Materials Meets Engineering - Frankfurt

Frederik Thoma

June 18th 2019

Agenda

- Requirements and challenges to the automotive industry
- Automotive evolution and scenario
- Radical change within European mobility market
- Plastic parts in an electrical vehicle, example: Jaguar I-Pace
- Smart materials fits new requirements

Requirements to future automotive industry

- All cars have to fullfil stricter CO2 and NOx requiremtens
- International commitment to reduce emissions (e.g. Kyoto-protocol, Paris agreement)
- Implementation of real driving emissions (RDE) test which completes WLTP*
- Reduction of fuel consumption

* Worldwide harmonized light vehicle test (lab test)

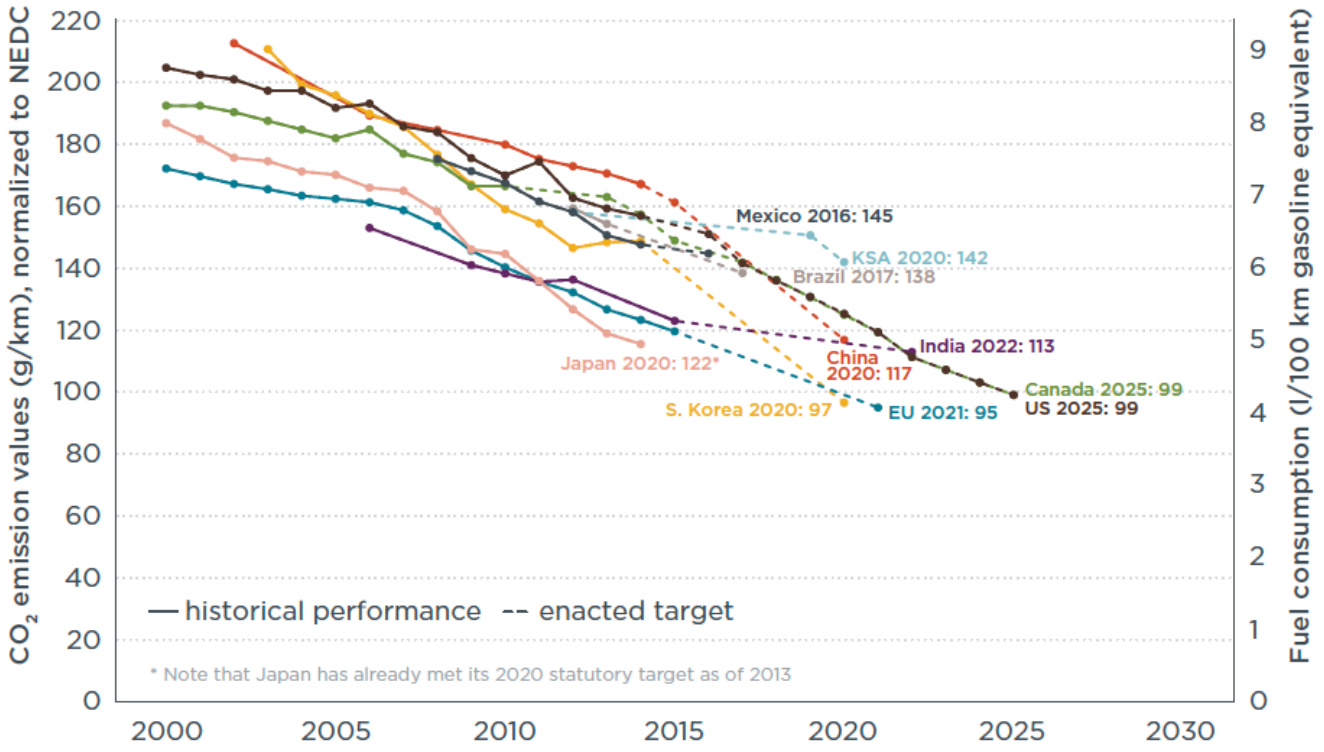


Figure 2. Historical fleet CO_2 emissions performance and current standards (gCO_2/km normalized to NEDC) for passenger cars

Source: international council on clean transportation www.theicct.org

Challenges for the automotive industry

Powertrain:
- Turbo charged smaller engines
- New developed DeNOx systems (e.g. SCR*)
- Enhanced charge air cooler systems (e.g. water cooled)
- Cylinder deactivation, Start/stop systems, energy recovery (micro hybrid system) etc.

Lightweight:
- Metal replacement
- Plastic replacement with other suitable plastics (e.g. PP instead of PA)
- Composites and hybrid structures (possible with PIT technique – will explain some sheets further)

