

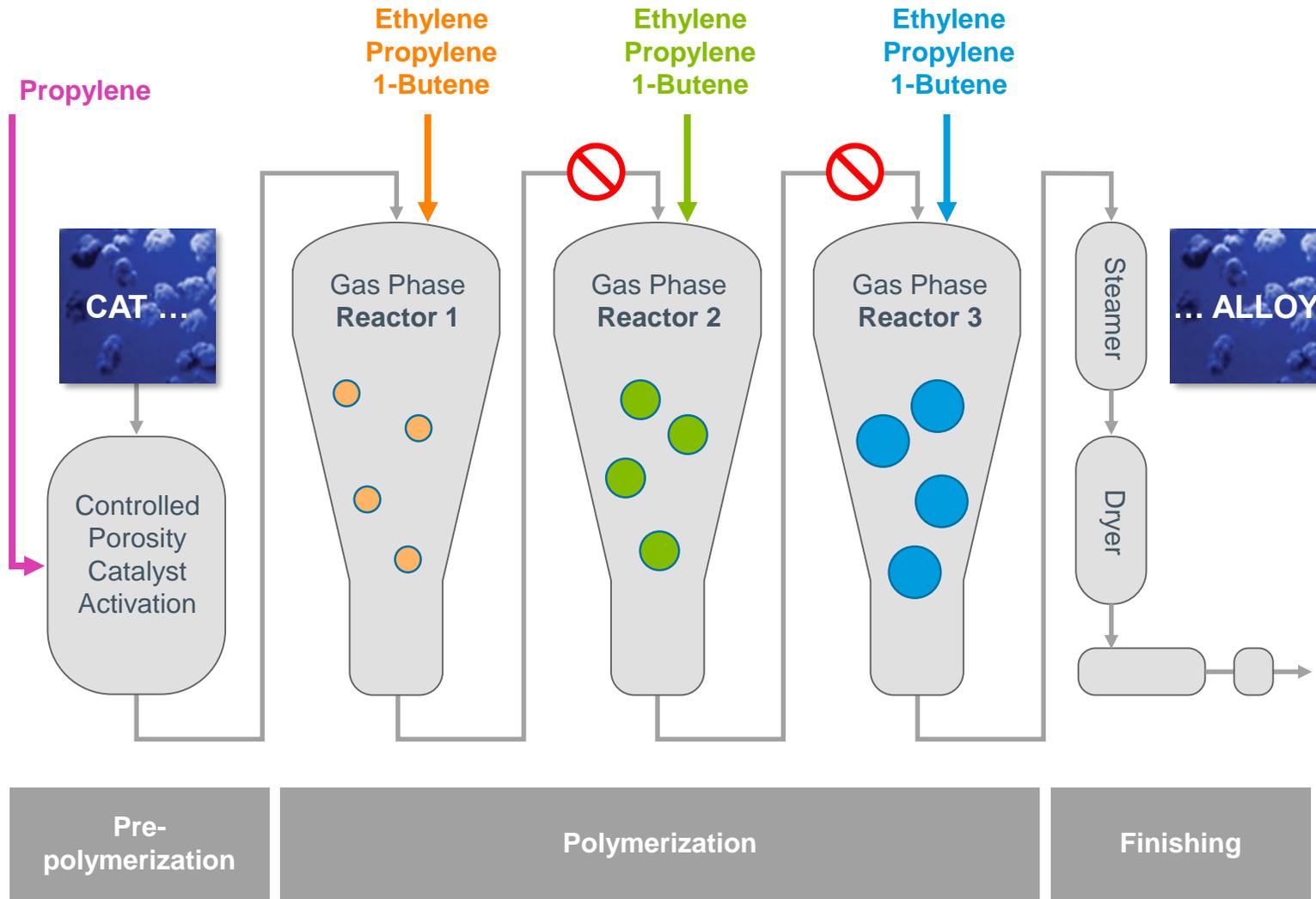
***Catalloy* technology process for Industrial applications**

Product properties

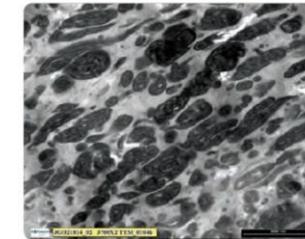
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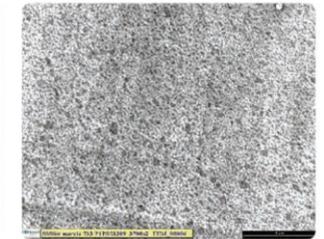
Catalloy production process – an ‘ALLOY’ not a blend



Ethylene
Propylene
Rubber Blend



Hifax CA10A



TEM (transmission electron microscopy)
3700x

During production, the *Catalloy* technology evenly distributes the rubber phase within a co-continuous PP phase, yielding superior properties when compared to a physical blend.

