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BRINGS OUT THE BEST IN PLASTICS

# High Performing Talc Reinforced Polypropylene for Automotive Weight Reduction

# Polykemi AB

## Independent thermoplastic compounder

- Family ownded, started 1968
- Employees: 200(EU)+50(CH)
- Turnover >EUR 65 Mil.
- 25 Compounding lines
- Production: 38.000 ton/year (50% PP-based)
- Customers: 50% Automotive, 90% Injection moulders


## Subsidiaries:

**Rondo Plast AB – Compounds based on recycled raw materials**

**Scanfill AB – Olefinic packaging materials**

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# Polykemi - 2015

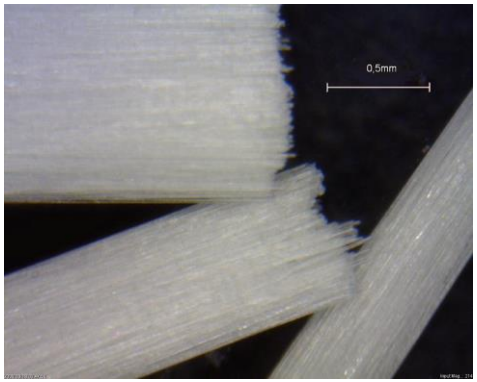
# >PP GFxx< - Decades old work horse

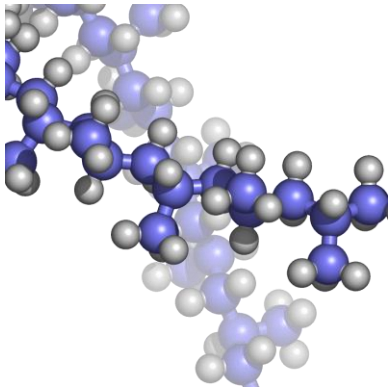
**Polykemi trade names:**

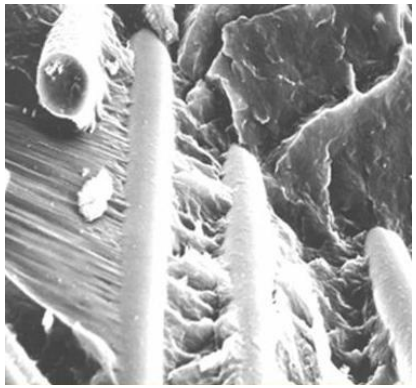
- **POLYfill HIP HC – Talc reinforced Polypropylene**
- **POLYfill HC – Glass reinforced Polypropylene**

➢ **In 2008 Polykemi decided to update >PP GFxx<**

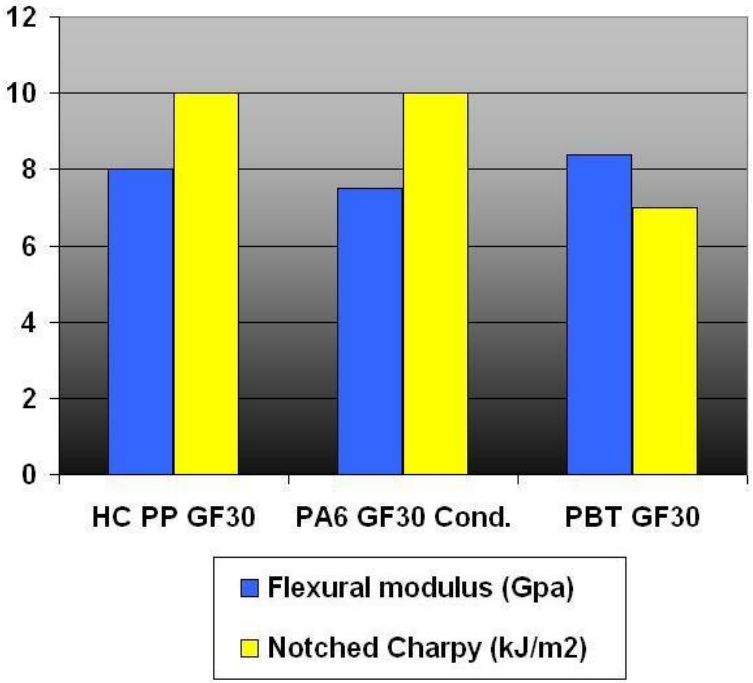
✓ Combining the best raw materials with the most recent advances in Process technology

