H & P Moulding

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Brief introduction

- Injection moulding company since 1979
- 19 IM machines
- Processing of (almost) all thermoplastic materials
- For 8 years processor of various types of bio-plastics, with focus on PHA
- Collaborating with other companies and institutes

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Business Scope

High Tech (verwarmingsindustrie) : Resideo, Bosch

Med Tech : Menicon, Johnson & Johnson Vision

Bio based : Happy Cups, Wad van Waarde

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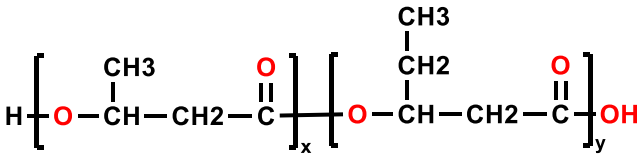
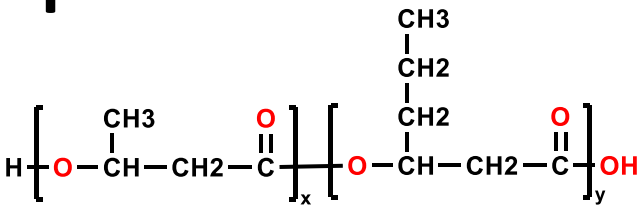
Current PHA products



PHBV



PHBH

More applications:

- Has good gas permeability barrier → good for food packaging
- (Disposable) plastics for medical industry,
- Still looking for more applications

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Processing PHA

Tensile bars

Moulded various PHA materials into tensile bars for various uses. Optimal processing temperatures and conditions were recorded for reference.

Enmat Y1000P

- Recycling tests
- Research
- Mechanical tests
- Degradation tests

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Processing PHA

Tensile bars

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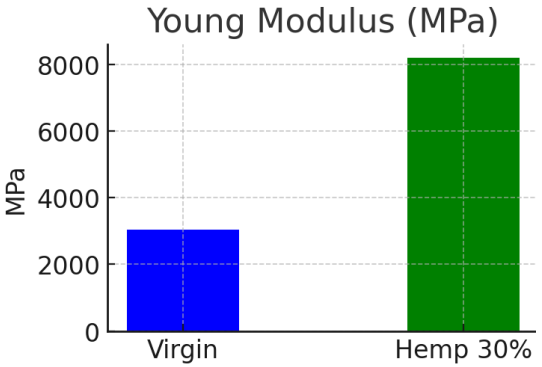
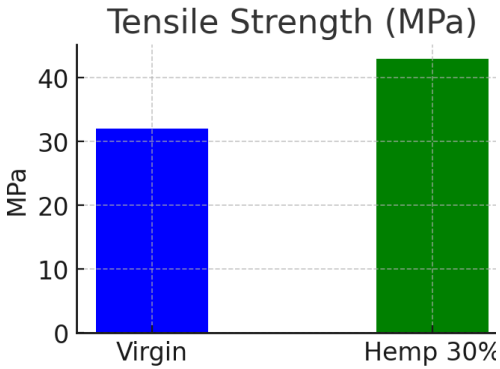
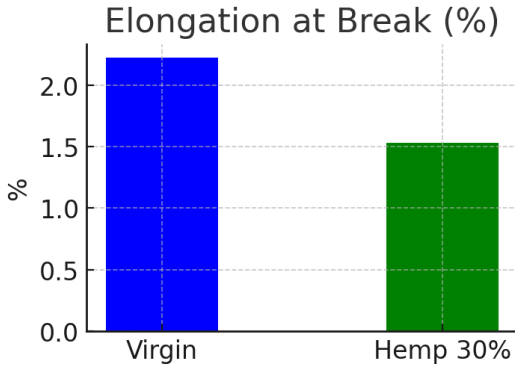
Enmat Y1000P + 30% Hemp fibres

