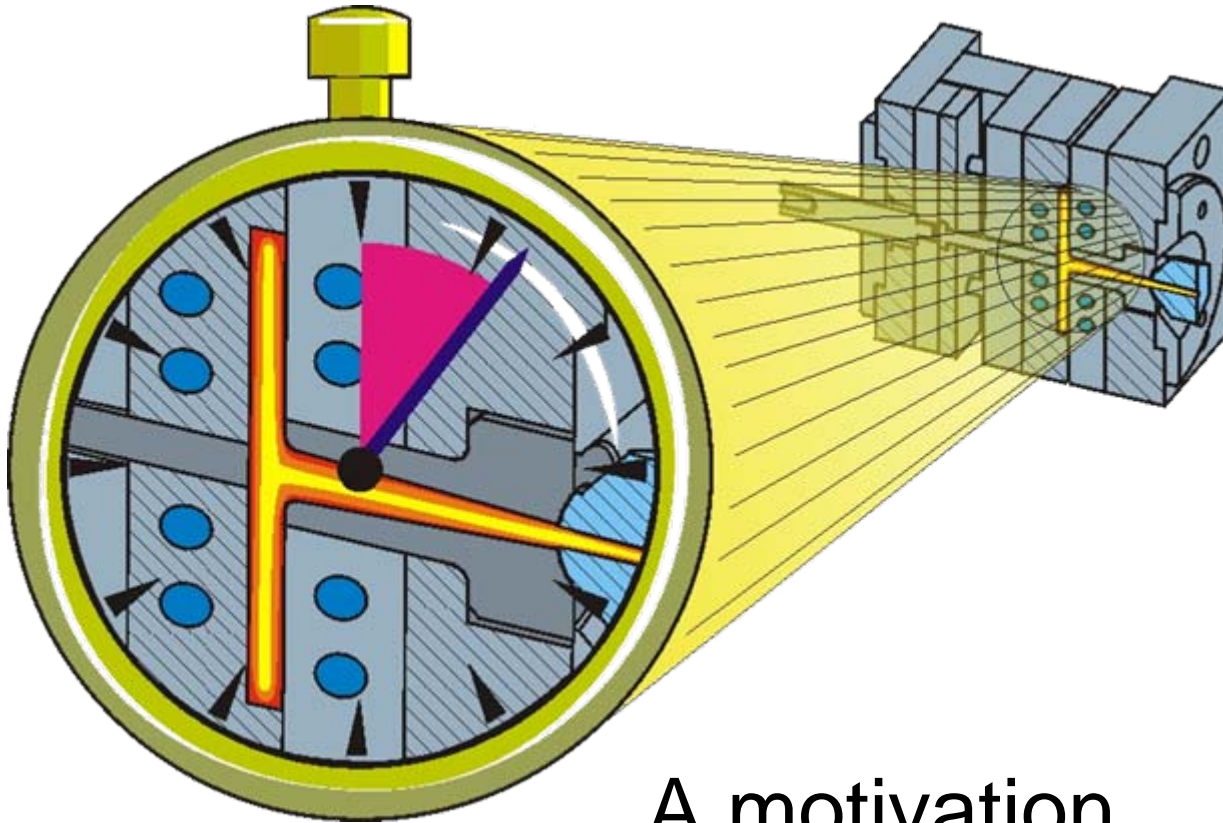


# Is the cost competitive material your best choice ??



A motivation

to look into more detail ...

# What is the most important technical property of a plastics material ?

Is it

- Stiffness / Strength ?
- Toughness ?
- Chemical resistance ?
- Temperature resistance ?
- Surface appearance ?
- Colour ?
- Processing characteristics ?
- ...

Or is this “technical” property called

- Price per kg ?

# Questions “answered” here

What should I consider when producing / planning a new part (price/kg or price/litre) ?

What are the additional cost-effects and time effects I need to consider ?

Is it possible to use a more expensive and higher quality material while optimising the profitability of my company ?

# Part costs analysis on an existing PP-tool

Cost	PP	ABS
<b>N° of parts</b>		
N° of cavities	2	
Cycle time	45 s	30 s
Parts per hour	160	240
<b>Processing</b>		
Machine (Depreciation, Plant costs, Electricity, Water, Processing aids)	13.37 €/h	
Manpower cost (10%)	1.91 €/h	
Tool (Depreciation.)	5.98 €/h	
Processing cost per hour	21.27 €/h	
Processing cost per part	0,133 €	0.088 €
<b>Material</b>		
Part weight	92 g	105 g
Material price	1.25 €/kg	1.55 €/kg
Material cost per part	0.12 €	0.16 €
<b>Total cost per part</b>	<b>0.253 €</b>	<b>0,248 €</b>

Same tool – identical wall thickness



Espresso machine cover

The most expensive material does not necessarily yield the most expensive part cost.