Electrification:
- Step by step combustion engine reduction to 20% by 2030

* Selective catalytic reduction

European mobility market will face radical change in 2030

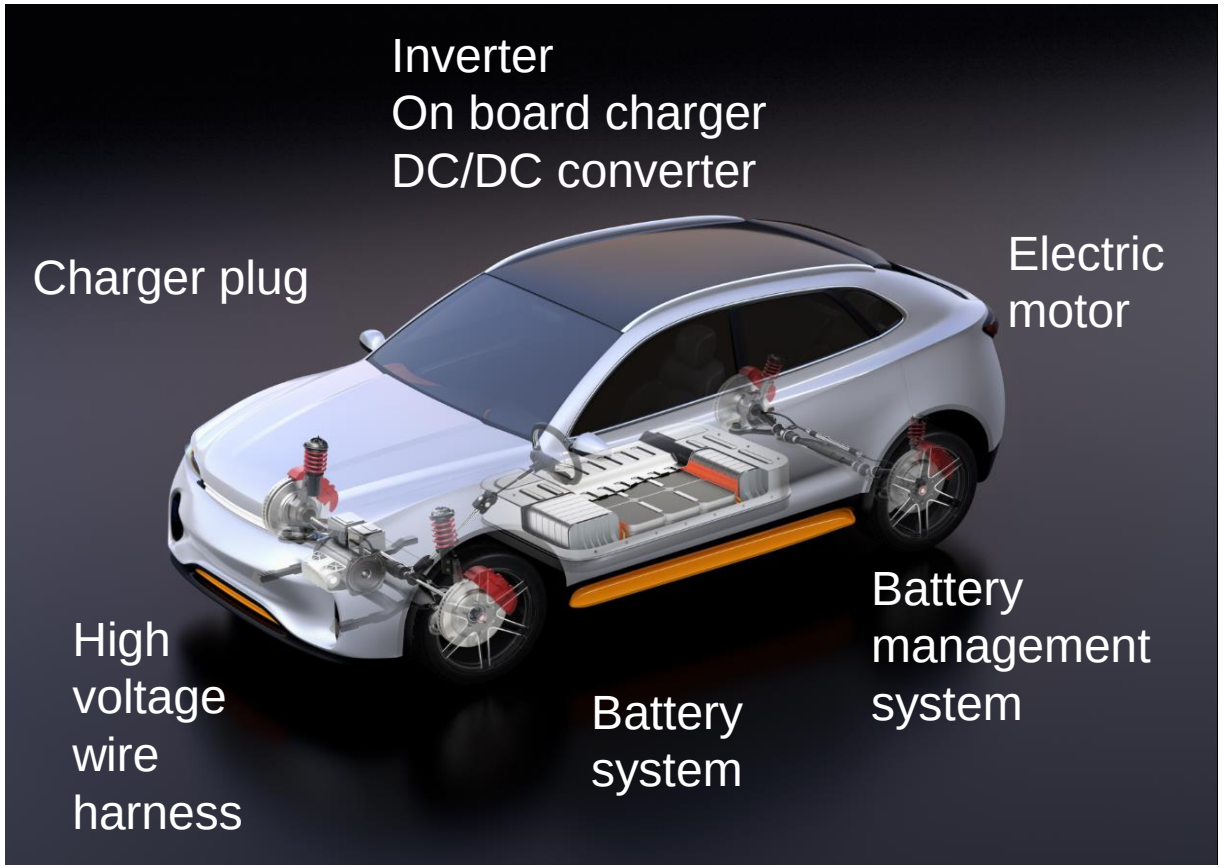
- 20-50% of all new car sales in Europe may be fully electrified by 2030
- New requirements will lead to new mobility trends:
  - Autonomous and shared mobility will increase greatly by 2030
  - The personal mileage will increase by two digit percentage
  - Car sharing will be more focused than an own car

European mobility market will face radical change in 2030

- 20-50% of all new car sales in Europe may be fully electrified by 2030

→ E-Vehicles have a lot of components which are not necessary in a combustion car

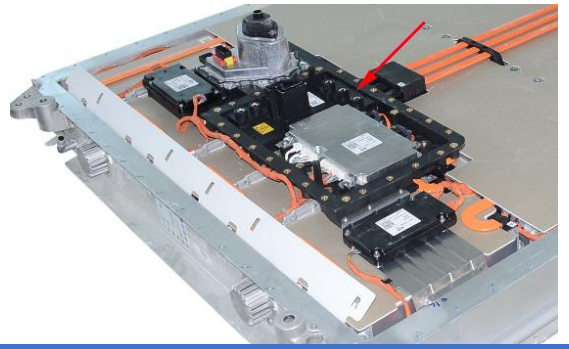
→ Plastics demand will increase significantly



Source: A2mac1

Examples of higher plastics demand → battery pack

All products are available within the APS portfolio !



