wood Plastic Composites
Fibre Based Packaging

WPC Characteristics

- Often substituting wood and made to look like wood
  - durability a key feature without ‘nasty’ chemicals
  - seen to substitute limited hardwood suppliers

- Sustainability key feature
  - Often recycled polymer
  - Natural wood component (20 to 70%)

WPC benefits

Compared with wood

- Durability
  - Long life, low maintenance
  - Wet area use
- Environmentally friendly
  - From waste material (generally)
  - No preservatives, no leaching (generally)
  - Saving hardwood forests
- Straight, consistent, stable

Compared with Plastic

- Environmentally friendly
- Cost
- Stiffer
- Texture
- Able to paint, nail, screw, drill
- Lower density than inorganic filled plastic

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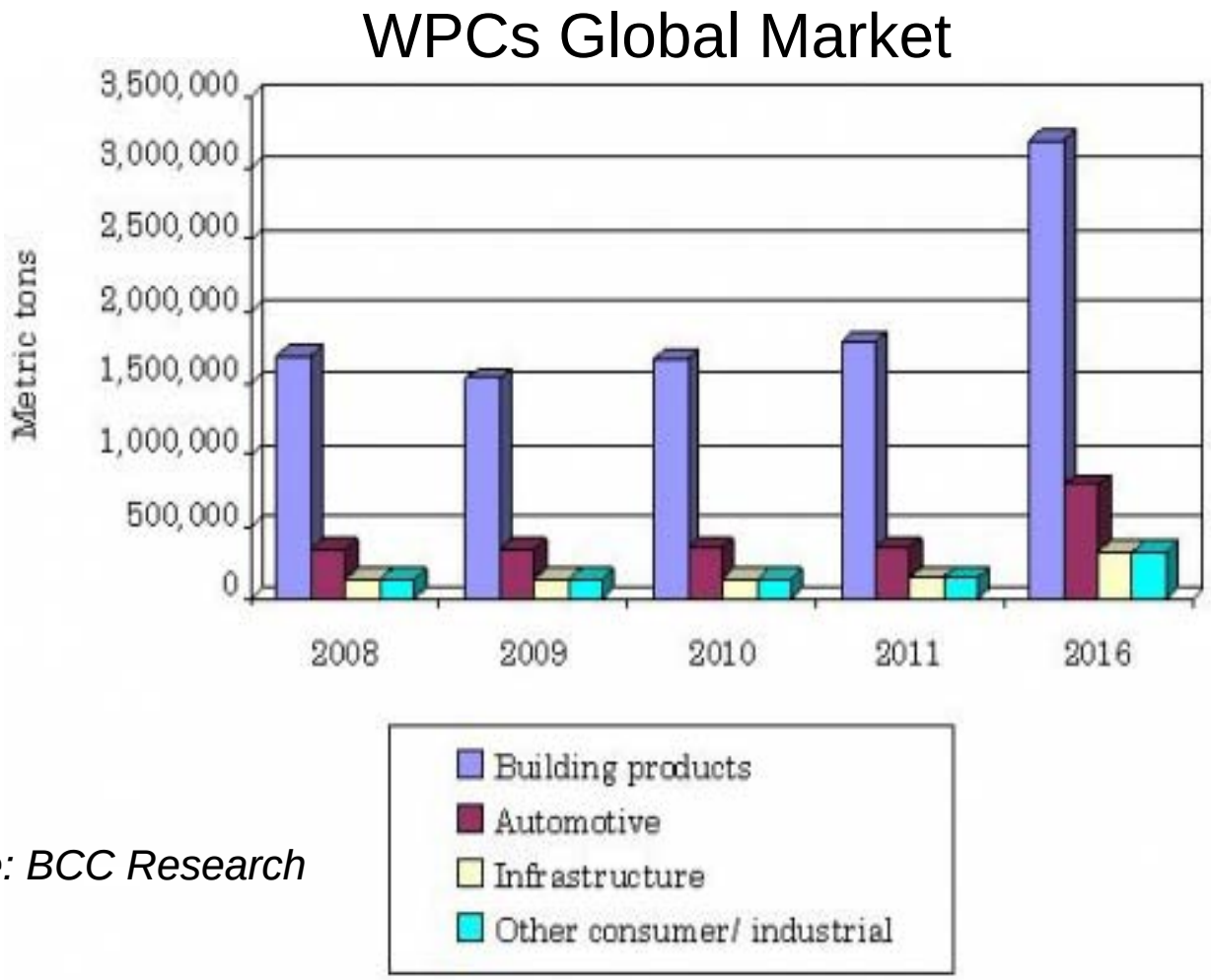
Market Background