Grades from Catalloy technology: *Hifax*, *Adflex*, *Softell* and *Hiflex* product families

Hifax

Outstanding impact for durable industrial and automotive applications.

Grades with an outstanding balance of mechanical performance, processability, high thermal resistance and aesthetics. Utilized by customers in durable applications, such as building and construction (e.g. single ply roofing), industrial, (e.g. wire and cable) and automotive (e.g. interior and exterior parts).

Hiflex

Improved impact stiffness and shrinkage performance balance.

The *Hiflex* TPO resins combine the uniqueness of LyondellBasell's existing *Hifax* and *Adflex* TPO resins, offering easy processing, flexibility, durability, low density, high thermal resistance and low gloss, with improved impact, stiffness and shrinkage performance balance when used in a compound.

NEW

Softell

Generation of soft products for industrial and consumer applications.

Combining toughness with flexibility, customers select these resins due to their resistance and elasticity. *Softell* resins provide an enhanced soft-touch feel and slip resistant grip used in electrical appliances and tools. Additional benefits include the ability to bond well with other polyolefins and additives and the capacity to effectively incorporate fillers.

Adflex

Very soft, flexible polyolefins.

Our *Adflex* family are very soft and flexible TPO resins used by a wide number of our customers in applications such as specialty films, as a blending partner to improve impact performance, extrusion coating, bitumen modification and consumer applications. In addition to enhanced flexibility, the *Adflex* resins exhibit excellent impact performance at low temperatures, outstanding haptic properties and soft touch.

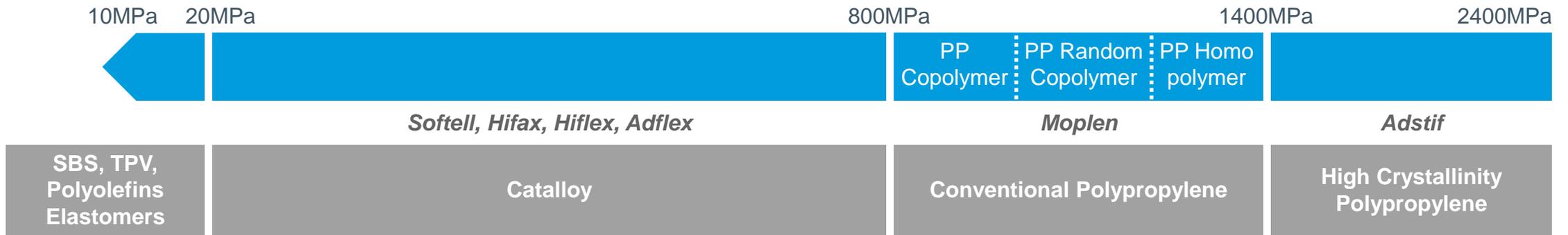


Grades from *Catalloy* technology: key properties

Grades from *Catalloy* technology enable the control of key properties such as:

Low Density
 Optical Properties
 Tear and Puncture Resistance Stiffness and Impact Balance
 Thermal Resistance Dimensional Stability
 Flexibility & Softness Easy Processing
 Compatibility with Polyolefins
 Low-Temperature Impact
 Durability / Weatherability