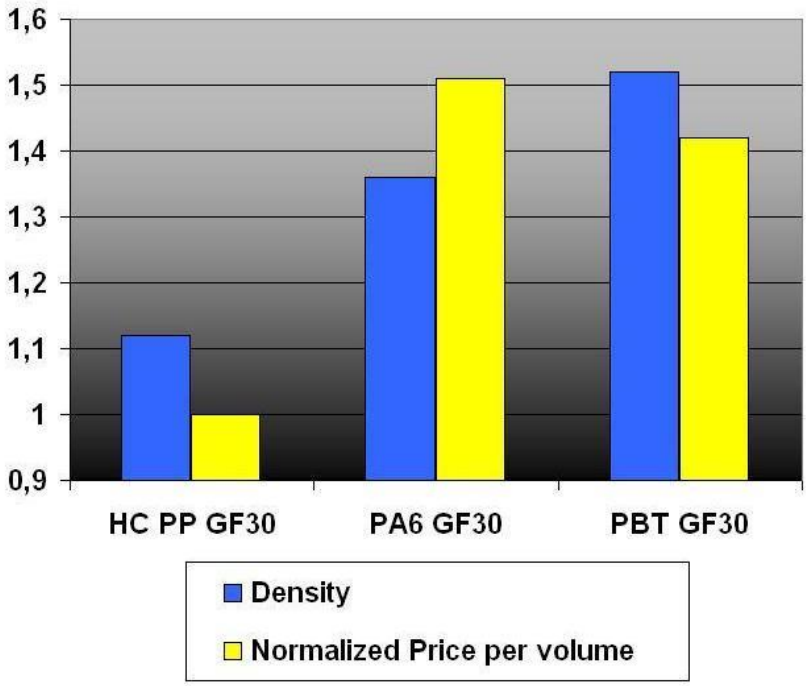




# POLYfill HC – saving weight since 2009

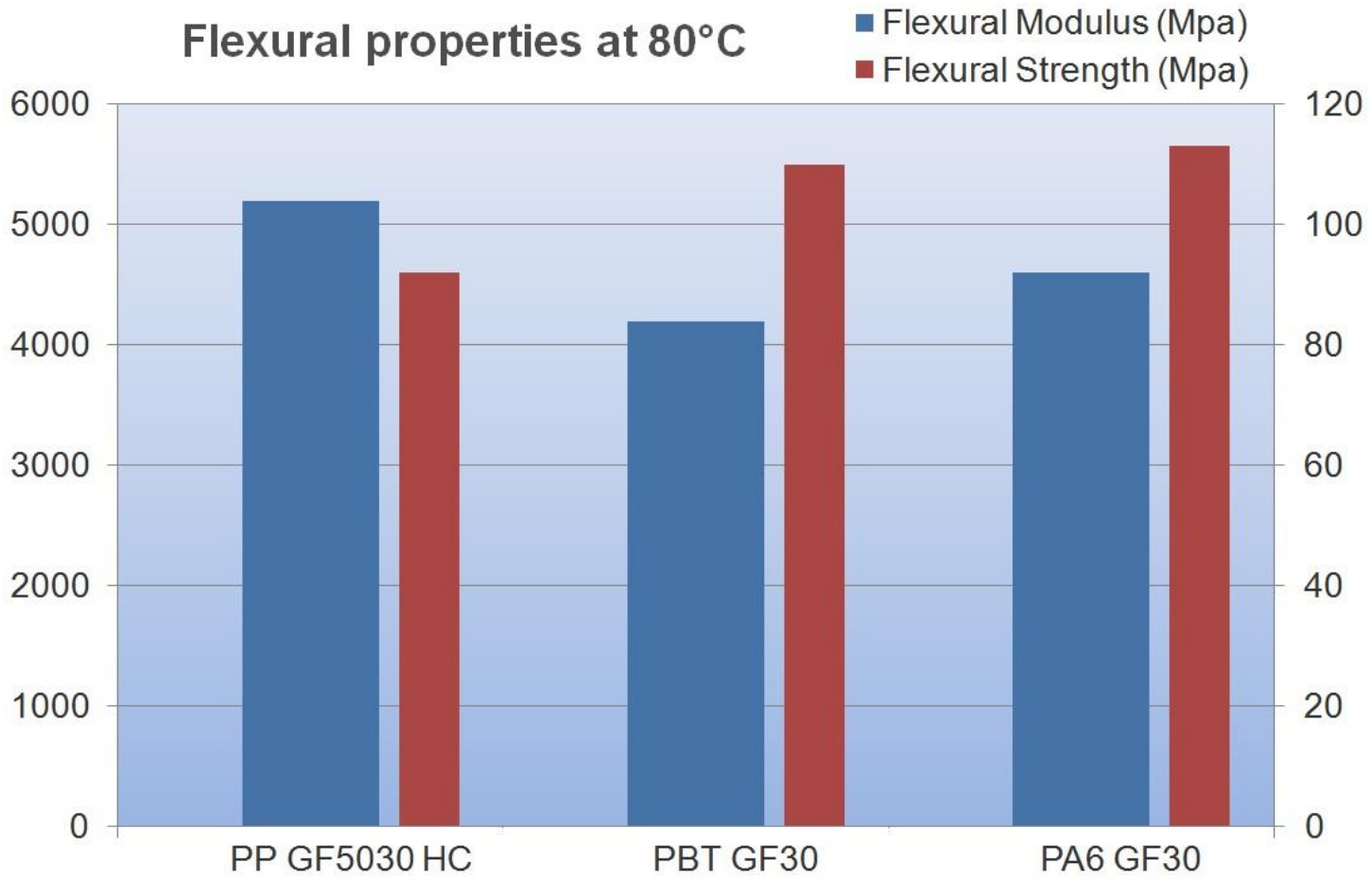



## High performance PP GF-compound

- Traditional solution might be 50% more expensive or 40% heavier (!)
- Competitive even against ”industrial” PA-grades
- Light weight with a cost advantage!

