

Schulamid Polyamides & CirculenRecover EP PA

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Agenda

- LyondellBasell Polyamide range
- Introducing the *Circulen* Brand
- Introduction of *Circulen*Recover EP PA
- Trends & next steps in *Circulen*Recover EP PA Range
- Example application – introducing TSL Outdoor's 2023 Snow shoe





LyondellBasell Polyamides range

Schulamid grades – The Complete Polyamide Product Range

Schulamid Product Range	General Information
<i>Schulamid 6</i>	compounds based on PA 6
<i>Schulamid 66</i>	compounds based on PA 66
<i>Schulamid 612</i>	compounds based on PA 612 (long chain polyamide)
<i>Schulamid XT</i>	compounds for extreme temperature applications requiring elevated long term heat aging properties
<i>Schulamid XM</i>	compounds blended with semi-aromatic polyamides showing an extreme modulus
<i>Schulamid PPA</i>	compounds based on semi-aromatic polyamides for high temperature applications
<i>Schulamid RD</i>	compounds with reduced density (followed by the number of base polymer – <i>Schulamid RD6</i>)
<i>CirculenRecover EP</i>	compounds based on post industrial recyclates (PIR)

Schulamid grades – Range architecture

Base Resin	Fillers	Features	Symbol	Color code	Packaging
PA6	Unreinforced	Heat Stabilized	H	Natural	Bulk
PA66	Glass Fiber	High Impact	HI	Blk	Octabins
PA666	Carbon Fiber	UV Stabilized	U	Other...	25kg bags
PA612	Glass Beads	Laser Weldable / IR transparent	LW		Other...
PPA	Mineral	Laser Markable	LM		
PA based mix (XM)		Improved Surface	IS		
Blend (RD)= reduced density		Fire retardant	FR		
		Glow Wire Tested	GW		
		Recycled Content	RC		
		... And many more			

 Changes to
 

Example: **SCHULAMID 6 GF50 H BLK968001, BG25HT**

Schulamid grades – Range architecture

- **MARKETS**

- **Automotive:** Fans, shrouds, covers, Structural components, light weighting
 - **Fire retardants:** Automotive grades, connectors, E&E applications, Appliances
 - **New mobility:** Advanced compounds (shielding, signal compatibility, hydrolysis resistance), metal replacement
 - **Consumer goods:** Structural components, covers, sporting equipment, permanent anti-static ATEX applications
 - **Building & construction:** Technical functions, hand-held & power tools
-
- **Range architecture built around features rather than applications**
 - **Compounding ability: custom products design & development**