Flexural Modulus



Grades from *Catalloy* technology: *Hifax*, *Hiflex* properties

	Low Temperature		Low Modules				Low Shrink
	CA7320A	CA12A	CA10A	CA7700A	CA212A	CA60A	CA207A
Melt Flow (ISO 1133)	2.1	0.8	0.6	1.4	8	15	7.5
Flexural Modulus	200	330	90	170	80	80	550
Tensile Strength at Yield	No Yield	9	No Yield	7.5	6	5	14
Elongation at Break	500	550	500	450	600	600	700
Charpy Impact Notched -20°C	100	100	110	NB	105	105	45
Charpy Impact Notched -40°C	95	100	5	110	4	2	5
Haze 1mm Plaque (Internal LYB)	-	-	-	-	-	-	23
Gloss 1mm Plaque (Internal LYB)	85	35	85	84	-	-	110
Post Molding Shrinkage (Internal LYB)	0.6	-	1.7	-	0.8	0.8	0.5
	<ul style="list-style-type: none"> ■ Low temperature impact ■ Excellent stiffness-impact balance ■ Low gloss ■ High thermal resistance 		<ul style="list-style-type: none"> ■ Softness ■ Flexibility ■ Broad MFR range ■ Low temperature impact 				<ul style="list-style-type: none"> ■ Low shrinkage ■ Good clarity ■ High gloss ■ Low Tg

Grades from *Catalloy* technology: Roofing Membranes

(Compounding)



Source: Imper

Application Areas

- Single-ply Roofing, “Green” and “White” roofs
- Replacement for alternative roofing materials, such as PVC, EPDM and Bitumen-membranes

Key Features

- Cost-Effective production and installation
- Durability more than 20 years of proven performance (with suitable stabilization)
- Weight Reduction / Low Specific Gravity
- Free of plasticizers, chlorine or heavy metals

Technical Properties

- Flexible for easy detailing
- High filler absorption
- High dimensional stability
- Heat resistant
- Good chemical resistance
- Flexibility without plasticizers at low temperatures

Hifax grades from Catalloy technology: Automotive Interior and Exterior Applications

(Technical Compound)



Application Areas

- Interior parts like consoles, pillar trims, door panels and dashboard skin
- Bumpers, side cladding and front grills

Key Features

- Processability
- Aesthetic
- Weight Reduction / Controlled Shrinkage
- Free of plasticizers, chlorine or heavy metals

Technical Properties

- Controllable gloss, good aesthetics, grain retention
- High softness and the excellent behavior at high and low temperatures
- Good haptics
- Excellent impact resistance at room temperature and low temperature resistance
- Flow mark free (anti-tiger striping) surface
- Low shrinkage

Softell grades from Catalloy technology: Automotive Interior Applications

(Technical Compound)



Application Areas

- Automotive interior parts which are technically demanding

Key Features

- Can replace engineering plastics for use in demanding customer applications
- Outstanding combination of performance
- Pleasing aesthetic look, without additional need for painting
- Dimensional stability

Technical Properties

- High Flexibility and low Shore hardness
- Excellent mechanical behavior at high and low temperatures
- High Grip effect
- Good haptic, soft touch
- Low Gloss surface finish without the needs for additional decoration (PP compounds containing Glass fiber)
- Good compatibility with PP, PE

