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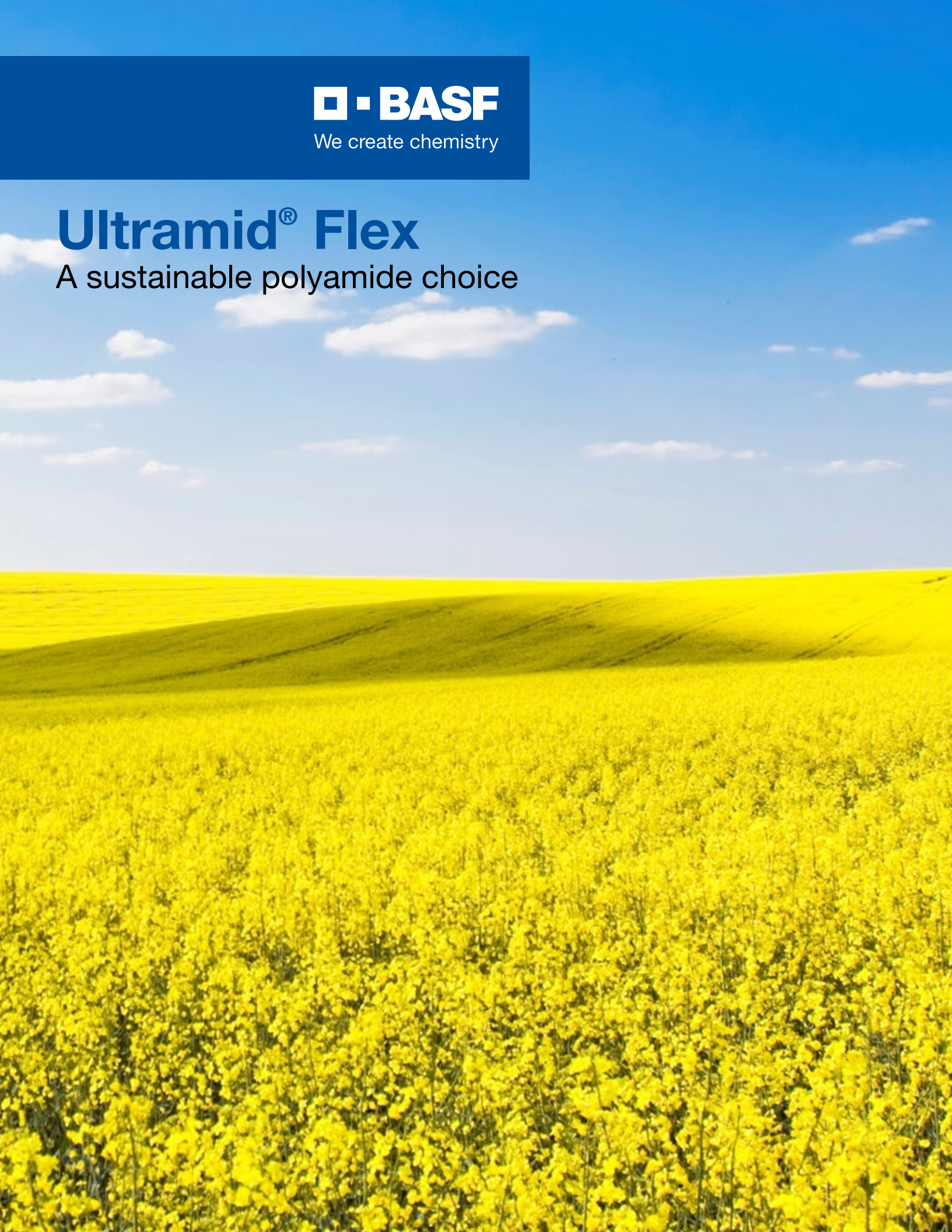
Ultramid® Flex