Base Plate in PPS GF40
→ e.g. Schulatec PPS GF40 black

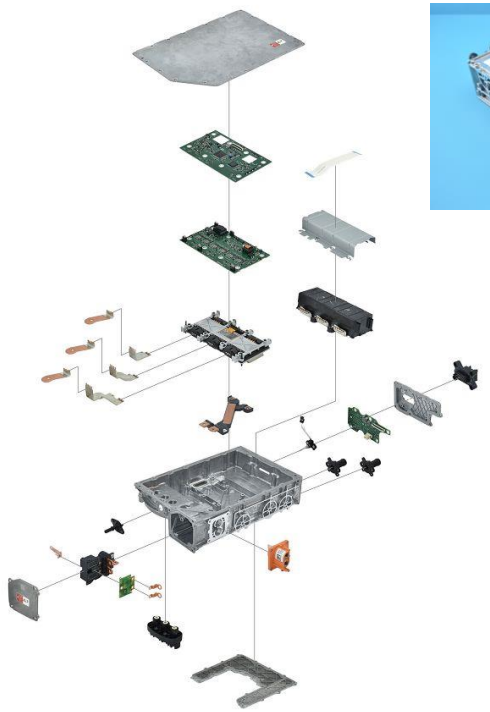
APS material opportunity	Application	Weight	Material	Material ref.	Manufacturer	#A2mac1 ref#
No Alternative	Cell Module, large	0,087	PPO	modified PPO-GF10	OEM Logo	1709-30
Schulablend M/MB	Relay Box	0,073	ABS+PC	PC+ABS	Isabellenhuette	1709-176
Schuladur A GF30	Relay Box	0,084	PBT	PBT GF30	LEM	1709-180
Schulamid 66	Relay Box	0,125	PA	PA66	n.a.	1709-159
Schulamid 66 GF30 FR	Relay Box	1,455	PA	PA66 GF30 FR	n.a.	1709-194
Schulamid 66	Wiring Harness	0,115	PA	PA66	OEM Logo	1709-234
Moplen / Hostacom	Service Disconnect	0,02	PP	expanded PP	OEM Logo	1709-272
Schulamid 66 GF30	HV Bus Bars	0,72	PA	PA66 GF30	n.a.	1709-269
Schulamid 66 GF30	Receptacle	0,413	PA	PA66 GF30	TYCO Electronics (TE)	1709-263
No Alternative	2nd BMS Master ECU	0,134	PPE	PPE+PS HI GF10 FR	OEM Logo	1709-96
tbd	Insulator / Shield, Upper	0,778	Other Plastics		n.a.	1709-20
tbd	Second Insulator/Shield, Upper	0,983	Other Plastics		n.a.	1709-24
Hostacom/Hifax	Front Protection	0,922	PPC	PP GF30-GF60	OEM Logo	1709-274
Schulatec PPS GF40	Electronic Components Base Plate	2,647	PPS	PPS GF40	Marquardt	1709-271
	Third Insulator/Shield, Upper	0,358		Other Plastics	n.a.	1709-594
	Total Plastic Parts	**8,914**				

9 kg of Plastics in the Battery pack

Source: A2mac1 / Alain Gourjault, LYB

Further examples for plastics within other main e-vehicle parts

Relay box → 2kg plastics (PA66, PA66GF30, PA66GF30FR, PBTGF30, PC+ABS



AC/DC inverter 1 and 2 → 4kg plastics (PBTGF30, PA66, PA66GF30, PPSGF30, PPSGF40

Charger → 4 kg plastics (PPAGF15, PA66GF25-35, PA6GF50, PBTGF30, ABS)

9kg + 10 kg additional volume for specific e-vehicle parts

Source: A2mac1 / Alain Gourjault, LYB

Plastic parts in an electric vehicle, example: Jaguar I-Pace

- **Engine**

Fuel type	Electric
Horse Power (PS)	400
Power (KW)	298
Max. torque (Nm)	696
Emission standard	Not applicable
Particle filter	Not applicable
Start/Stop	Yes
Drivetrain	AWD
GearBox Type	Direct drive

- **Hybrid / Electric battery**

Battery type	Lithium-Ion (Li-Ion)
Watt-hour Rating (kW-h)	90
Capacity (Ah)	232
Battery voltage (V)	388