Grades from *Catalloy* technology: Soft Profiles, Gaskets



Application Areas

- Soft Profiles and Sheets

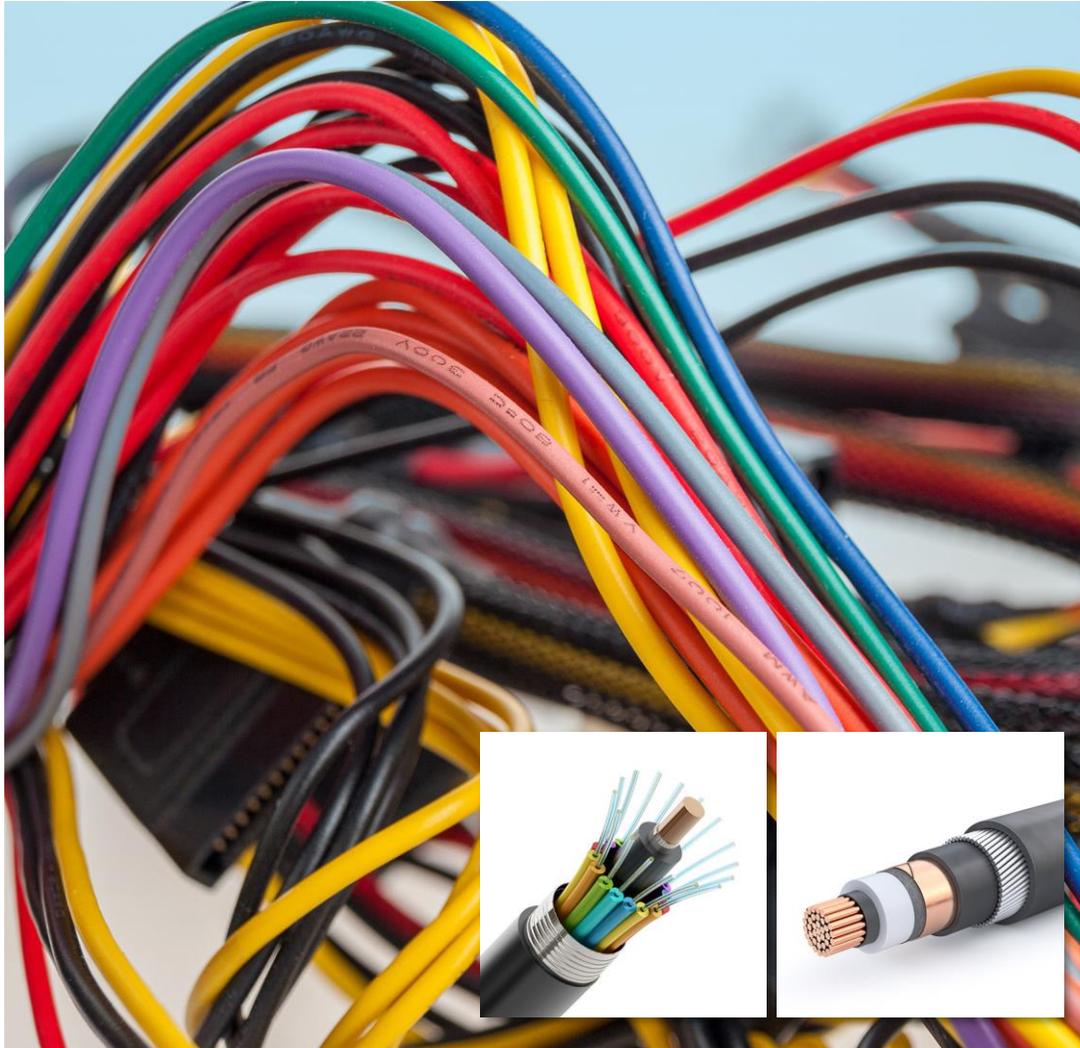
Key Features

- Suitable for the extrusion, calendaring and extrusion blow molding of very soft film and sheet and extrusion of flexible profiles