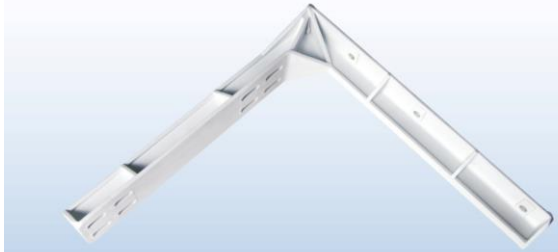
# Performance at elevated temperatures

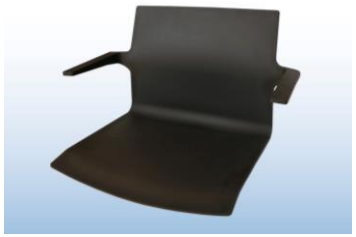



- Stiffness similar to PA6 and PBT GF30 at 80°C
- Long term properties can be ensured with optional heat stabilisation

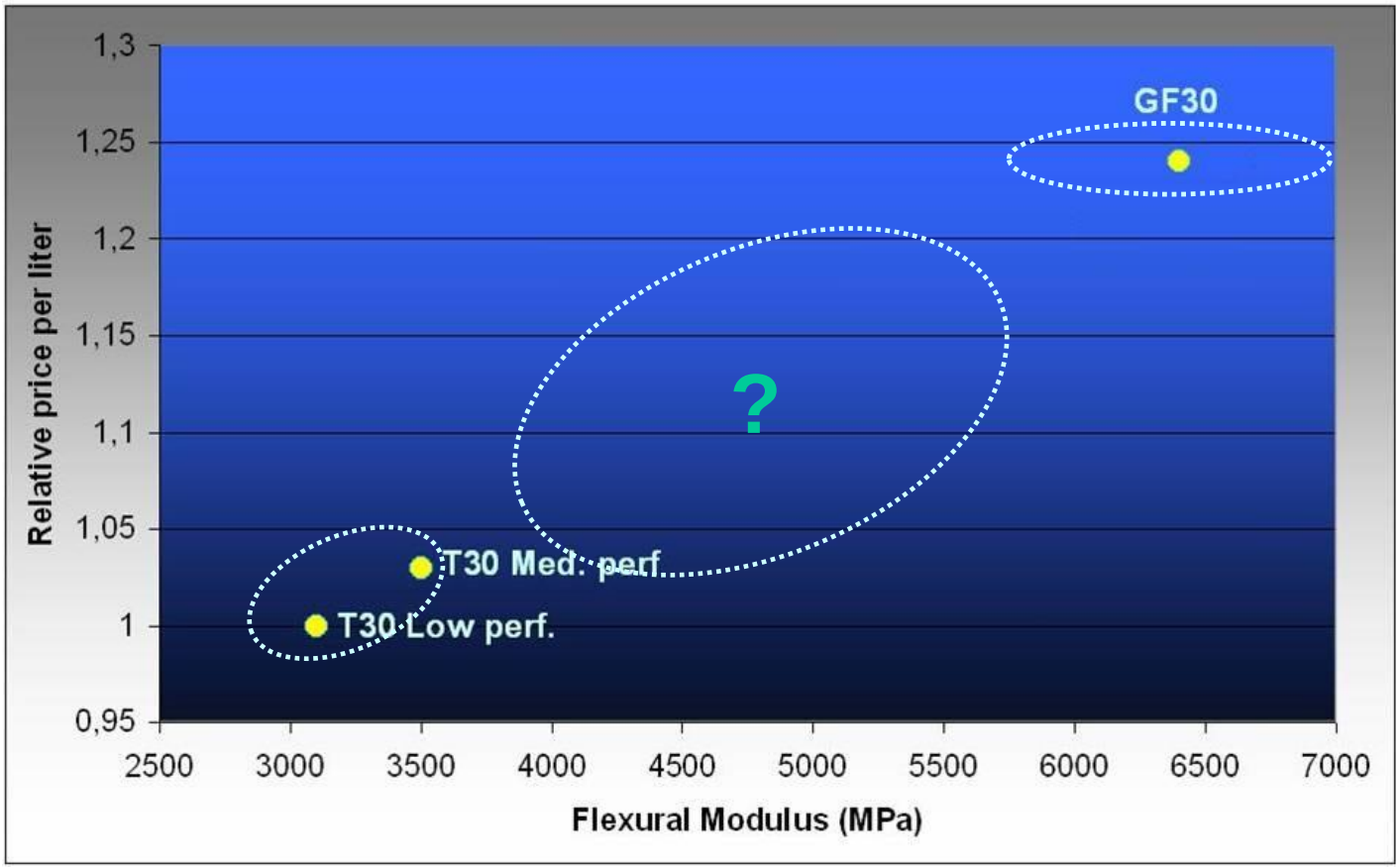
# Reducing weight with POLYfill HC –

## It works!



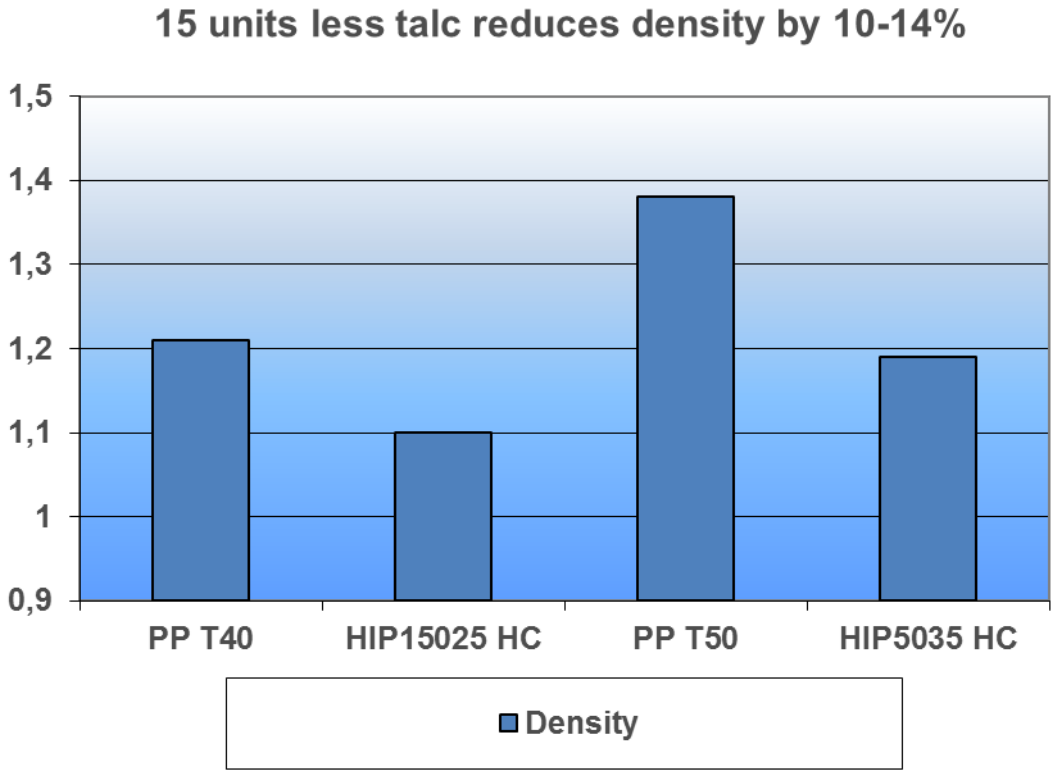