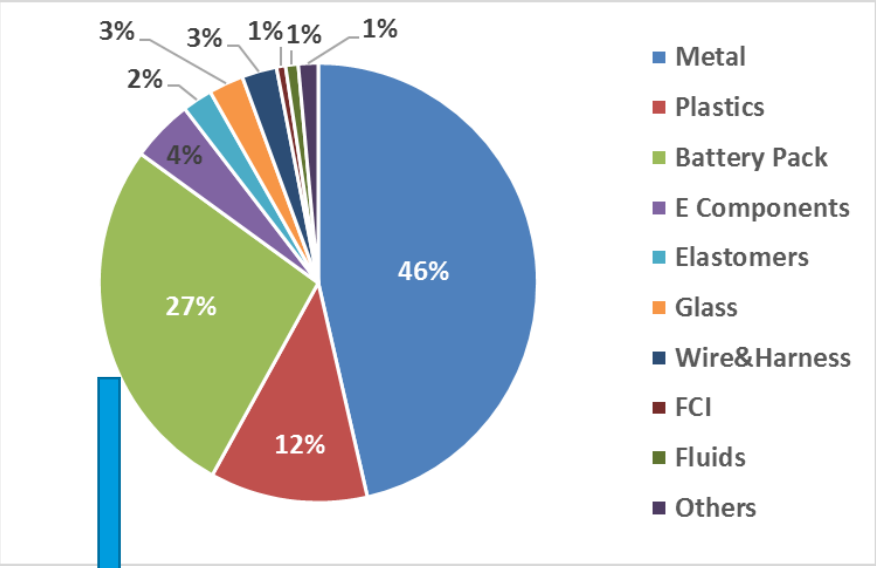
- **Performances (OEM datas)**

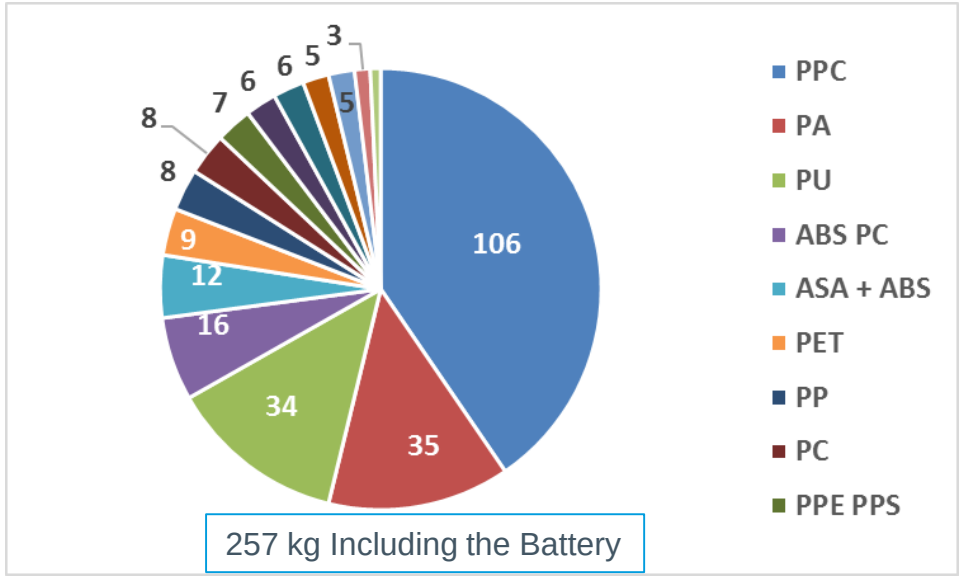
Top Speed (km/h)	200
Acceleration 0-100 km/h (s)	4.8

Plastic grade	Volume (kg)	APS portfolio	Brand name
PPC	106	✓	Hostacom
PP	8	✓	Moplen
PA	35	✓	Schulamid PA
PBT	6	✓	Schuladur A
ABS	9	✓	Ronfalin ABS
ABS+PC	16	✓	Schulablend
ASA	3	✓	Ronfalin ASA
PC	8	✓	Perlex
PE	6	✓	Hostalen
PES	1	✗	e.g. Ultrason
POM	2	✓	Schulaform
PUR	34	✗	e.g. Desmopan
TPE/TPV	5	✓	Invisiona
PET	9	✓	Schuladur E
PMMA	2	✓	Polyman PMMA
PPE	1	✗	e.g. Noryl
PPS	6	✓	Schulatec PPS
total	257	14 of 17 grades	

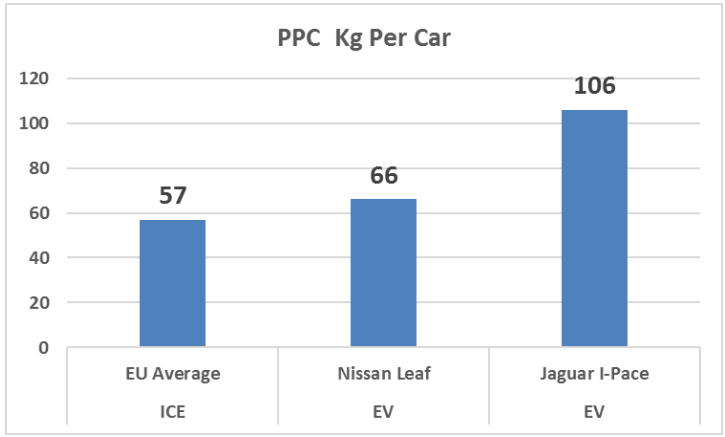
Source: A2mac1

Materials in the Jaguar I-Pace





257 kg Including the Battery



PPC volume in the I-Pace is higher than the average EU ICE cars

Source: A2mac1 / Alain Gourjault, LYB

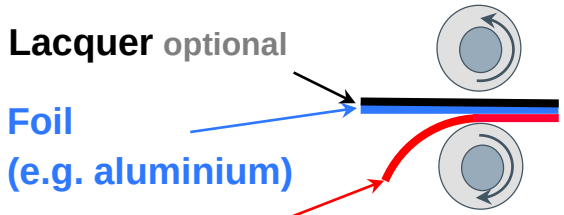
New requirements and new trends within European mobility market

- New requirements will lead to new mobility trends:
  - Autonomous and shared mobility will increase greatly by 2030 (connected cars lead to high amount of electrical component –> EMV shielding, flame retardant products)

→ PIT Technology can be a smart solution for the EMV shielding topic

PIT – LyondellBasell technology for cost effective approach

PIT laminate preparation (LyondellBasell Competence Partner):



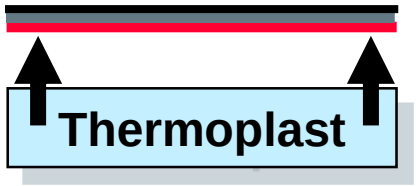
Lamination

PIT Laminate

Semi finished good

To be delivered to molder

Back injection step (Tier1):



Standard process:
Injection molding
Extrusion,
Thermoforming
Compression, etc.