Technical Properties

- Low stiffness
- Excellent low Shore Hardness
- Very good impact resistance

Grades from *Catalloy* technology: Wire and Cables



Application Areas

- Wire & Cable

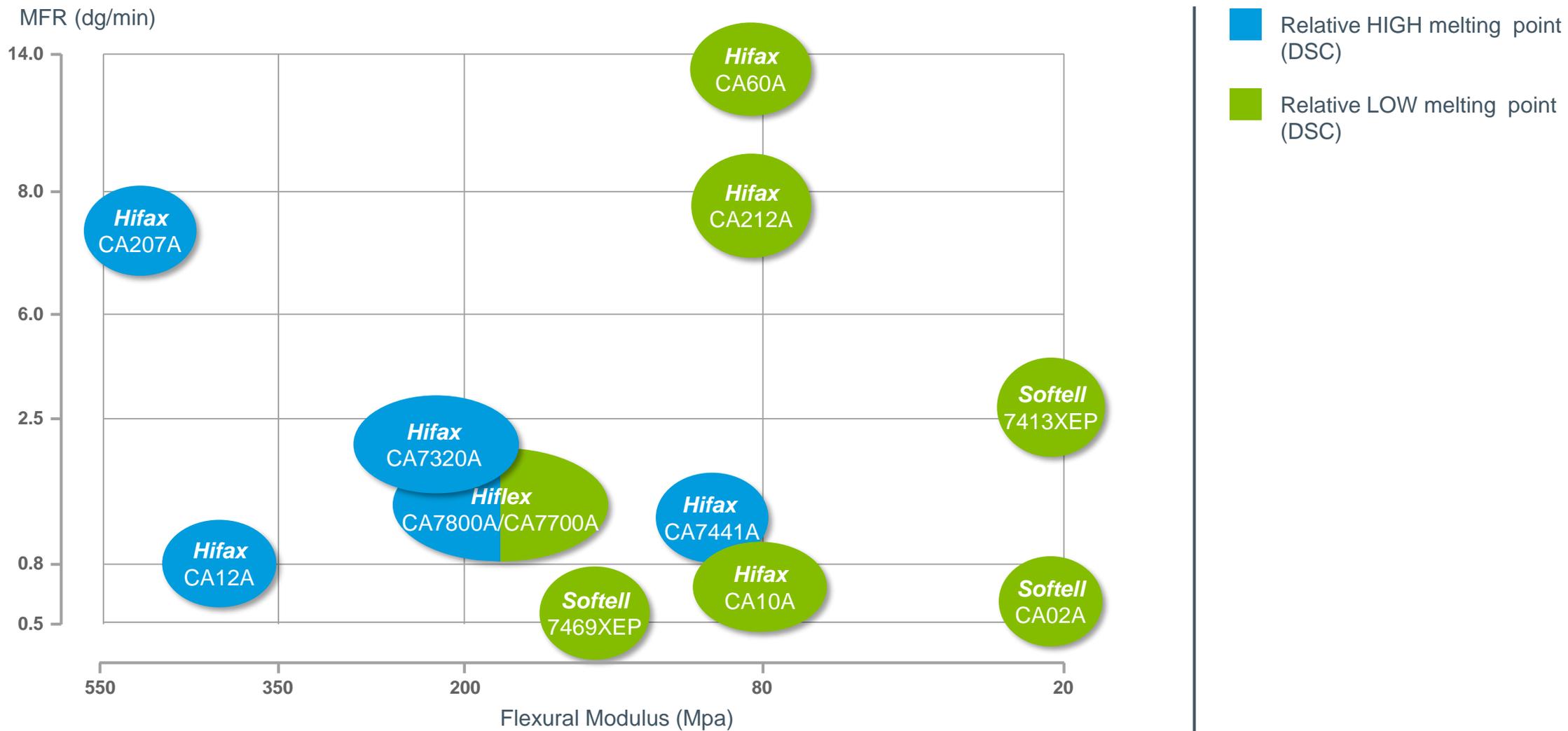
Key Features

- Building blocks for energy distribution cables and flame retardant compounds
- Processability
- Mechanical balance
- Free of plasticizers, chlorine or heavy metals

Technical Properties

- Good mechanical property performance
- High thermal resistance
- Environmental advantages over other insulating materials
- High filler loading
- Halogen free (in FR formulations)
- Flexibility of use and their ease of handling during the extrusion process

Key properties of *Catalloy* technology grades



Addressing customer performance requirements with *Hifax*, *Hiflex* and *Softell* grades from *Catalloy* technology

In rigid polypropylene-based compounds:

Improve impact resistance

Modify stiffness

Mould shrinkage adjustment

Gloss modification and aesthetics

Flow improvement

CLTE adjustment (coefficient of linear thermal expansion)

Improved soft-touch performance

Improved incorporation of mineral fillers

Elimination of “Tiger Stripes”

Addressing customer performance requirements with *Hifax*, *Hiflex* and *Softell* grades from *Catalloy* technology

In soft compounds (TPO, TPV and TPE):

Softness and impact strength optimisation

Improved temperature resistance

Increased toughness

Soft-touch enhancement

Weathering enhancement

Mold shrinkage and process ability improvement

Gloss control

Cost optimisation

In masterbatches and concentrates:

Carriers and flow aids, especially for hyperfilled concentrates and liquid additives

TPO: Thermoplastic Polyolefins blends with outstanding properties.