- Feasibility tests
- Mechanical tests







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Processing PHA

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Kaneka X331N

- Research

PHACT 1000

- Feasibility test - alternative to TPE?
  - Soft rubbery material

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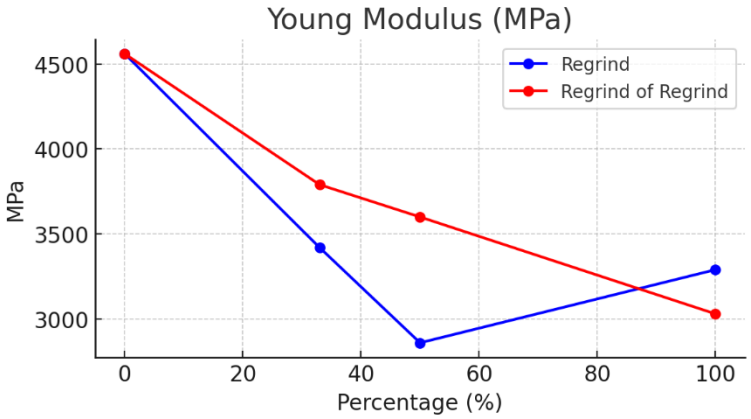
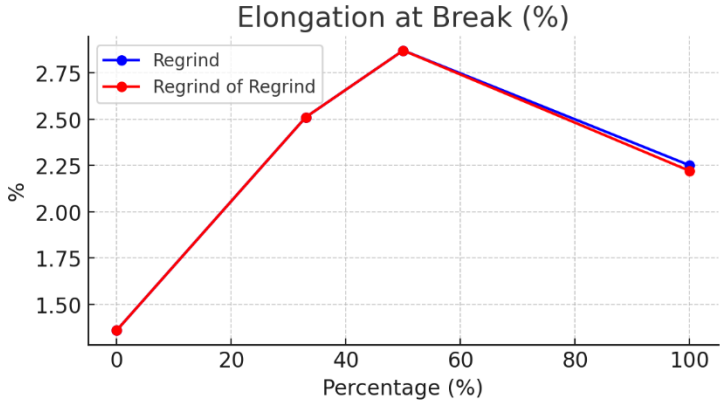
Recycling PHA

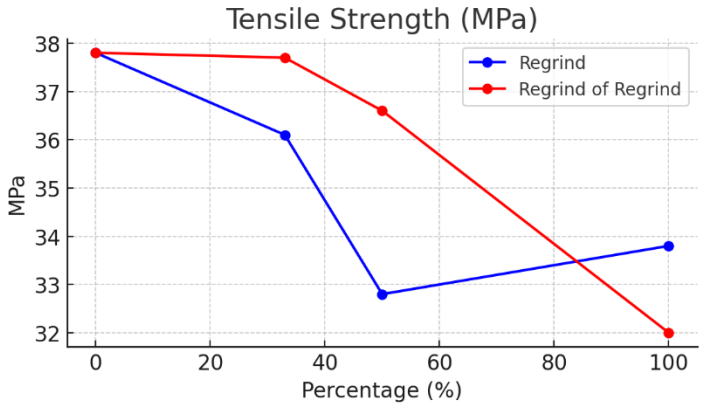
Tensile bars

Testing the effect of recycling PHA on mechanical properties and observing trends with various percentages of regrind

Enmat Y1000P







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Recycling PHA

Cups

Testing how regrind affects processibility and appearances of cup products. Increased amount of regrind caused increased amounts of flash. No observable change in feel or appearances.

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Product testing

Wadkop

The Wadkop cup is composed of three units: cup, ring, and lid.

- Each product unit was moulded with various PHA materials to test suitability.
  - Enmat Y1000P – rigid and crystalline
  - Kaneka M304 – semi rigid and more amorphous
  - Kaneka X331 – rigid and more amorphous
  - Biomer P209P – flexible and crystalline
  - Biomer P263 – more rigid and crystalline
  - Compounded PHBV with slip agents

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Product testing

Wadkop

Lid	Ring	Cup	Comments
Enmat	Enmat	Enmat	Poor fitting dimensions → ring too small Adhesion of lid to cup → Very difficult to open Leakage present
X331	X331	X331	Average fitting dimensions → ring slightly too small Adhesion of lid to cup → Very difficult to open No leakage
M304	M304	M304	Good fitting dimensions → correct size ring Adhesion of lid to cup → Very difficult to open No leakage

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Fitting dimensions: More amorphous PHA has better dimensional stability. Shrinkage differs between crystalline and amorphous materials.

Material adhesion: All PHA shows significant adhesion, even with slip agents

Prevent leakage: Cup and lid must be flexible material

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Degradation tests

Tensile bars

Buried ~ 4 months vs new

Running Degradation tests

Tensile bars

New degradation tests are being conducted with enmat. Three tensile bars are buried outside. Degree of degradation and mechanical properties will be tested after 6-12 months.

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Running Degradation tests

Cups

Degradation under ideal circumstances. High amounts of fertiliser in soil.

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Why not use PHA for everything?

- How can we increase the acceptance of bio-plastics
  - Technically
    - Mechanical properties on par with fossils?
    - Consistent quality?
  - Financially/economically 
  - Validation 

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High quality & **P**recision Moulding