Cycle time reduction is 30 % faster with ABS.

Considerations if the tool does not yet exist:  
Example: Better modulus → lower wall thickness

Increased stiffness

- Thinner wall thickness
- Reduced cycle times

(Function <sup>2</sup> to wall thickness)

→ **Savings: Material**

→ **Savings: Production costs**

Example:

Part of new material shall feel as stiff as of the former one

→ For an identical flexural modulus of the part:

ABS parts 9 % thinner than PP

$$\frac{\text{Wall thickness ABS}}{\text{Wall thickness PP}} = \sqrt[3]{\frac{\text{E module PP}}{\text{E module ABS}}} = 0,91$$

*What is relevant in your specific part ?*

*• Flex. modulus ?*

*• Tensile strength ?*

*• Flow length ?*

*• ...*

# Part costs analysis including wall-thickness reduction

Cost	PP	ABS	ABS
<b>N° of parts</b>			
N° of cavities	2		
Cycle time	45 s	30 s	25 s
Parts per hour	160	240	288
<b>Processing</b>			
Machine (Depreciation, Plant costs, Electricity, Water, Processing aids)	13.37 €/h		
Manpower cost (10%)	1.91 €/h		
Tool (Depreciation.)	5.98 €/h		
Processing cost per hour	21.27 €/h		
Processing cost per part	0,133 €	0.088 €	0.073 €
<b>Material</b>			
Part weight	92 g	105 g	95 g
Material price	1.25 €/kg	1.55 €/kg	1.55 €/kg
Material cost per part	0.12 €	0.16 €	0.15 €
Total cost per part	<b>0.253 €</b>	<b>0,248 €</b>	<b>0,223 €</b>

Cycle time reduced  
by 17 %

Wall thickness  
reduced by 9 %



Further 2,5 cent reduction !

# Additional benefits from cycle-time-reduction

Cost	PP	ABS	ABS
N° of parts			
N° of cavities	2		
Cycle time	45 s	30 s	25 s
Parts per hour	160	240	288