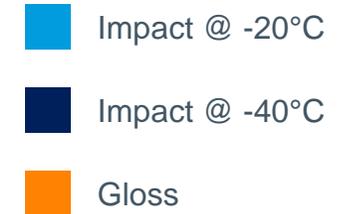
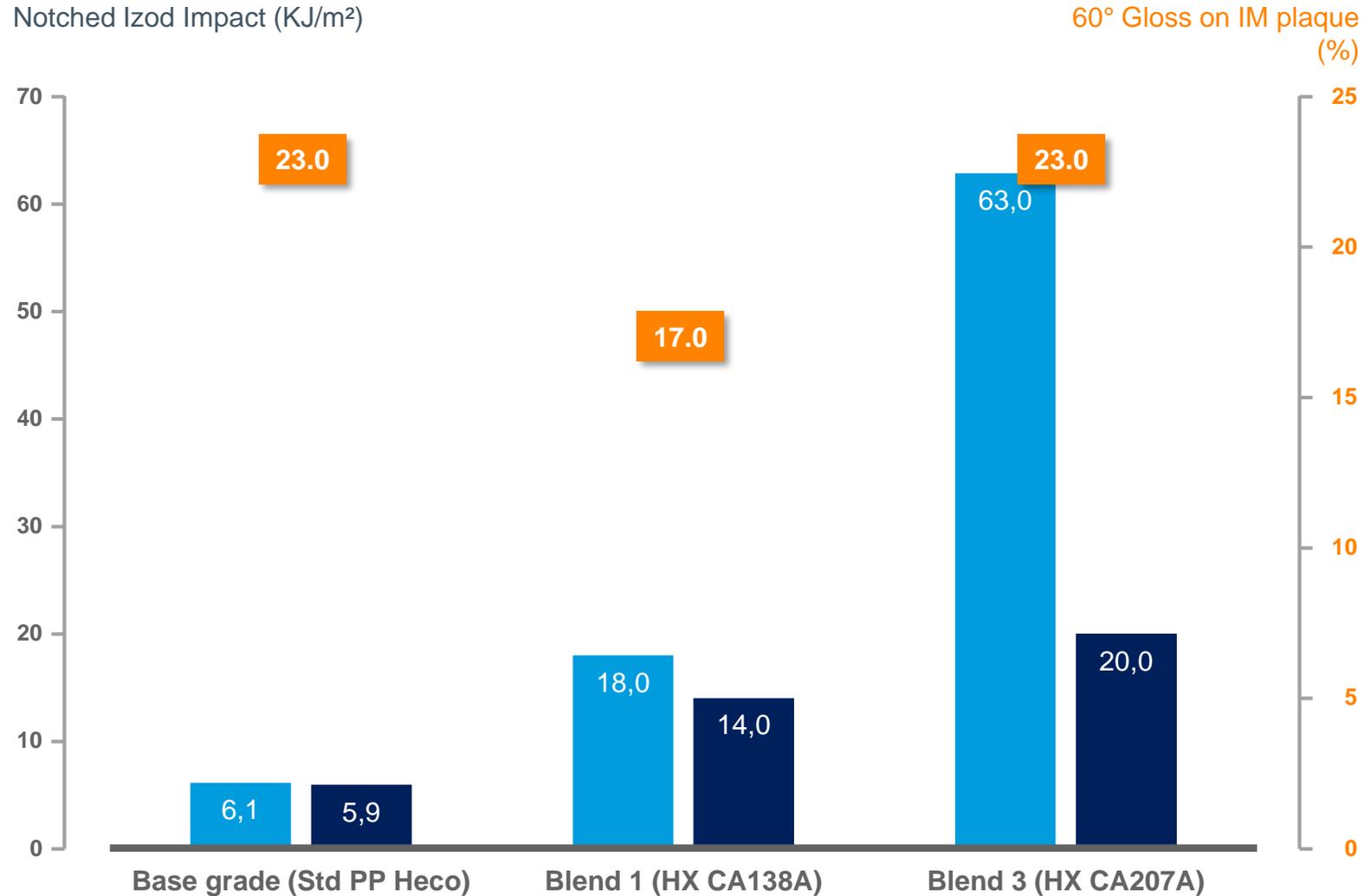
TPE: Thermoplastic blends of hard polymer (Styrene) and elastomer particles. ($D > 0.97 \text{g/cm}^3$)

TPV: Thermoplastic vulcanisates. In most cases EPDM dispersed in PP. ($D > 0.9 \text{g/cm}^3$)

Modification of a PP Filled Compound

Heco PP + 12% talc + 35% *Hifax* impact modifier

Notched Izod Impact (KJ/m²)