# How can we push the boundaries of *talc* reinforced PP even further?



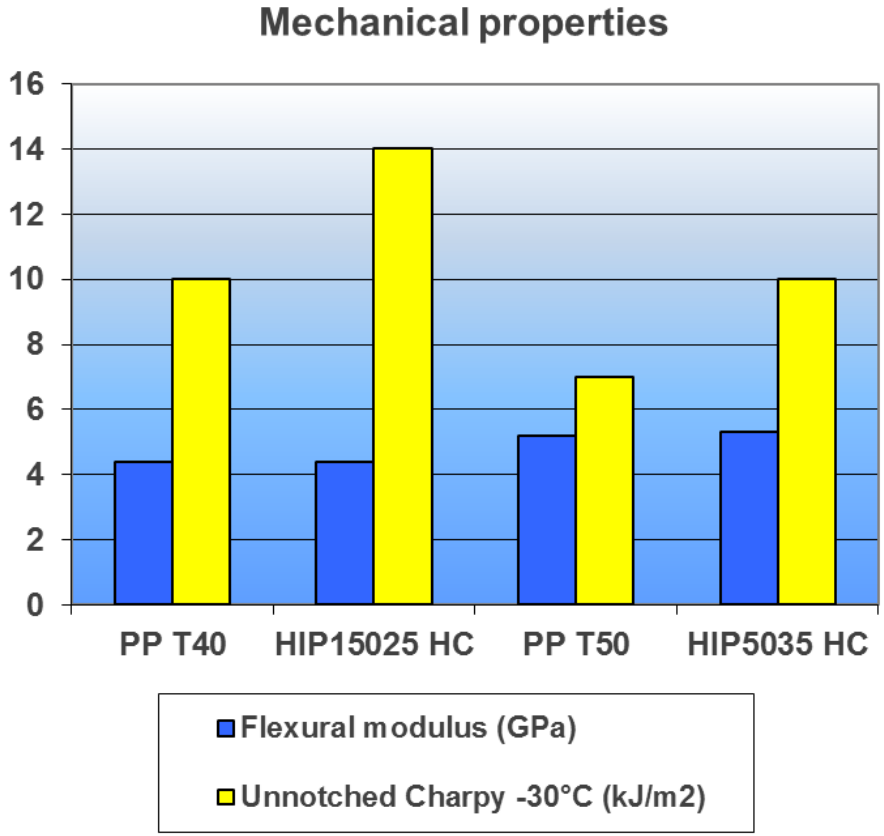

- ✓ Cost optimization of over engineered PP GF10-30
- ✓ Weight saving relative to PP T20-50

# Weight saving by density reduction




- ✓ Material substitution with a lower density material has an insignificant technical risk and enables a resource efficient and rapid implementation.