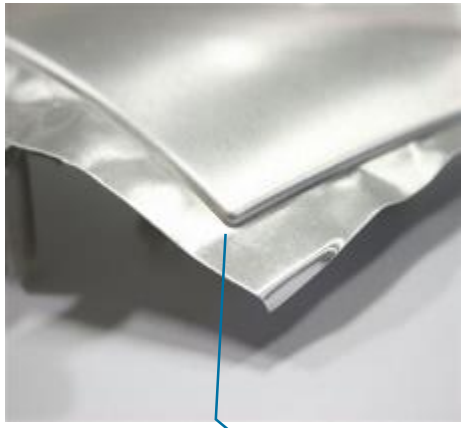
Final part

PIT – Smart approach for hybrid parts in one injection step

PIT Laminate (to be inserted into molding machine)

After molding step

After molding step with right tooling concept



Edges are well shaped

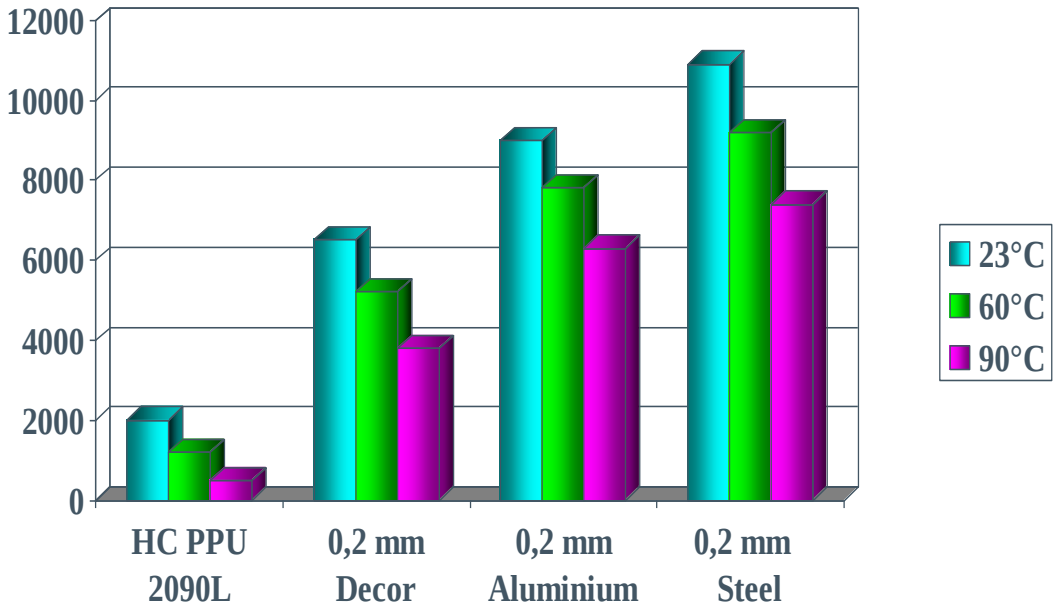
Part without PIT

Source:
Lyondellbasell / trials

PIT – Smart approach for hybrid parts in one injection step

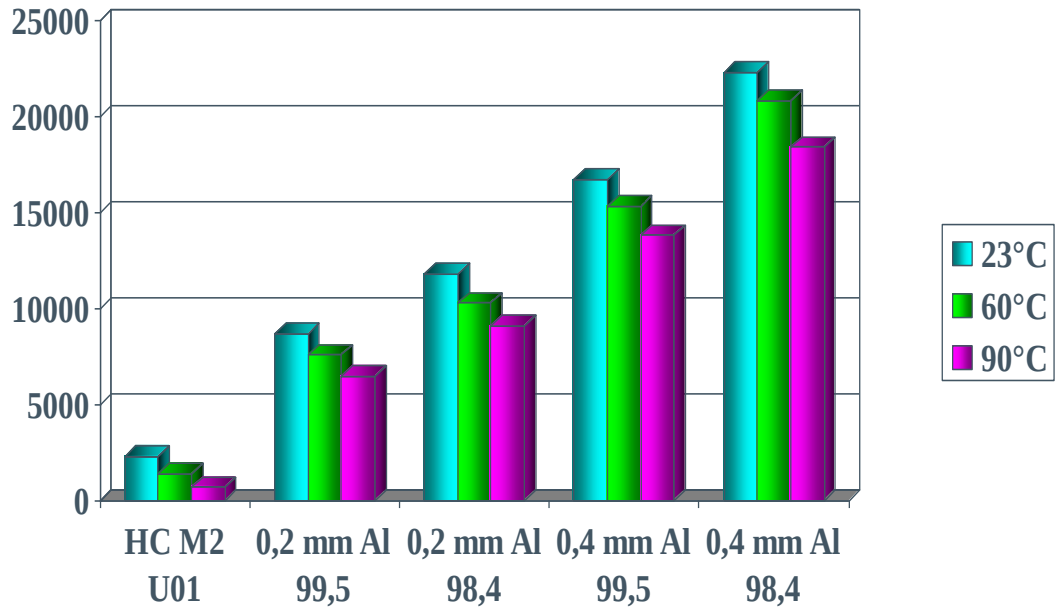
Flex Modulus
MPa ISO 178

Hostacom PPU 2090L (unreinforced)



Flex Modulus
MPa ISO 178

Hostacom M2 U01 (PP TD20)