Introducing the *Circulen* Brand

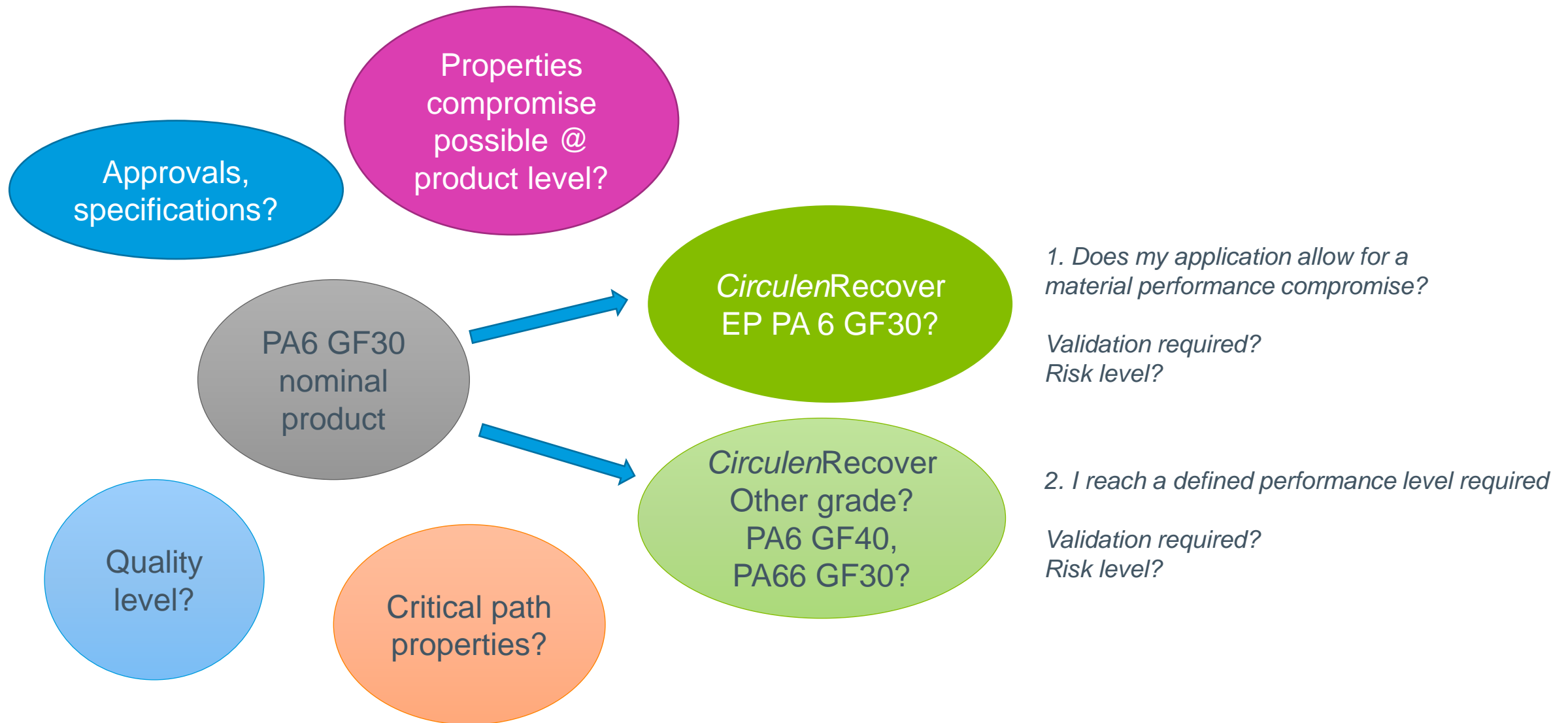
Links

The screenshot shows the LyondellBasell website homepage. At the top left is the LyondellBasell logo with the tagline "Advancing Possible". To the right is a search bar with the placeholder text "What are you looking for?". Below the search bar is a navigation menu with the following items: "About Us", "Products & Technology", "Sustainability", "News & Events", "Careers", and "Investors". The main content area features a large graphic with the word "UNLOCK" in colorful letters (U: blue, N: light blue, L: pink, O: orange, C: green, K: green) overlaid on images of various plastic products like bottles, containers, and a suitcase. To the right of the "UNLOCK" graphic is the "circulen by lyondellbasell" logo, which consists of a colorful circular graphic. Below the logo is the text "Sustainable Solutions for Customers" and a blue button labeled "Learn more".

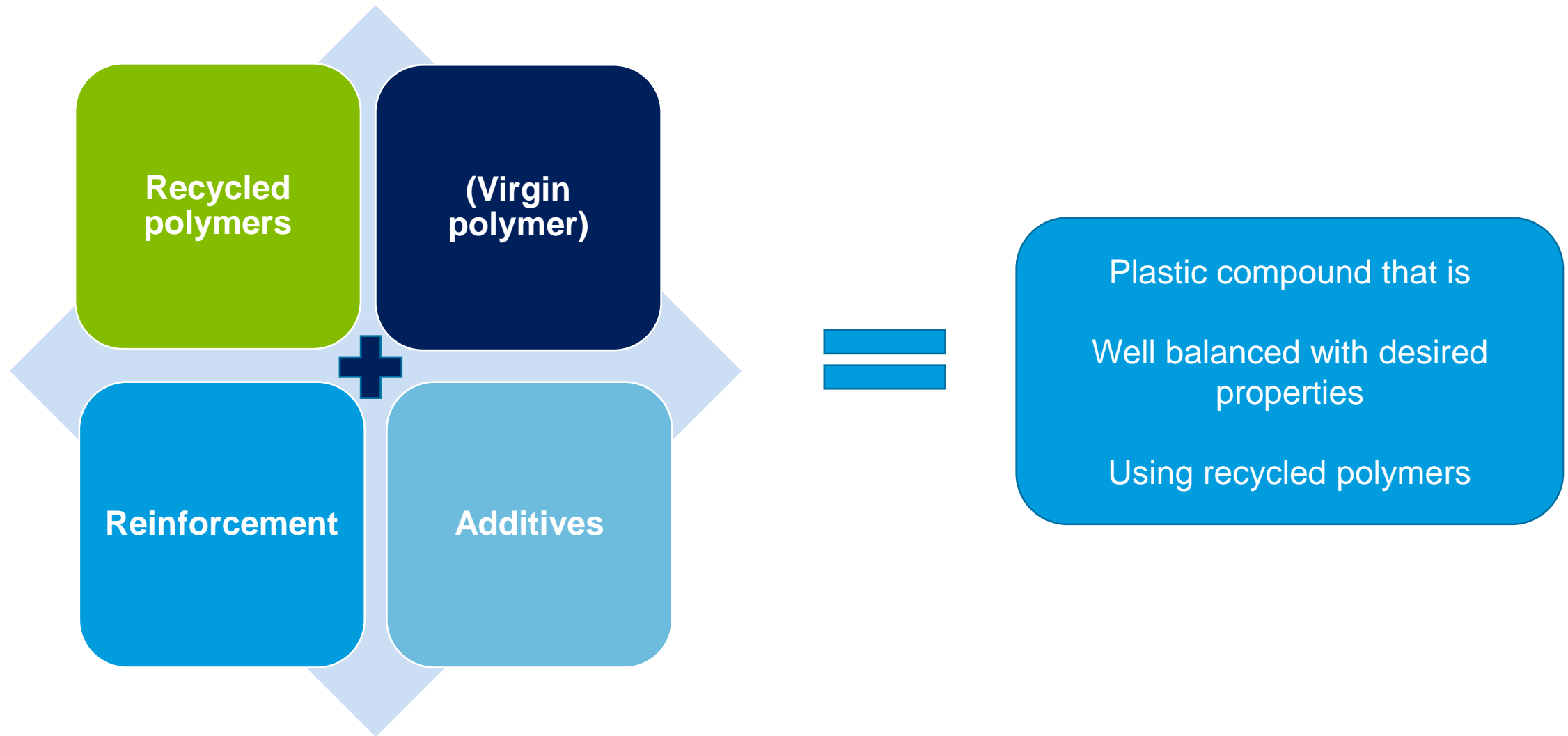
- www.lyondellbasell.com/Circulen
- www.lyondellbasell.com/sustainability