# Less talc – same properties

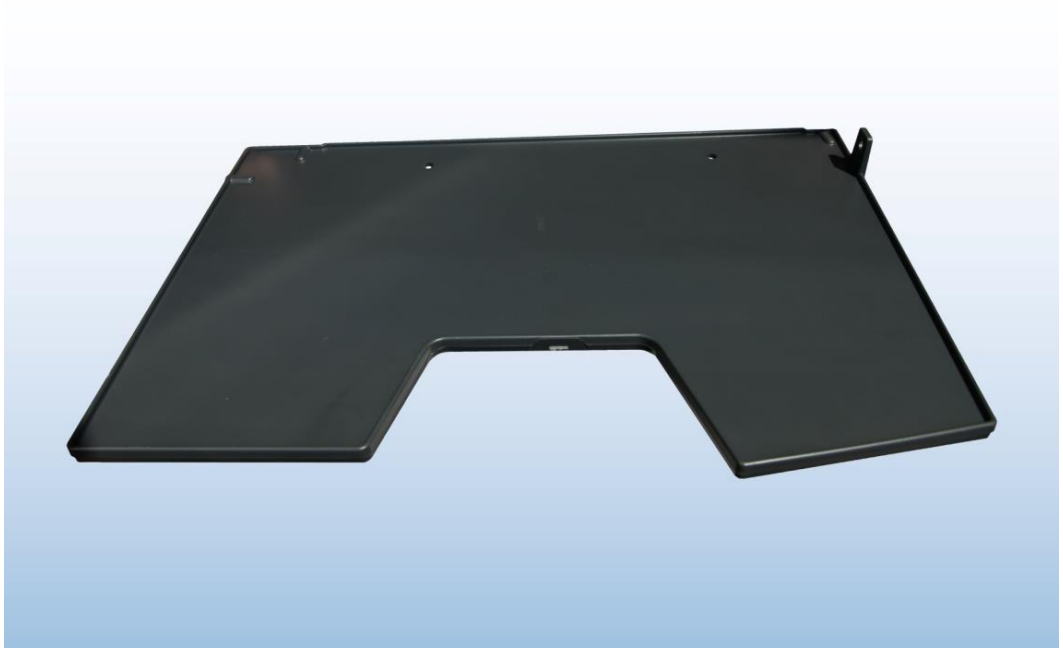



- ✓ Mechancial and thermomechanical properties are equal or better than traditional materials.
- ✓ 15 units less talc results in different shrinkage!

# POLYfill HIP15025 HC used in VW XL1

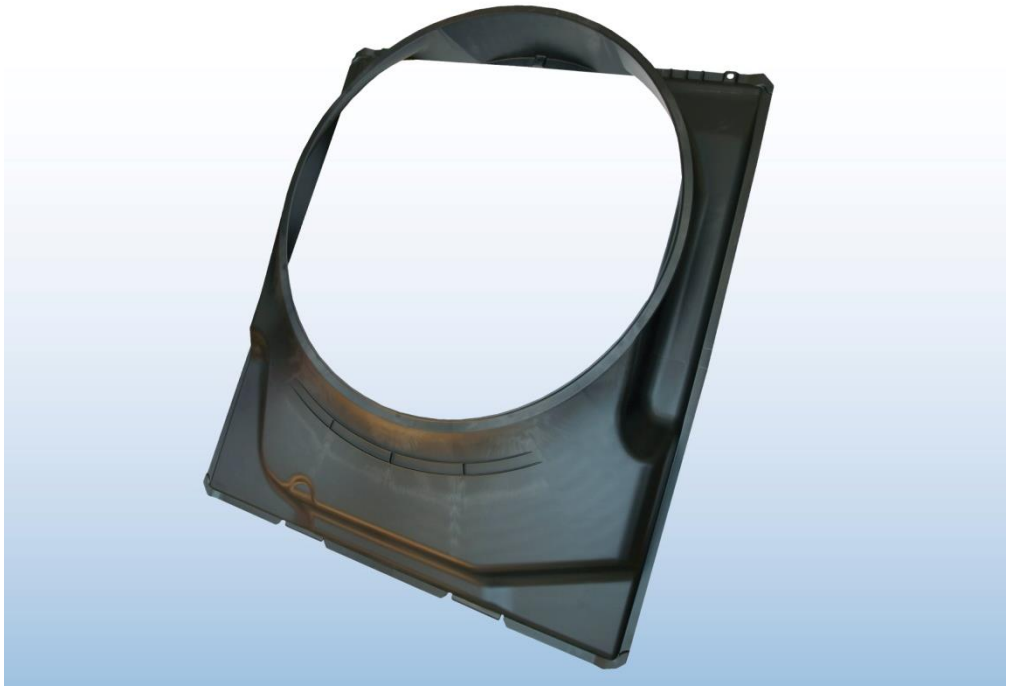
- ✓ Innovative material for an innovative car – HIP15025 HC employed in the headlight housing
- ✓ Weight saving compared to traditional PP T40

# Commercialised - POLYfill HC:



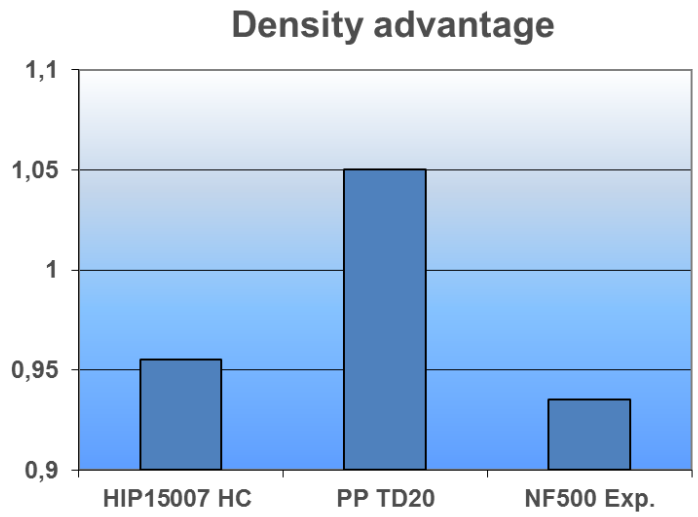
- ✓ Storage shelf – Truck interior
- ✓ Material: POLYfill PP HIP15025HC Grey
- ✓ Has replaced an expensive metal & plastic hybrid
- ✓ Features: Improved scratch resistance, thermal stability, weight reduction and lower system cost