Electromagnetic shielding for batteries and powertrain

Abbildung 1: Empfangsspule im Stahlgehäuse

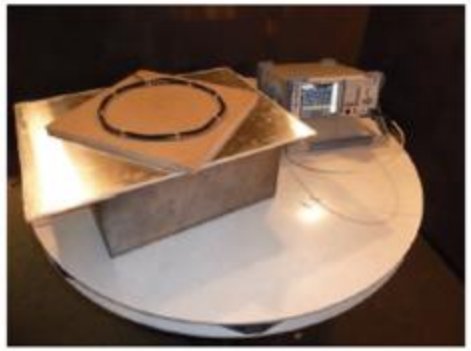
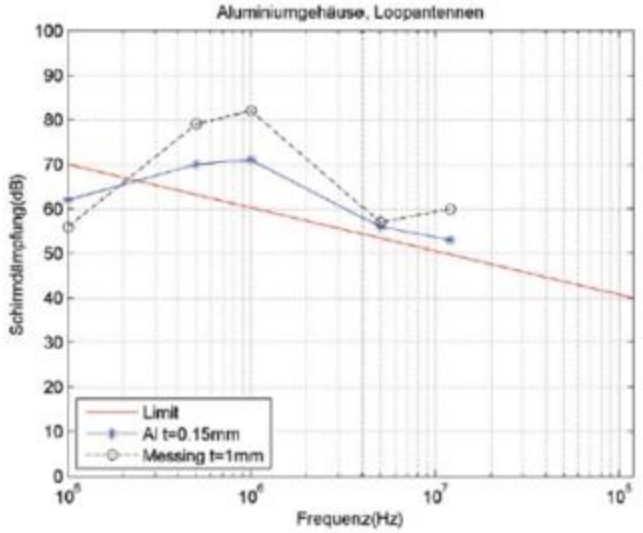


Abbildung 2: Messung mit Al-Platte



Co-operation with Prof. Dr. Norbert Seliger University of Applied Science Rosenheim Laboratory for EMV

Electromagnetic shielding, light weight, design freedom

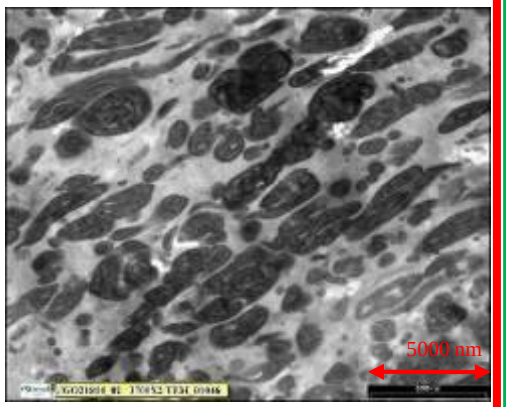
New requirements and new trends within European mobility market

- New requirements will lead to new mobility trends:
    - The personal mileage will increase by two digit percentage (also people will use cars which do not have a driver license → robo taxis)

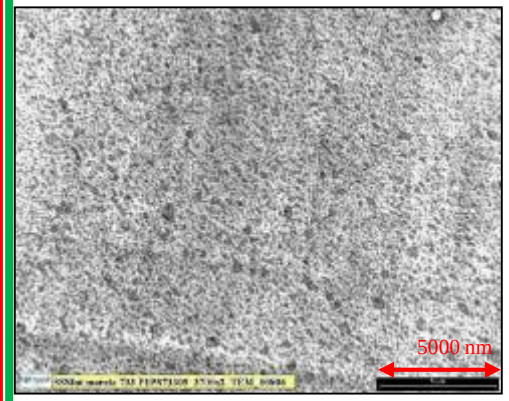
→ Robo taxi interiour will be more functional than estatic – use of *Softell* products.

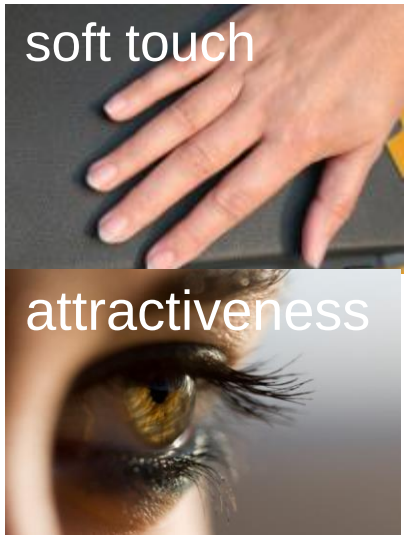
Softell – A smart solution for new interior requirements

Classical PP Compound
compounded blend of
PP and impact modifier



Softell *is a PP EPR*
With fine dispersed rubber





Softell®:

Name for base polymer

Name for PP compound *Softell* TKG 300N

containing *Softell* resin as building block

Source:
Lyondellbasell /Michael Büdinger

Softell TKG 2039N scratch & mar performance vs. PPTD20 Compound

	PPTD20 (Black)	*Softell* TKG 2039N (Black)
Scratch Resistance PV 3952 (10N)	DL*	DL*
Typical automotive leather grain	2,7	0,3
Fine grain	4,5	0,1
Mar resistance as per PV 3974 (3N)	DL*	DL*
Typical automotive leather grain	1,4	0,93
Fine grain	1,87	0,7
Gloss level (60 °)	%	%
Typical automotive leather grain	4	2,9
Fine grain	1,4	1,1

Values has been measured on VW 216 IP trim part

Source:
Lyondellbasell /Michael Büdinger

Softell Textile: A new material for attractive textile appearance

Based on *Softell* matrix LyondellBasell has developed a material with „textile look“

Advantages:

- Good surface quality, low gloss
- Good impact / stiffness balance
- Soft touch w/o textile
- Low gloss
- High scratch and UV-resistance
- Low odour and emissions
- Cost & weight saving
- Air Bag deployment behavior