- World market US $ 2.1 billion* (2010)
  - 15% compound growth last 5 years
- Based on lower melting point plastics; predominantly:
  - Polypropylene (PP)
  - Polyethylene (PE)
  - Polyvinyl Chloride (PVC)

Natural fibre composites - Lucintel

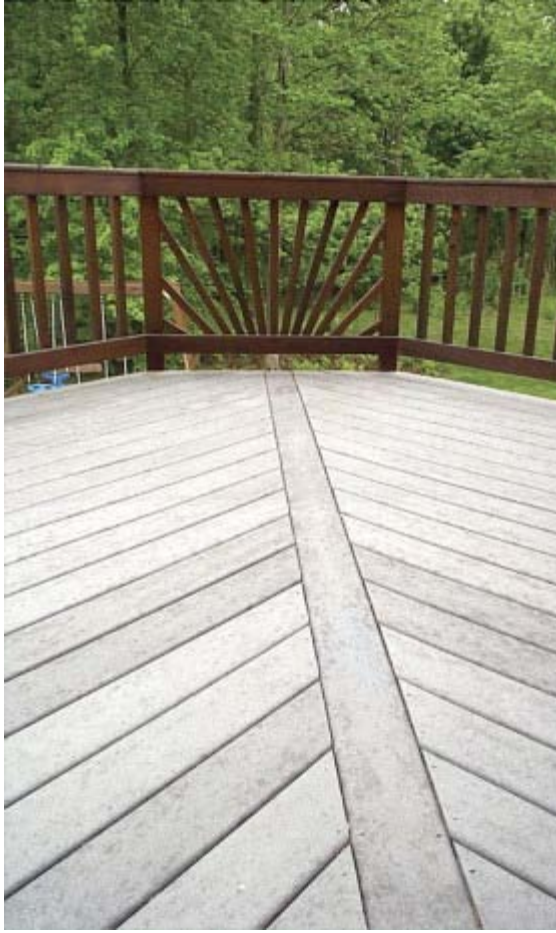
Beologic

WPC Applications



Source: BCC Research

North American Market



- Construction sector focused
- Using waste wood and plastic
  - Primarily HDPE and extruded product
- Decking has dominated and driven growth
  - 70% WPCs into decking and railing
- > US $ 1 billion WPC market (2010)

  (1 million tons/annum)

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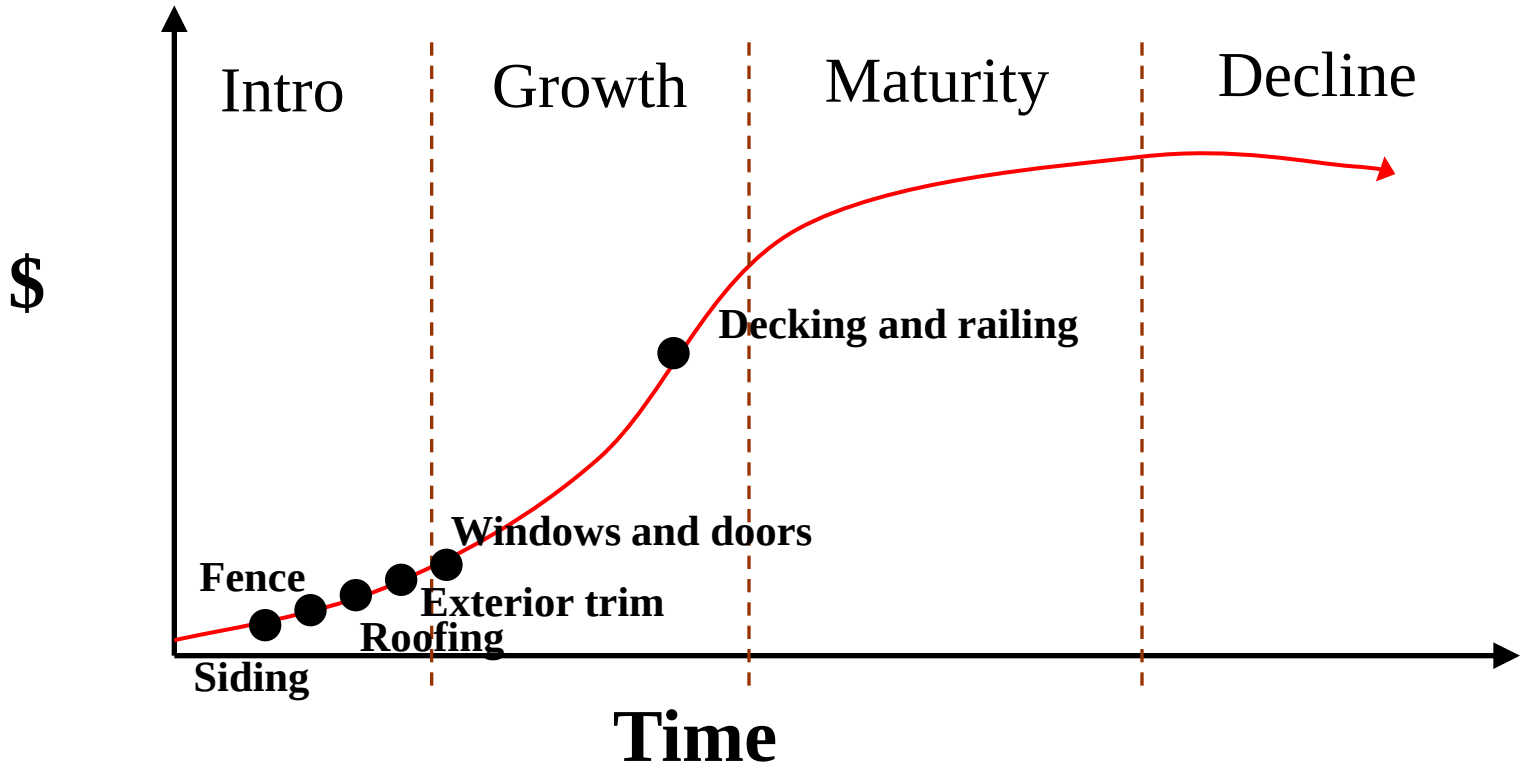
US WPC Market Trends