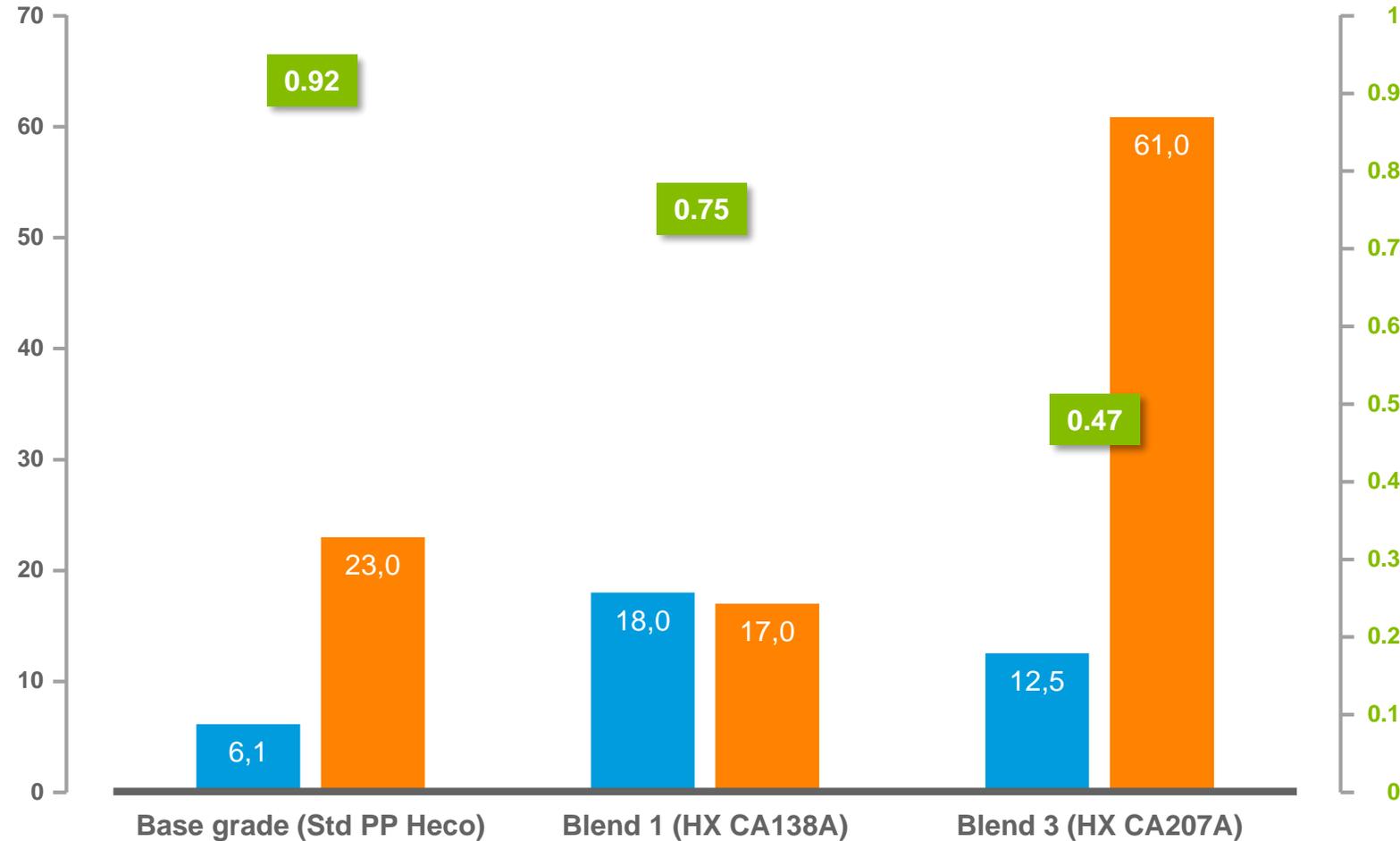


- The addition of *Hifax* CA138A or *Hifax* CA7320A drastically improve the impact resistance and aesthetic properties of filled (or unfilled) compounds
- The product portfolio from *Catalloy* technology offers adaptable solutions to meet challenging customer requirements and specifications

Low Temperature Impact Modification of Filled Compound

Heco PP + 12% talc + 35% *Hifax* impact modifier

Notched Izod Impact (KJ/m²) /
60° Gloss on IM plaque (%)



- *Hifax* CA138A significantly increases the impact resistance and also reduces the gloss of the filled compound.
- *Hifax* CA207A further reduces the shrinkage of the compound and increases the gloss.