Source:
Lyondellbasell /Michael Büdinger

Fabric Wrapped Components replacement : Upper Pillar Trim
Textile Roofliner

- ***Softell Textile***
- Process simplification. Single step injection molding eliminates multiple steps required for fabric wrapped components.
- **Cleanability** – for future car sharing
- Lower emissions and odor due to the elimination of adhesives
- EV – quiet PLEASE !!
- **Sound Dampening** – NVH – PC/ABS ?
- Total system cost reduction
- BMW A/B Deployment - ductile
- **No Adhesive = VOC “FREE”**
- Recycling is easier.
- Airbag shot testing on black and textile upper pillars were positive

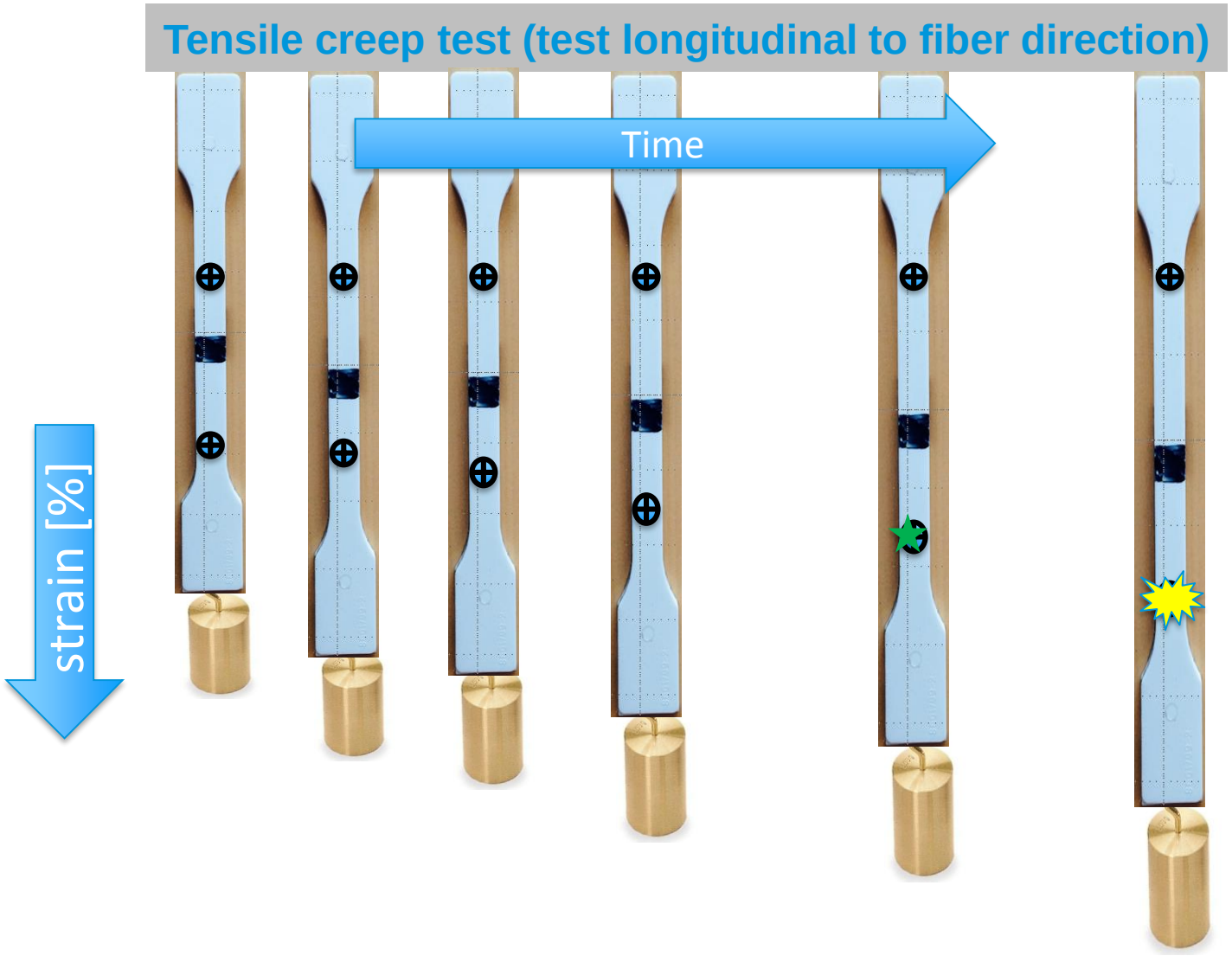
Source:
Lyondellbasell /Michael Büdinger

European mobility market will face radical change in 2030

- New requirements will lead to new mobility trends:
  - Car sharing will be more focused than an own car (enhanced requirements according plastic parts → long fibre grades, low creep PP like advanced copo PP and PIT (plastic interface technology) for structural parts are suitable