Sourced from Principia Partners 2008

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European Market

- 120,000 tonnes WPCs (2010) plus automotive
  - 51% annual growth
- Virgin PP and PVC most common (cf waste HDPE in US)
- Decking/extruded products taking off
  - Hollow or foamed profiles common

IKEA WPC chair - Ogla

Twinson decking

Polyplank profiles

European Automotive

- Long natural fibre reinforced plastics
  - Compete with glass fibre reinforced plastic
- ‘High tech product of renewable raw materials with special applications’

10 to 15kg weight saving
in C class Mercedes

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Asia

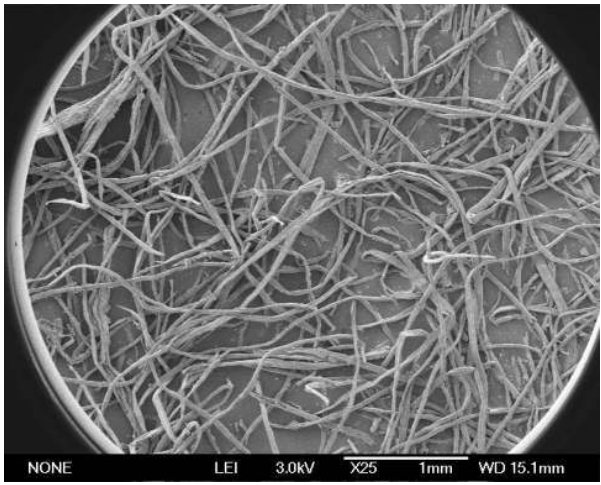
- Rapid growth from China
  - Government support
  - Low in timber resources
  - WPCs featured in Beijing Olympics 2008
  - China 80,000 tons (2006) to 300,000 tons (2010)
- Innovative products – decking, windows, doors
- Rest of Asia 114,000 tons (2010)

Toyota Prius – PLA kenaf

Example Chinese Products

- Addressing quality issues
- Companies with over 100 production lines
- > 500 patents awarded
- > 20 universities doing WPC research

Higher Performance WPC's



Fillers are added to plastics to:

- Reduce cost
- Improve stiffness
  eg wood flour, mineral fillers

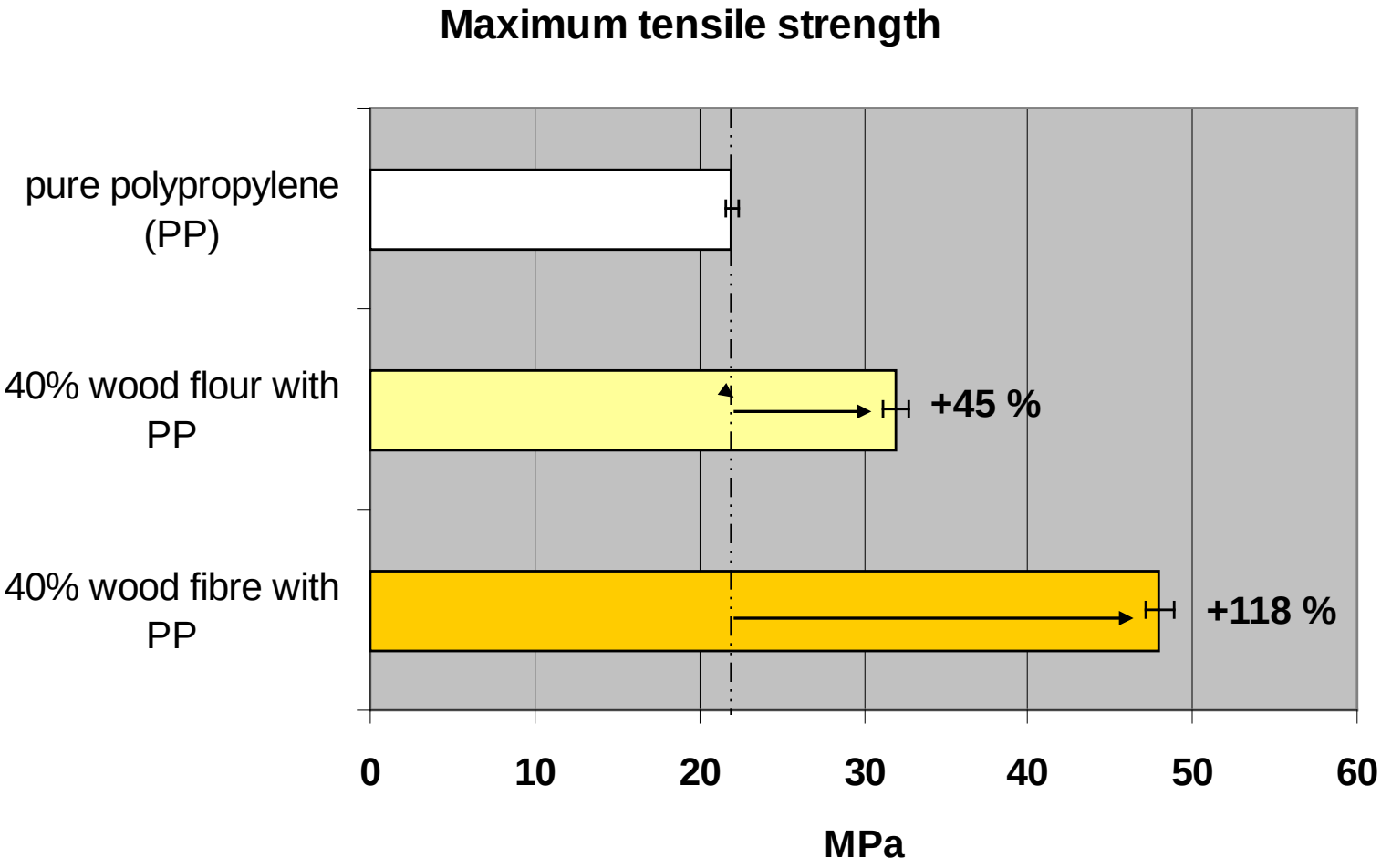
Fibres are added to plastic to:

- improve strength and stiffness (reinforce)
  eg glass fibre, agrifibre (some cost reduction)

Wood fibres can do both:

- Reduce cost
- Improve strength and stiffness

Strength Improvement from Fibre Reinforcing – Scion Technology



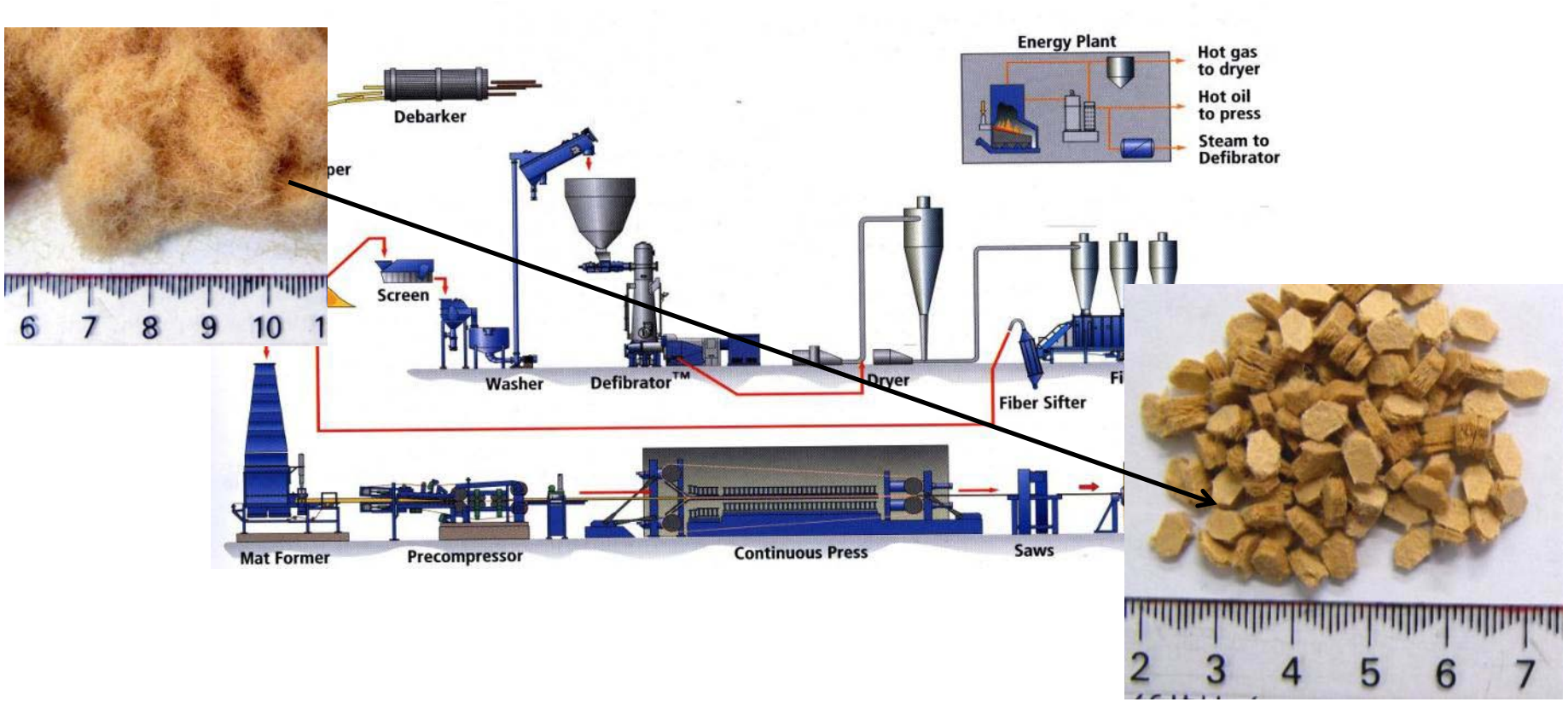
All samples polypropylene base and fibres ‘coupled’ to plastic

Technology Description

Loose wood fibre

Technology Description

“A patented method for manufacturing wood fibre rich pellets, that can be fed into plastics processing equipment to reinforce thermoplastic.”



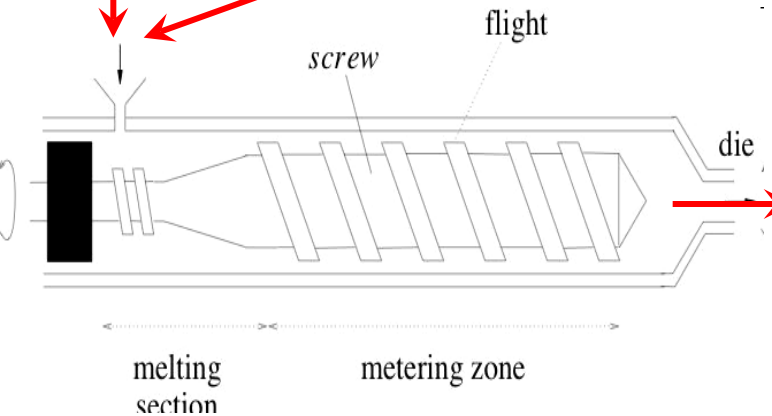
Other Benefits

- Consistent, reliable supply from MDF mill
- Easy to handle
- Free flowing
- Minimised dust and explosion risk
  (cf wood flour or loose fibre)
- Can be used with a range of plastics
  (including bioplastics)