CirculenRecover EP PA Range

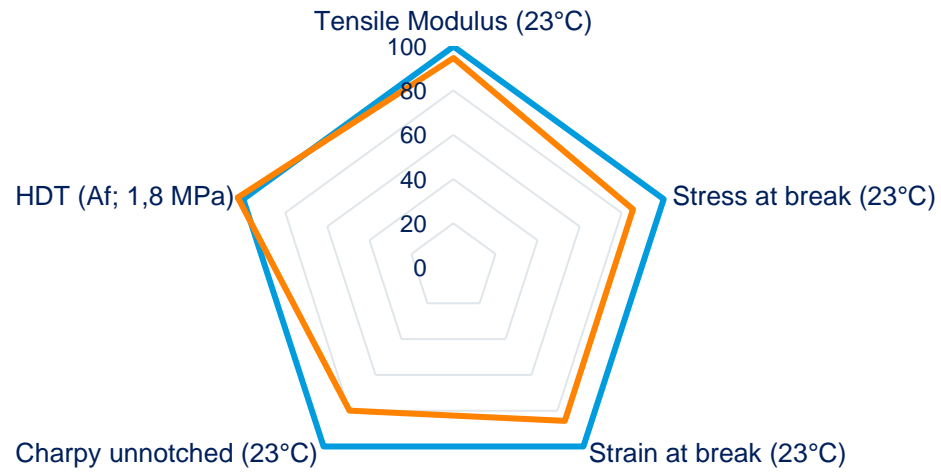
CirculenRecover Polyamides – Material choice



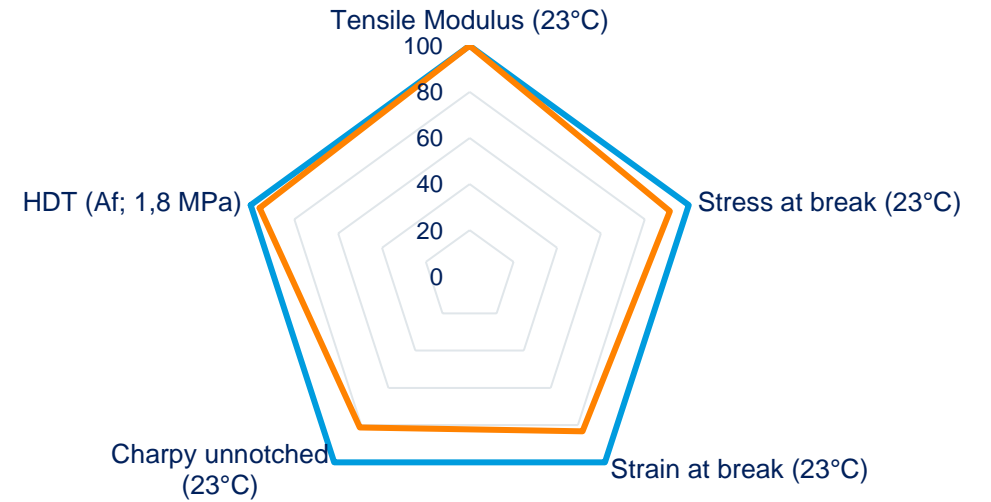
Engineering plastic compounds based on recycled materials: *CirculenReCover*