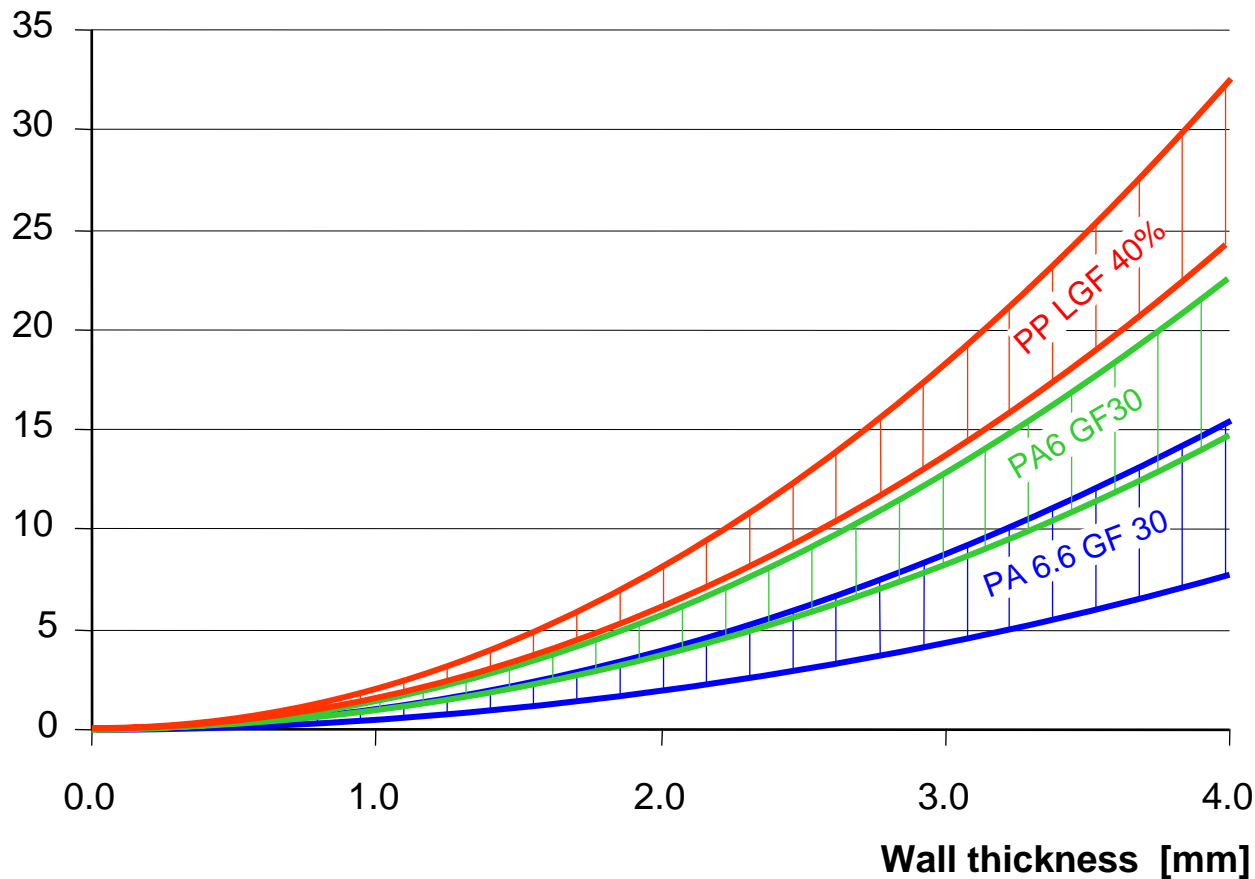


Cycle time reduction (here: 45 % !) may have further value

- Freed-up machine capacity → additional profits from producing further (different) parts, i.e. improve rentability of this equipment
- Reduced no. of cavities (tool cost)
- Smaller machine size (machine cost)

# Another example: Selection of material for a fan-housing

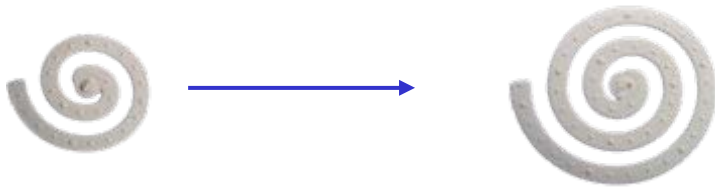
Cooling time [s]



Automotive fan-housing

# Another example: PBT Hi-Flow replacing standard PBT

High-Flow grade has twice the flow-length of standard grade



*Ultradur® B 4300G6*  
*PBT 30% GF **High Speed***

- Thinner wall thickness possible
- More precise filling

25% reduction in cycle-time



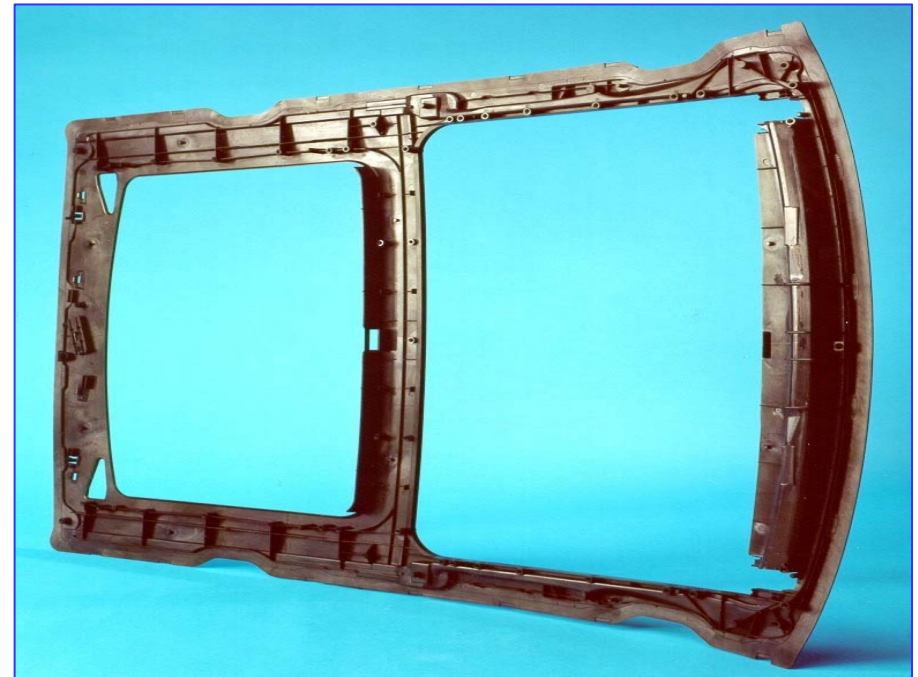
# Another example: PBT Hi-Flow for an open roof-frame

## Part improvements:

- Fewer weld-lines
- Better mechanics
- Reduced warpage

## Process improvements

- Simplified hot-runner-system
- Fewer gates
- Cycle time reduction



# Conclusion

It does make sense to look into more detail !!