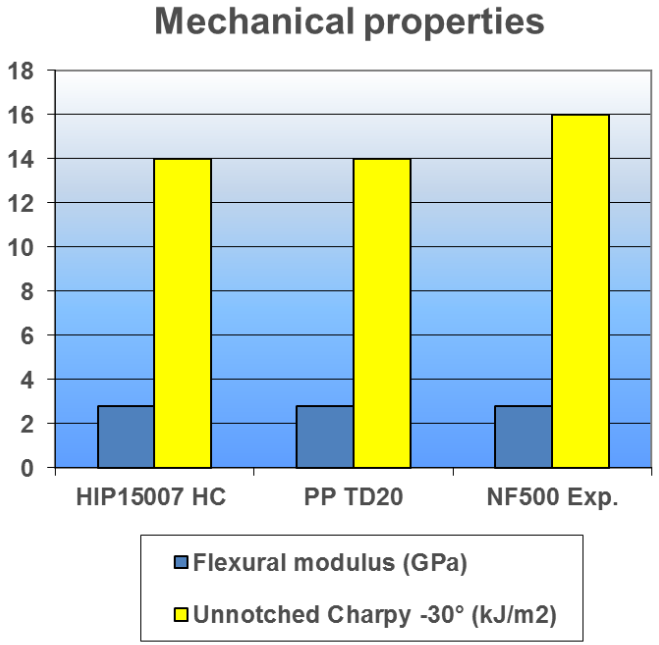
# Commercialised - POLYfill HC:



- ✓ Fan shroud – engine compartment - Truck
- ✓ Material: POLYfill PP HIP5035 HC VT2
- ✓ Has replaced PP with 50%Talc
- ✓ Features: Improved dimensional stability at high temperatures with reduced part weight

# Next step – Confront PPH TD20




- ✓ Performance profile of traditional PP TD20 possible with only 7% talc!

Charpy unnotched at -30°C shown to accentuate the lack of differences in impact performance.
NF500 is an experimental grade with natural fibre.

# High performance talc, high performance polymer…

## Can we really afford this?

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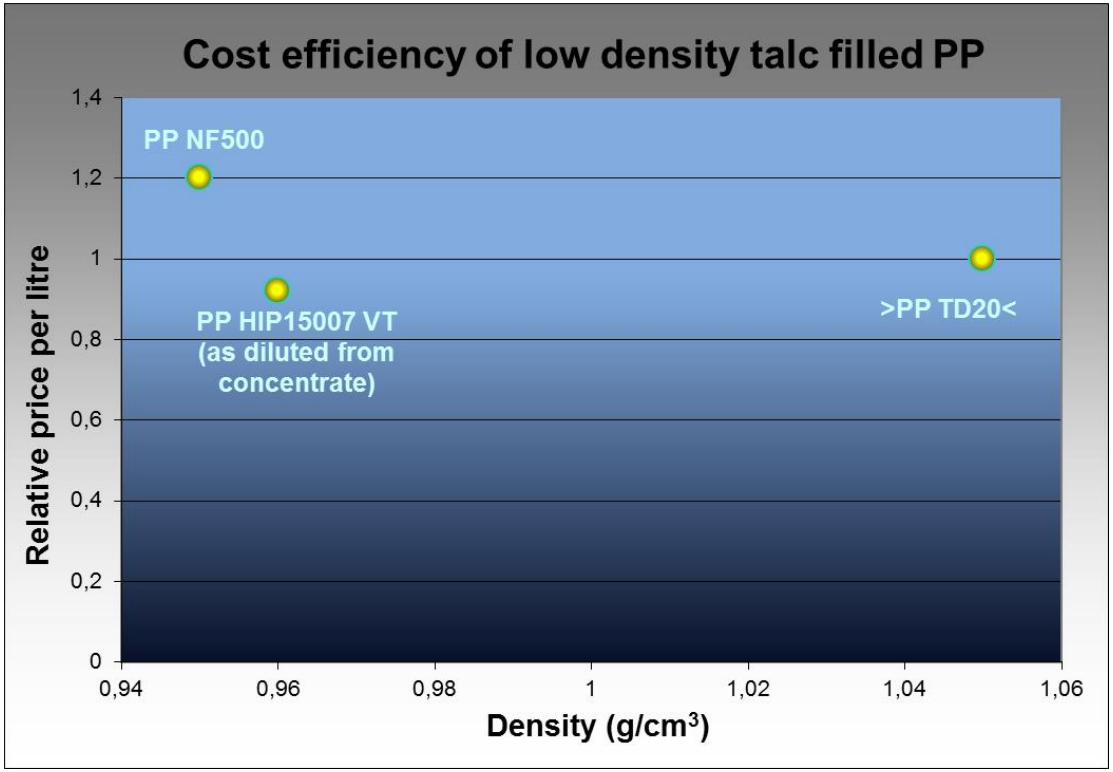
# Can a “salt & pepper-mix” be a route to superior PP TD07 cost efficiency?

- ✓ 1/3 concentrate with 21% + 2/3 reactor grade PPH dry blend significantly reduces production costs
- ✓ Automotive TIERs already mix PP LGF and PP Talc concentrates for structural parts and bumper fascias
- ✓ The molder can mix by himself or buy a premix