CirculenRecover – EP PA performance overview



— SAM 6 GF30 H - dry (=100%)



— SAM 66 GF30 H - cond. (=100%)



CirculenRecover EP – Base Products in Development Phase

Schulamid RC new nomenclature (PA6 and PA66 Circular Economy Polyamide Compounds)

Brand name: *CirculenRecover EP*

<i>CirculenRecover EP: PA6 resin</i>	Functionalities*
<i>CirculenRecover EP PA6 GF20 H BLK</i>	H, FR
<i>CirculenRecover EP PA6 GF30 H BLK</i>	H, FR
<i>CirculenRecover EP PA6 GF30 HI H BLK</i>	H, HI
<i>CirculenRecover EP PA6 GF35 H BLK</i>	H, FR
<i>CirculenRecover EP PA6 GF50 H BLK</i>	H

<i>CirculenRecover: PA66 resin</i>	Functionalities*
<i>CirculenRecover EP PA66 GF15 HI H BLK</i>	H, HI
<i>CirculenRecover EP PA66 GF20 H BLK</i>	H, FR
<i>CirculenRecover EP PA66 GF30 H BLK</i>	H, FR
<i>CirculenRecover EP PA66 GF30 HI H BLK</i>	H, HI
<i>CirculenRecover EP PA66 GF35 H BLK</i>	H, FR
<i>CirculenRecover EP PA66 GF50 H BLK</i>	H
<i>CirculenRecover EP PA66 GB30 H BLK</i>	H
<i>CirculenRecover EP PA66 MKF4015 H BLK</i>	H
<i>CirculenRecover EP PA66 MV HI H BLK</i>	HI, H
<i>CirculenRecover EP PA66 MV SHI H BLK</i>	SHI, H



Product datasheets available online
New – Datasheets now feature
DIN91446 data

*: H: heat stabilized; HI: high impact; SHI: super high impact, FR: Flame retardant

CirculenRecover EP – Base Products in Development Phase

CirculenRecover EP PA (PA6 and PA66 Polyamide Compounds)

CirculenRecover EP PA6	Pre-consumer Recycled Content [%]*
<i>CirculenRecover EP PA6 GF20 H BLK</i>	55
<i>CirculenRecover EP PA6 GF30 H BLK</i>	45
<i>CirculenRecover EP PA6 GF30 HI H BLK</i>	30
<i>CirculenRecover EP PA6 GF35 H BLK</i>	40
<i>CirculenRecover EP PA6 GF50 H BLK</i>	25



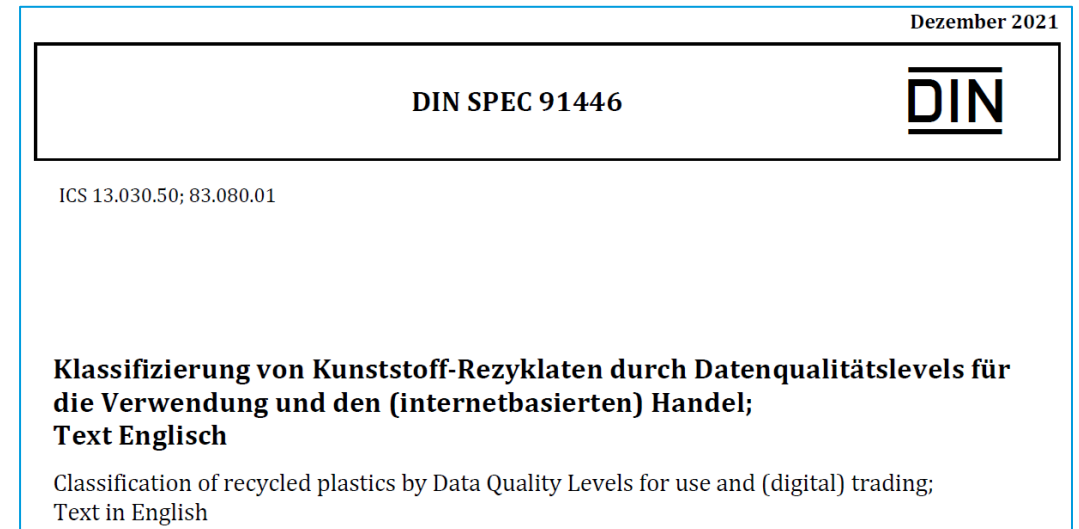
CirculenRecover EP PA66	Pre-Consumer Recycled Content [%]*
<i>CirculenRecover EP PA66 GF15 HI H BLK</i>	75
<i>CirculenRecover EP PA66 GF20 H BLK</i>	75
<i>CirculenRecover EP PA66 GF30 H BLK</i>	65
<i>CirculenRecover EP PA66 GF30 HI H BLK</i>	55
<i>CirculenRecover EP PA66 GF35 H BLK</i>	60
<i>CirculenRecover EP PA66 GF50 H BLK</i>	45
<i>CirculenRecover EP PA66 GB30 H BLK</i>	65
<i>CirculenRecover EP PA66 MKF4015 H BLK</i>	55
<i>CirculenRecover EP PA66 MV HI H BLK</i>	90
<i>CirculenRecover EP PA66 MV SHI H BLK</i>	80