Plastic/Composite Processing

Profile extrusion

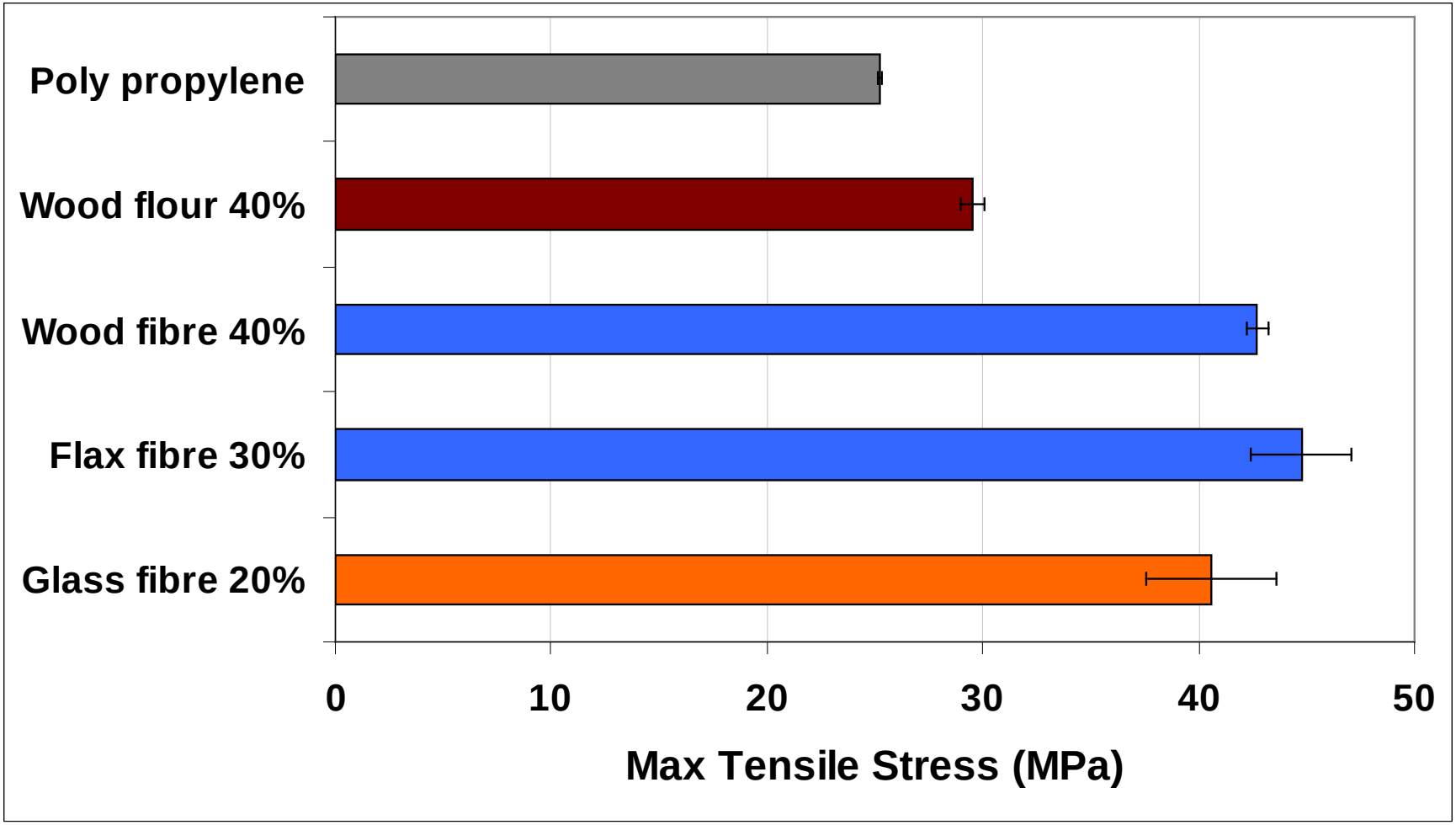
Wood plastic pellets



Extrusion Compounding

Injection moulding

Comparative Performance



All samples polypropylene base and fibres ‘coupled’ to plastic

Commercialisation

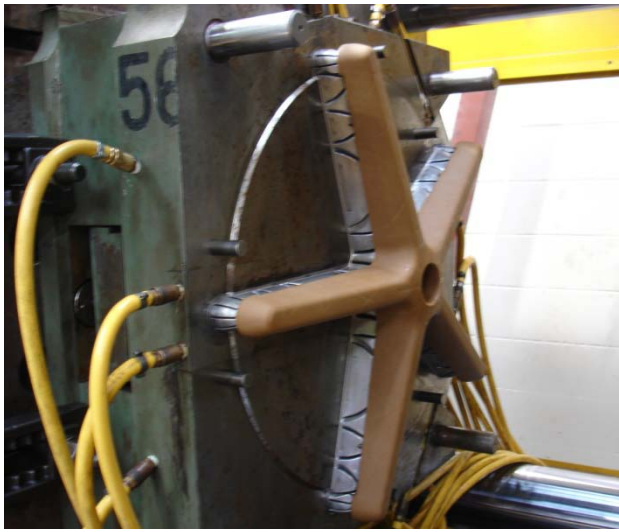
- NZ
  - Slow to commercialise
  - Limited injection moulding opportunities
- International
  - Sonae Industria signed license for Europe
  - US license option
  - Extensive interest
  - WoodForce™.