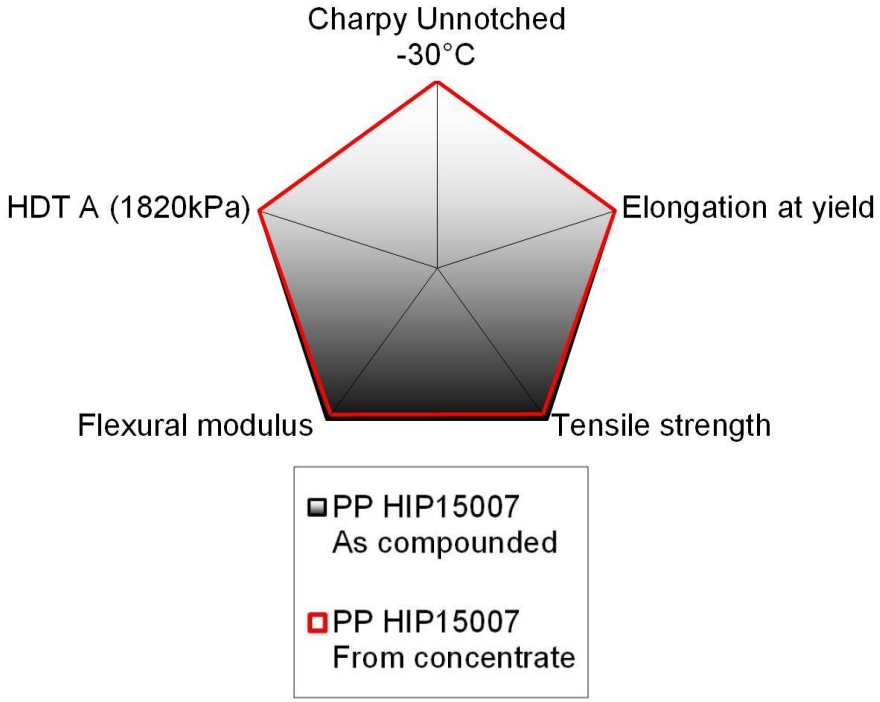
# Cost saving by salt & pepper-mixing




✓ Weight reduction AND cost reduction are possible at the same time

The >PPH TD20< in the above comparison is a virgin, highly heat stabilised talc reinforced polypropylene homopolymer coloured black.
The natural fibre reinforced NF500 in the comparison is a 100% compound.

# Dilution from concentrate




A 21% talc filled concentrate is diluted with a ”generic” virgin high performance PP hompolymer that has a matching viscosity for maximum compatibility.

Specimen were produced on a 35T clamping force Arburg. Relative to typical settings the back pressure and fill time were slightly increased to somewhat increase the mixing taking place in the barrel.

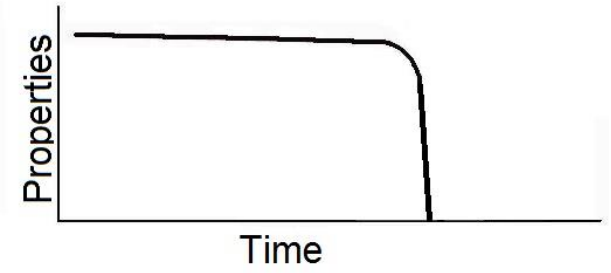
- ✓ Tests confirm dilution does not sacrifice properties
- ✓ Also dilution of concentrates from variations of HIP15007 has been confirmed possible
- ✓ Two grades of PP for dilution validated at this point

# Long term heat ageing

- ✓ Design target – To be able to pass the infamous VW-heat aging test of 150°C for a minimum of 700 hours

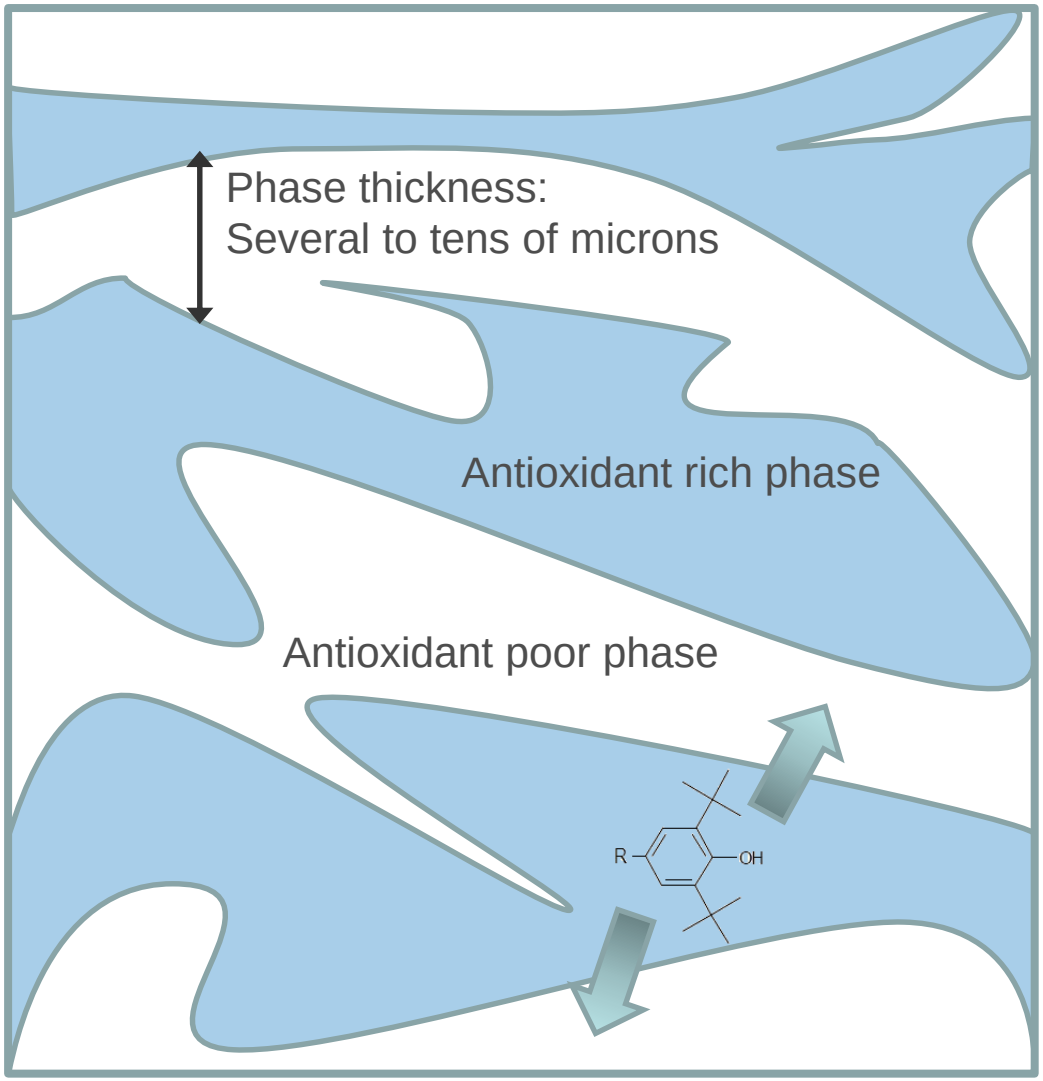
VW 44045:PP6 has the requirement for >PP-TD20< materials, for other than interior uses, to pass 700hours without showing ”signs of disintegration typical for decomposed PP”. Ageing is taking place continuously in an oven with mechanically circulated air.