A sustainable polyamide choice



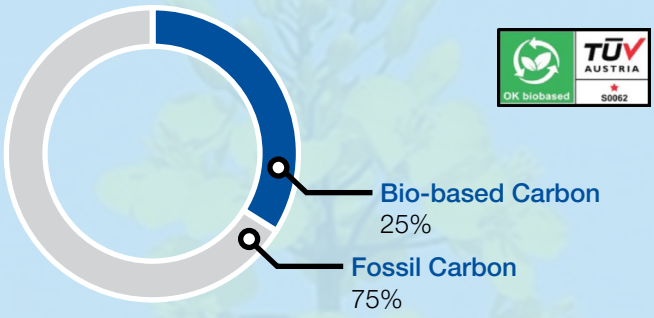
Ultramid® Flex: A sustainable polyamide choice

The Ultramid® Flex F40L product family is a copolymer blend of polyamides made partially bio-based content. These long-chain polyamides are ideal as PA12 replacements and are suitable for:

- extrusion applications
- mono-wall hose, outer hose jacketing and core tubes for multilayer air brake hose
- industrial hydraulic, pneumatic and exhaust hose

Ultramid® Flex F40L copolymers have the mechanical properties and chemical resistance needed for demanding hose applications, as well as provide superior adhesion to core layers which can eliminate the cost and complexities of tie layers.

- A portion of the raw materials are sourced from rapeseed oil
- 25% average bio-based carbon content*



- Lower carbon footprint compared to PA6 and PA6/66
- Appealing choice for sustainable product

* Determined by measuring the 14C/12C and 13C/12C isotopic ratios using accelerator mass spectrometry as described by ASTM D6866

Properties	Ultramid® Flex F40L1	Ultramid® Flex F40L	Ultramid® Flex F40L2
Tensile modulus, 23°C, MPa	820	496	345
Stress at break, 23°C, MPa	40	34	37
Strain at break, 23°C, %	189	162	228
Tensile modulus, 130°C, MPa	132	118	105
Stress at 20% strain, 130°C, MPa	6.7	6.3	5.2
Izod notched impact strength, 23°C, KJ/m^2	73	104	112
Izod notched impact strength, -40°C, KJ/m^2	7	4.5	4.6

Expanding the Ultramid® portfolio for demanding applications

Lower Stiffness / Higher Flexibility

Less hydrogen bonding /
Lower degree of crystalinity

Apolar Character

Chemical resistance: e.g., Zinc Chloride
Lower water uptake compared to PA6 and PA66 → better dimensional stability

Sustainability

Partial bio-based content

Towards Long-chain Aliphatic Polyamides

e.g., PA6.10 / PA6.12 / PA11 / PA6.12

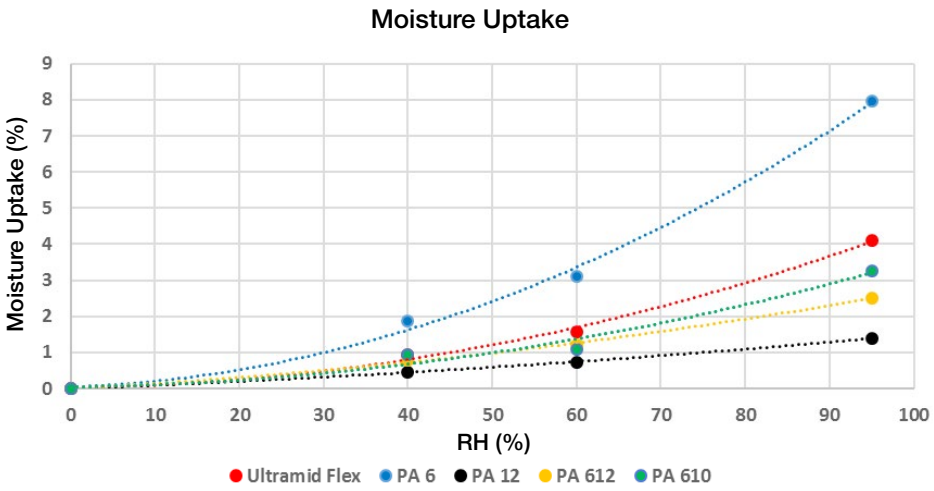
Key advantages

- Low moisture absorption
- Inherent flexibility
- Resistance to road salt environmental stress cracking (50% aqueous $ZnCl_2$)
- Methanol resistance per SAE J844
- Excellent adhesion to TPU, PA6, and PA12
- Partial bio-based content (25%)