A more expensive product may be cheaper to my bottom-line due to...

- Processing
  - Cycle-time benefits
  - Part quality
- Production workshop
  - Machine cost
  - Machine utilisation
  - Tool-cost
- Overall part performance
  - Quality considerations
  - Marketing aspects
  - Fully optimised component



Profit from newly enhanced products - ex: High flow grades

# BACKUP (Formulae)

# Cost breakdown per part for a given component

	<b>Cost item</b>	<b>Influenced by</b>
Material cost	Material	Part volume
Production costs	Manpower	Cycle time
	Building	Cycle time
	Electricity	Cycle time
	Maschine costs	Cycle time
	Tool costs	No. of parts
	Water	Cycle time

# Assumptions

- All production costs are proportional to the cycle time
- When injection moulding times are not known  
→ Cycle time = cooling time
- Optimized cooling system
- De-moulding temperature derived from temperature for sufficient melt stiffness
- Possible cooling time delays not taken into consideration
- Plant running at full capacity

# When is it justified to substitute the current material 1 by material 2 ?

**When: Part cost with Material 2 < Part cost with Material 1**

**Part cost = Material costs + Production costs**

$$\left( \frac{\text{Material costs}}{\text{Part costs}} \right)_{\text{Mat 1}} < \frac{1 - \frac{\text{Production costs}_{\text{Mat 2}}}{\text{Production costs}_{\text{Mat 1}}}}{\frac{\text{Material costs}_{\text{Mat 2}}}{\text{Material costs}_{\text{Mat 1}}} - \frac{\text{Production costs}_{\text{Mat 2}}}{\text{Production costs}_{\text{Mat 1}}}}$$

Typically 40 to 70 %

# Cost comparisons

## Production costs comparison

$$\frac{\text{Production costs}_{\text{Mat 1}}}{\text{Production costs}_{\text{Mat 2}}} = \frac{\text{Cost factor} \cdot \text{Total cycle time}_{\text{Mat 1}}}{\text{Cost factor} \cdot \text{Total cycle time}_{\text{Mat 2}}}$$
$$\approx \frac{\text{Cooling time}_{\text{Mat 1}}}{\text{Cooling time}_{\text{Mat 2}}}$$

## Material costs comparison

$$\frac{\text{Material costs}_{\text{Mat 2}}}{\text{Material costs}_{\text{Mat 1}}} = \frac{(\text{p.V.Price})_{\text{Mat 2}}}{(\text{p.V.Price})_{\text{Mat 1}}}$$
$$= \frac{(\text{p.s. price})_{\text{Mat 2}}}{(\text{p.s. price})_{\text{Mat 1}}}$$

Volume Price , not kg-Price

Influence of wall thickness

Wall thicknesses can vary dependant on mechanical properties of chosen material!

# Production costs

Production costs =

$$\left( \begin{array}{l} \frac{\text{Manpower costs}}{\text{Time}} + \\ \text{Space costs} + \\ \frac{\text{Machine costs}}{\text{Time}} + \\ \text{Tool depreciation} + \\ \frac{\text{Utilities}}{\text{Time}} + \frac{\text{Water}}{\text{Time}} \end{array} \right)$$

■ Total cycle time

# Relative Part cost advantage

$$\frac{\text{Part costs}_{\text{Mat 1}} - \text{Part costs}_{\text{Mat 2}}}{\text{Part costs}_{\text{Mat 1}}}$$

=

$$\frac{\text{Material costs}_{\text{Mat 1}}}{\text{Part costs}_{\text{Mat 1}}} \cdot \left( \frac{\text{Production costs}_{\text{Mat 2}}}{\text{Production costs}_{\text{Mat 1}}} \frac{\text{Material costs}_{\text{Mat 2}}}{\text{Material costs}_{\text{Mat 1}}} \right) + \left( \frac{\text{Production costs}_{\text{Mat 2}}}{\text{Production costs}_{\text{Mat 1}}} \right)$$

# Relative cost benefits from PP to ABS substitution

Example : espresso machine cover