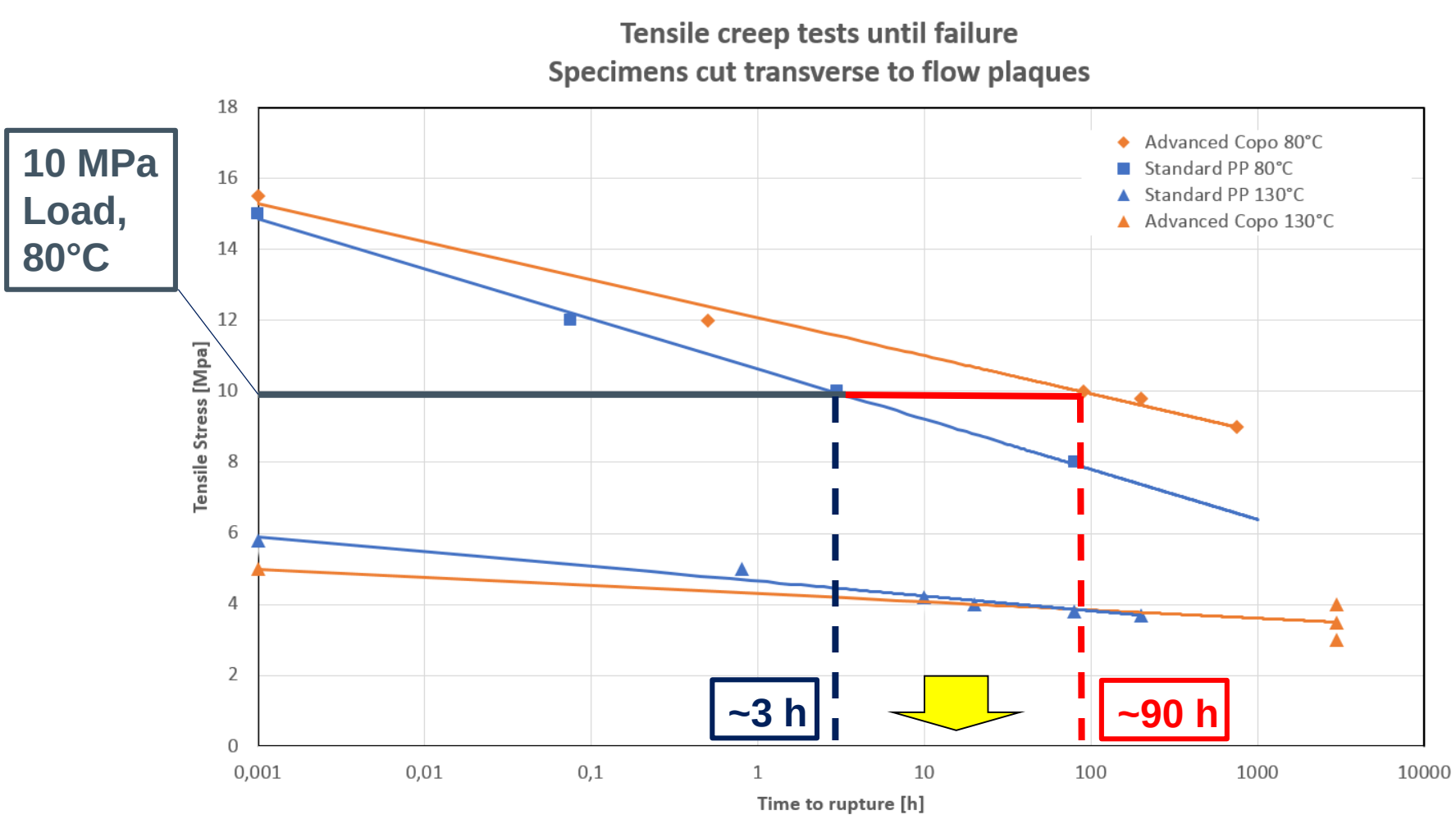
→ Example: Surge tank within hybrid vehicles. Due to higher permantent use this application will be stressed more. Solution: Advanced PP with lower creep leads to reliable parts.

PP glass fiber - known materials for structural parts with a new feature
Deflection vs. time (at elevated temperature) = material creep



Source:
Lyondellbasell /Klaus Klemm

PP glass fiber - known materials for structural parts with a new feature
Deflection vs. time (at elevated temperature) = material creep



Source:
Lyondellbasell /Klaus Klemm

Lower creep = longer life

European mobility market will face radical change in 2030

There are high investments necessary for the e-vehicle infrastructure

- Charging stations with fast loading system
- At home wall boxes
- Charging plugs

Smart solutions for new requirements

POLYFLAM® RMMK 125
SCHULADUR® A MV14 SHI FR1

PA/ABS, unreinforced, V-0 @ 0,8 mm, high impact
PBT, unreinforced, V-0 @ 0,8 mm, high impact

Wall box / company ABL sursum

Charging plug / company Phoenix Contact

Source:
Lyondellbasell / Phoenix Contact / ABL Sursum

Summary

- Requirements and challenges to the automotive industry
- Automotive evolution and scenario
- Radical change within European mobility market
- Plastic parts in an electrical vehicle, example: Jaguar I-Pace
- Smart materials fits new requirements

lyondellbasell
Advancing Possible

Thank you for your attention!

Disclaimer

- Before using a product sold by a company of the LyondellBasell family of companies ("LyondellBasell"), users should make their own independent determination that the product is suitable for the intended use and can be used safely and legally. LyondellBasell MAKES NO WARRANTY, EXPRESS OR IMPLIED (INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE) OTHER THAN AS AGREED TO BY LyondellBasell IN THE PRODUCT SALE CONTRACT.

  LyondellBasell prohibits or restricts the use of its products in certain applications. For further information on restrictions or prohibitions of use, please contact a LyondellBasell representative.

  Users should review the applicable Safety Data Sheet before handling the product.

  Mention products that are stated in this powerpoint are a trademark owned and/or used by the LyondellBasell family of companies.