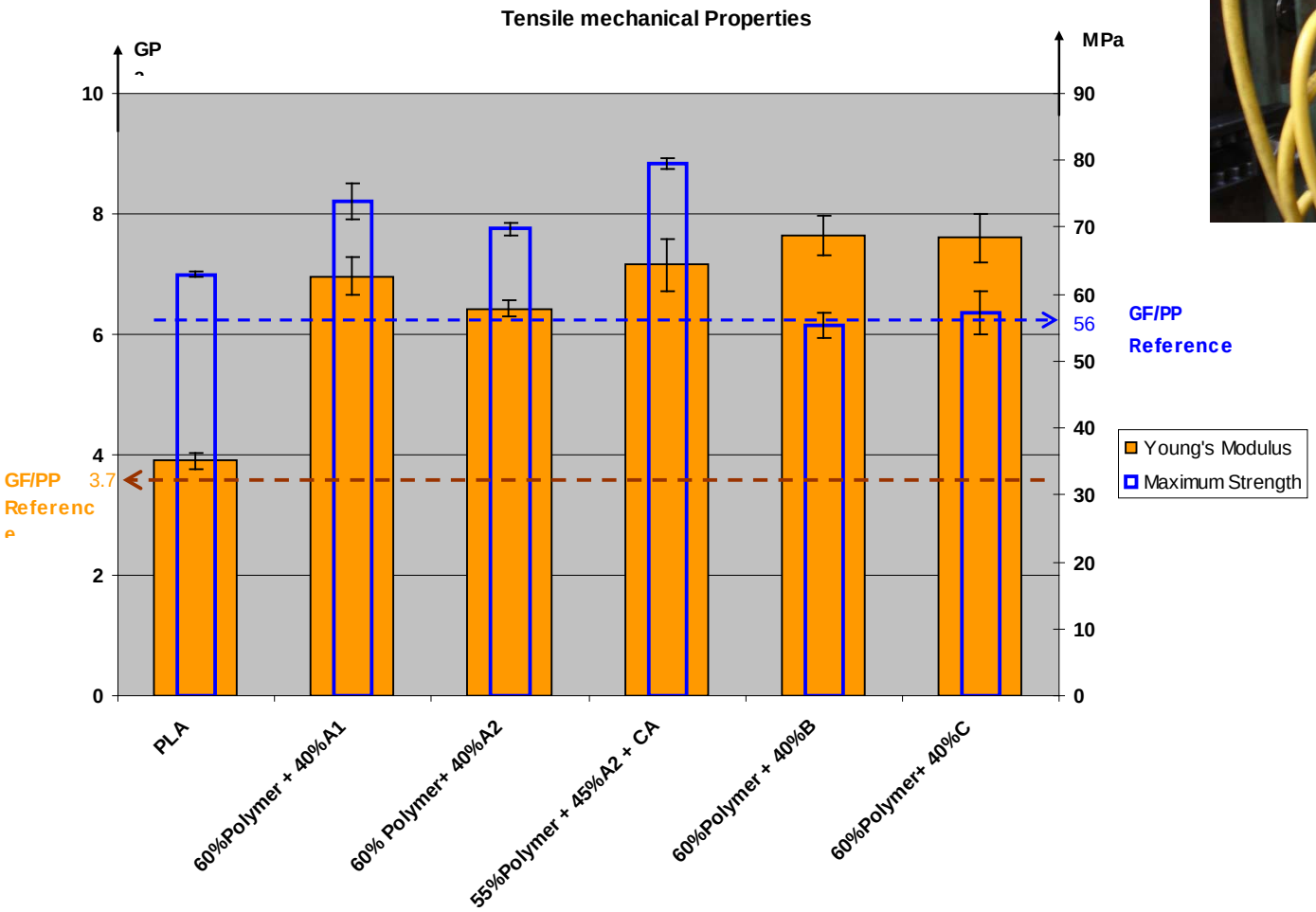
woodforce
natural strength for plastics

http://www.woodforce.com/

Wood Fibre Reinforced Bioplastics

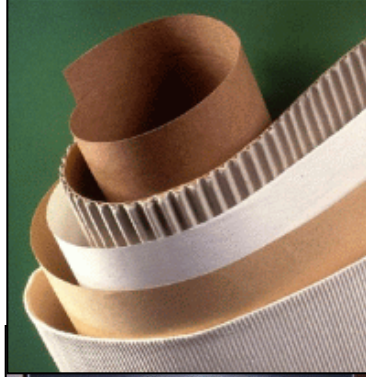
Five star chair base moulded at Galantai Plastics