*Pre-consumer recycled Content: Based on 100% of total formulation (including filler, additives, additives and pigments) – rounded in 5% steps
The tradename "Schulamid" may be abbreviated "SAM" in documents or on labels, "Recover" may be abbreviated "RC".

CirculenRecover EP PA – Commercial range

- **Documentation level**

- All Technical datasheets are available in LyondellBasell portal
<https://www.lyondellbasell.com/en/products-technology/advanced-polymer-solutions/technical-data-sheets/engineered-polymers-tds/>
- TDS are documented according to **DIN spec 91446:2021**
 - Aiming at controlling the way recycled content is reported
 - As well as grading a documentation level related to the recycled content source
- Safety Datasheets are available as well
- LCA data is being documented (Work in progress)
 - An LCA request form has to be filled in
 - Please reach out



CirculenRecover EP PA Range trends

CirculenRecover EP PA – FIRE RETARDANT

- **CirculenRecover EP PA – FR versions first tests**
 - *CirculenRecover* EP PA shows good fire resistance compatibility
 - Heat deflection, impact slightly lower as recycled content increases
 - Flammability properties like UL94, GWIT and GWFI show identical values
 - UL listing would not be an issue
 - Electrical properties are unchanged

CirculenRecover EP PA FR can be sampled

CirculenRecover EP PA – new developments

CirculenRecover EP PA, color matched can be sampled

■ Color matched compound

- New source allows even up to WHITE coloration (PA 6)
 - Volume secured and guaranteed
 - 40+ T available today (white)
- Other colors possible:
 - Blue, green, red going through customer validation stages today
 - Vivid colors preferable (light yellow, brown difficult)
 - PA6 or 66 base
 - NAT version in progress =>

■ Trend: Visualize recycled source

- Customer ask for “dots” or “points” to differentiate product
- Achievable through compounding or masterbatch
- Example: Background color + black dots



Schulamid Polyamides – Moving forward

▪ Current developments

- Post-Consumer sources
 - Origin & content challenges
- Recycled origin fillers
 - Carbon Fibers
- Conductivity & resistivity
 - Thermal
 - Electric
 - Signal conductivity or shielding
 - Anti-static
 - EMI (Electro-magnetic interferences) shielding
- Food contact grades range extension

▪ Technology trends

- UWB, radar signals
- Automation & sensors (camera, sensor activation of functions, remote accessibility, autonomous driving)
- New drivetrains = new requirements (temperature, batteries, dielectric fluids, function controls)
- Screen controls vs buttons, device connectivity (phone, keys)
- Passenger experience (touch, feel, lighting, comfort, assistance & connectivity)