Characteristic behaviour of PP during heat ageing:




- ✓ Procedure: Molded plates (thinnest section 1mm) are monitored for signs of ageing

# Dry blend two phase morphology




- Virgin resin: Stabilized for 200-400h at 150°C
- Concentrate: Stabilized for >>1000h at 150°C
- Concentrate also contains talc and carbon black, which inhibits migration while it also destabilizes its own phase!

This blend survives 1000h at 150°C

!

# Weight saving opportunities

| Interior: | Existing material: | POLYfill Proposal |
|---|---|---|
| Dashboard structural parts | PPH TD20 | HIP15007 HC |
| Parts of center console | PPH TD20 | HIP15007 HC |
| Air intake duct | PPH TD40 | HIP15025 HC |
| **Under the hood:** | | |
| Air filter box | PPH TD40 | HIP15025 HC |
| HVAC Unit | PPH TD20 | HIP15007 HC |
| Timing belt cover | PPH TD40 | HIP15025 HC |
| Engine cosmetic cover | PPH TD40 | HIP15025 HC |
| **Exterior/Other:** | | |
| Head light housing | PPH TD40 | HIP15025 HC |
| Rear light housing | PPH TD20 | HIP15007 HC |
| Fog lamp support | PPH TD20 | HIP15007 HC |
| Fuel supply system canister | PPH TD40 | HIP15025 HC |
| Cowl grille | PPH TD20 | HIP15007 HC |
| Bumper technical parts | PPH TD20 | HIP15007 HC |
| Central bumper reinforcer | PPH TD20 | HIP15007 HC |

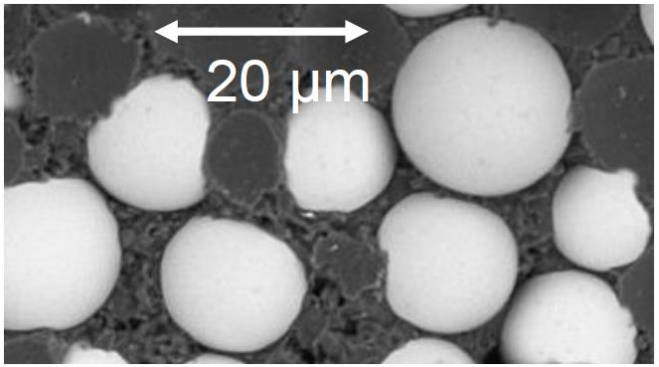
**Market references TD20:** Hostacom M2 U02, Exxtral HMU202, CMU201
**Market references TD40:** Hostacom M4 U05, M4 U02, Exxtral CMW402

# Challenges for a 7% talc compound

- ✓ The automotive industry has a preference for reducing weight with high profile step changes
- ✓ Implementation of the comparatively even more attractive offering with high performance PP GF materials has been slow
- ✓ The higher shrinkage prevents implementation in existing molds in many cases
- ✓ Recycled PP TD20 will still be cheaper in many applications

# On the upside…

- ✓ Weight saving possible with very low risk, low implementation cost and reduced price per part
- ✓ Combination with glass bubbles, Mucell or other foaming technology can reduce density further, while nullifying the issue with higher shrinkage relative to PP TD20




*PP homopolymer with 4% glass bubble & 6 % fine talc*

| | |
|---|---|
| Charpy Notched, (kJ/m$^2$, 23°C) ISO 179 | 2,7 |
| Charpy Unnotched (kJ/m$^2$, 23°C) ISO 179 | 20 |
| Charpy Unnotched (kJ/m$^2$, -30°C) ISO 179 | 12 |
| Flexural modulus (MPa) ISO 178 | 2700 |
| Flexural strength (MPa) ISO 178 | 54,4 |
| Ash content (%) | 10,3 |
| Density (g/cm$^3$) | 0,92 |

**Average shrinkage HIP15007 VT:** 1,8%
**Average shrinkage 6% fine talc & 4% glass bubbles:** 1,4%

# On the upside…

- ✓ This is not some dubious ”nano-magic”! This technology is reproducible, reliable and easy to wrap ones head around.

The properties we have with HIP15007 are more or less what the "nanoclay concept" promised ten years ago.
That involved adding 6% nanoclay (costing ten times that of talc) to polypropylene, together with a few percent of coupling agent (costing twice that of polypropylene).

The talc approach is a lot smarter.

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# Thank you for listening!

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www.polykemi.se