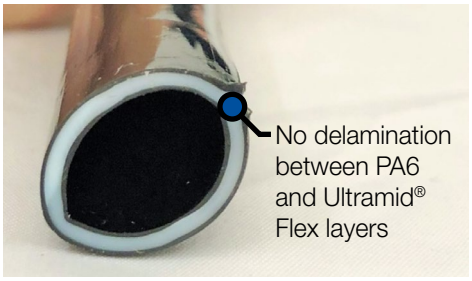
Ultramid® Flex: Key features

- Soft long-chain polyamide with low water uptake
- Excellent toughness
- Good chemical resistance

Reduced moisture absorption



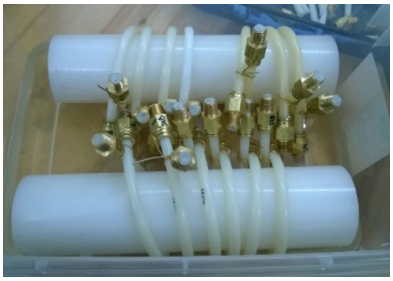
Strong layer adhesion



PA6 ULT Flex

Chemical resistance

SAE J844 – $ZnCl_2$ resistance

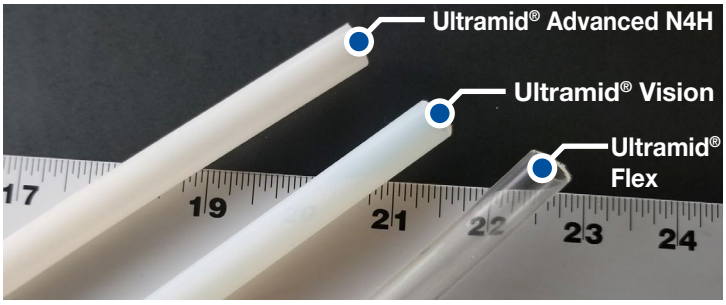


- 50% aqueous zinc chloride solution
- Immersion of stressed tube for 200 hrs at 23°C
- Ultramid® Flex XA3532 and PA12 tubes show no evidence of cracking
- Ultramid® PA6 tubes failed within minutes of immersion into zinc chloride solution

Methanol chemical resistance (SAE J844)

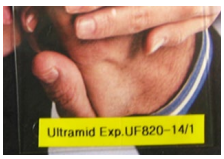
- Tube samples were immersed in 95% methyl alcohol for 200 hrs at 24ºC
- Tubing did not show any evidence of cracking

Material with high transparency

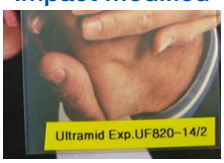


PA6

Ultramid® Flex



Ultramid® Flex Impact Modified



Ultramid® Flex:
Chemical resistance[1]

	Function	Conditions	Ultramid® Flex	Ultramid® B40L (PA6)	Ultramid® C40L (PA6/66)	PA12
Zinc chloride	salt resistance	20°C	+	-	na	+
Nitric acid (30%)*	strong acid	RT, 1 days	+	-	--	na
Na-hypochlorite	disinfection, bleach, oxidizing agents	70°C	O	-	na	+
Acetic acid (10%)	weak acid, cleansing supplies	70°C	+	+	na	+
Methanol (98%)	alcohol	RT, 60°C, 70°C	+	+	na	+
n-Octanol**	fatty alcohol	1 hr at 40°C plus 24 hrs at 25°C	+	+	na	na
n-Heptane**	alkane	1 hr at 40°C plus 24 hrs at 25°C	+	+	na	na
NaOH (50%)	alkaline stability	20°C	+	+	na	+
Fuel E10	nonpolar, aliphatic	60°C	O	+	na	O
HCL (2%)	strong acid	70°C	-	-	na	+
Phosphoric acid (30%)	strong acid	70°C	-	-	na	+

KEY:
+ resistance
- no resistance
O limited resistance
na not available

[1] unless otherwise noted, viscosity measurements, mechanical properties and dimensional changes were used to determine chemical resistance

* 50 µm films were fixed in slide mounts (Diarahmen) and stored in 20 & 40 % aq. HNO_3 at room temperature

** 2 g/L solutions were prepared; %Weight change was used to determine chemical resistance, by comparing the initial and final weight of granules

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