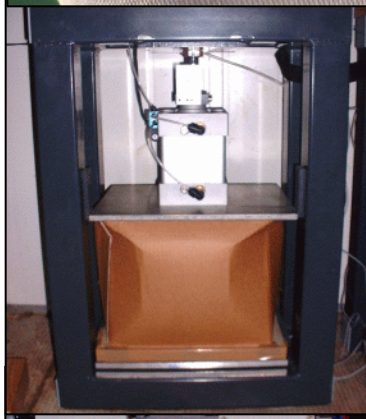


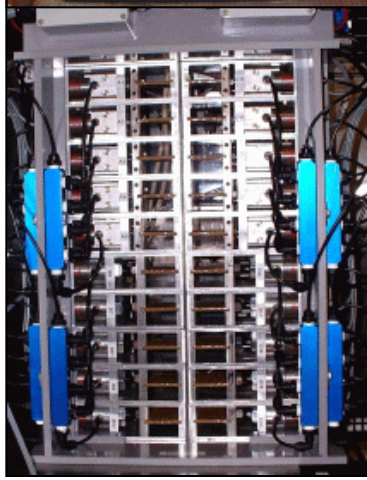


Fibre Based Packaging

- Fibre production and characterisation
- Paper making and pulp thermoforming
- Paperboard and box testing
- Research
  - Chemical functionalisation
  - Additives, Coatings
  - Hybrid Processes / Composites
  - Coated / Printed products
  - High humidity performance







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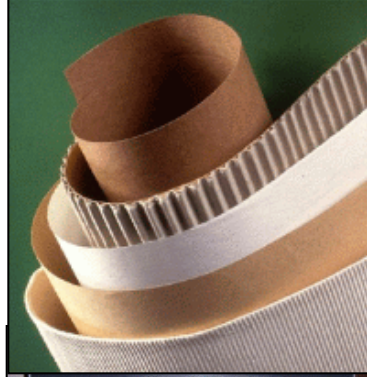
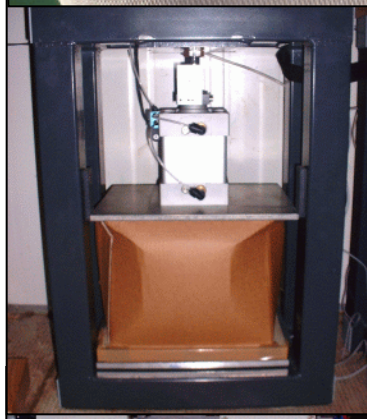
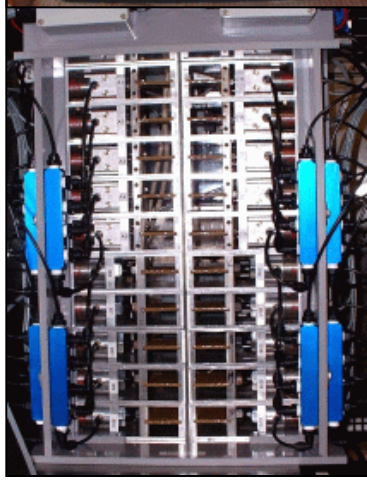
Functional Food Packaging*

- Supporting NZ food exports
- Coolstore application
- Improved creep resistance
- Barrier coatings
- Printing technologies
- Sensor / smart packaging technologies
- Anti-microbial







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*Collaboration with AgResearch, Plant and Food Research, Massy University, Victoria University,

Summary

- Wood Plastic Composites target sustainability
- Area of rapid growth and opportunity
- Novel technology developed and patented in NZ
  - wood fibre reinforcement
- Multi-material solutions need considering

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Typical Properties of polypropylene based WPCs injection moulded using MDF 'Fibre' for reinforcement.
Note: These are indicative properties only and could vary with materials and processing conditions used.

	Neat PP	30% Fibre	40% Fibre	40% flour (WPC)	Variability	Generic WPC	Generic Talc PP	Generic glass fibre PP
Tensile Modulus (GPa)	1.4	3.4	4.5	3.6	± 0.3	2.8 – 5.3	0.9 – 3.2	1.7 – 6.6
Tensile Max Stress (MPa)	25	35	44	32	± 2	21 - 35	21 – 30	30 - 90
Flexural Modulus (GPa)	0.9	-	4.4	2.4	± 0.2	1.9 – 4.9	1.4 – 3.0	1.6 – 6.7
Flexural Max Stress (MPa)	32	-	80	54	± 4	38 - 62	20 – 47	37 - 123
Izod notched Impact (J/m)	53	-	49	39	± 4	27 – 59	19 – 97	52 – 215
Izod unnotched Impact (kJ/m^2)	-	-	180	-	± 10	-	315 – 830	418 – 813
Flow Shrinkage ex mould (%)	1.7	-	0.3	0.5	± 0.2	0.4 – 0.8	0.6 – 1.4	0.08 – 0.6

'Generic Properties' were obtained from *http://prospector.ides.com*. These are typical values for a wide range of PP grades and filler loadings. Variability is an estimate only, based on a number of different sets made using similar setting over a period of time..

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