Around Polyamides

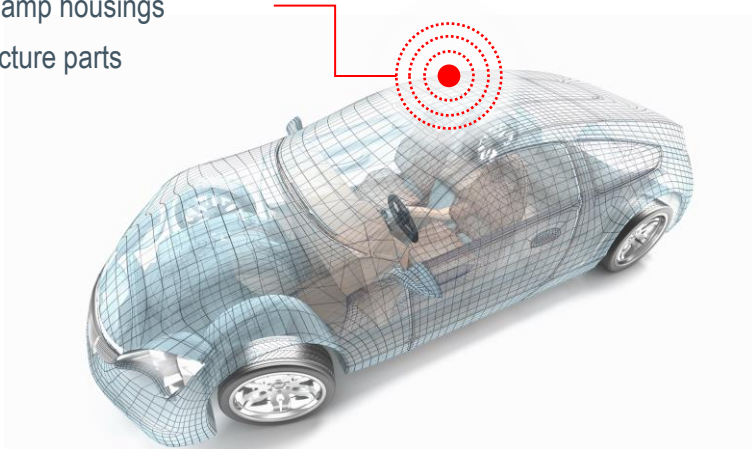
Schulamid Polyamides – Around Polyamides

▪ Sustainability Case study: *Schuladur PCR*

- PBT blend with PCR PET coming from Water bottles
- High performance material

Structure components:

- Roof bar supports
- Foglamp housings
- Structure parts



Schuladur® PCR family

Properties	Units	Standards	GF 15	GF 20	GF 20 HI	GF 30	GF 45
MFR, 260°C / 2,16 kg	g/cm³	DIN EN ISO 1133	18	24	12	20	11
Tensile Modulus	MPa	ISO 527-2	6.700	8.100	6.200	11.000	15.500
Tensile Stress	MPa	ISO 527-2	110	125	100	140	160
Tensile Strain	%	ISO 527-2	2,4	2,5	3,5	2,1	1,7
Charpy Notched							
23°C	kJ/m²	ISO 179/eA	5	6	11	8	8
-30°C	kJ/m²	ISO 179/eA		5	7	8	
Charpy Unnotched							
23°C	kJ/m²	ISO 179/eU	25	30	60	55	50
-30°C	kJ/m²	ISO 179/eU		28	60	50	
HDT @ 1,8 MPa	°C	ISO 75	186	200	190	205	208

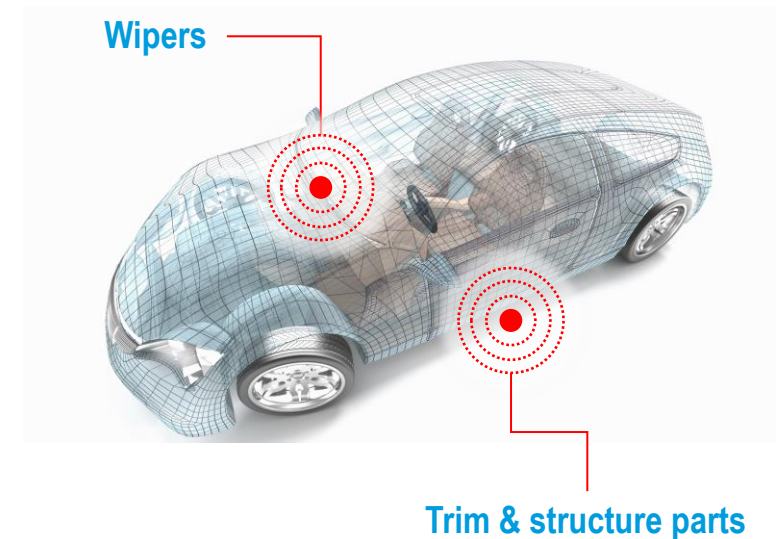
↑
latest development:
Specialty!

Making LyondellBasell your products one-stop shop

Schulamid Polyamides – Around Polyamides

▪ Foaming:

- Masterbatch used @ Tier injection process, allowing micro-bubbles to appear in a part's thickness cross section (picture)
- **Polybatch EV-0425BA**
- 5% to 15% weight save
- Good aspect
- Little impact on part integrity
- Sink mark management: Allows big wall thickness for specific applications
- Make a component more efficient in terms of cost, weight, thus price
- While also contributing to sustainability by optimizing suppliers process
- Can be a value proposition for existing parts & processes



Making LyondellBasell your products one-stop shop

Schulamid Polyamides – Around Polyamides

■ APS - Masterbatches & Additives

- Our Masterbatches can provide additives fit to requirements: foaming agents, anti statics, friction modifiers – Near Infrared colors for end of life detection & recycling

■ APS - Colors

- Our Colors give you a wide range of standard, or custom colors for your product ranges
- When compounding multiple colors is not an option, our colors can be supplied from our plants on the material basis you need

■ Other Business units - Olefins & Polyolefins

- In addition to performance polymers, our wide range of Olefins & Polyolefins can also complete a comprehensive offer



LyondellBasell – The one-stop shop for your product

Thank you