Main characteristics

- Easy handling and storage (free flowing pellets)
- Broad Process ability (extrusion, injection molding, calendering, blow molding, cast film ...)
- Flexibility
- Softness
- High impact resistance at low temperature
- Good elongation at yield and at break
- Good Tear and Puncture resistance
- Good Thermal resistance
- Esthetic (mat or glossy)
- Medium to Low shrinkage
- High compatibility to PP, PE, TPE's, TPO
- Good Chemical Resistance
- Long Durability (when correctly stabilized)
- Low C-emissions
- Low density
- Halogen and plasticizer free

Catalloy Products

PROPERTIES	PHYSICAL		MECHANICAL						THERMAL			OPTICAL		SPECIFIC PROPERTIES FEATURES	TYPICAL APPLICATIONS & TECHNOLOGY FEATURES	
	Density	MFR 230°C, 2,10kg	Flexural Modulus	Tensile Stress at Break	Tensile Elong. at Break	Notched Charpy impact strength			Shore D Hardness	Tg DMTA	Heat Deflect. Temp. HDT/B	Vicat Softening Temp.	Gloss at 60° 1mm plate			Tm
	23°C	ISO 1133	ISO 178	ISO 527- 1, -2	ISO 527- 1, -2	23 °C	-20 °C	-40 °C	ISO 179	ISO 868	Internal Method	ISO 75B-1, -2 (0.45 MPa)	ISO 306/ A50			ASTM D2457
Units	g/cm ³	g/10 min	MPa	MPa	%	kJ/m ²			Points	°C	°C	°C	-	°C		
Catalloy Grades																
Softell CA7469A	0.88	0.5	130	7	500	NB	NB	80	87 (Sh.A)	-40	39	50	36	142	Outstanding softness, low gloss	Extrusion, injection molding, compounds for automotive interiors
Softell CA 02 A	0.88	0.6	30	10	500	NB	NB	9	75 (Sh.A)	-25	38	41	72	142	Very good impact, supersoft	Extrusion, injection molding, impact modifier for compounds
Hifax CA 10 A	0.88	0.6	90	11	500	NB	110	5	30	-25	40	60	85	142	High softness, low vicat	Extrusion, softness and impact modifier in automotive compounds
Hifax CA 7441 A	0.88	0.8	85	12	500	NB	NB	6	30	-25	40	56	85	163	Combination of excellent thermal properties and flexibility	Extrusion, injection molding, impact modifier for compounds
Hifax CA 12 A	0.88	0.8	330	13	550	70	100	100	36	-45	50	78	35	163	Good balance between softness and vicat, low gloss	Extrusion, softness and impact modifier in automotive compounds
Hifax X 1956 A	0.89	0.9	800	30	500	95	10	5	57	-30	70	145	57	163	Tiger stripes corrector	Extrusion, injection molding
Hiflex CA 7700 A	0.88	1.4	170	10	450	NB	NB	110	33	-45	40	75	84	142	High softness, toughness at very low temperature, high thermal properties; good compatibility with PO	Impact modifier, injection molding and extrusion
Hiflex CA 7800 A	0.88	1.2	210	11	450	NB	85	110	35	-45	40	85	87	163	High softness, toughness at very low temperature, high thermal properties; good compatibility with PO	Impact modifier, injection molding and extrusion
Softell CA 7413 A	0.87	2.5	30	8	600	NB	NB	8	75 (Sh.A)	-25	38	41	85	142	Outstanding softness, high flowability	Extrusion, injection molding, impact modifier for compounds
Hifax CA 7320 A	0.88	2.1	200	10	500	NB	100	95	32	-40	40	62	85	163	Very good impact, processability	Extrusion, injection molding, impact modifier for compounds
Hifax CA 138 A	0.88	2.8	500	10	400	70	100	50	41	-45	58	90	20	163	Low-temperature impact modifier, low gloss, good processability	Impact modifier for automotive compounds
Hifax CA 207 A	0.89	7.5	550	22	700	65	45	5	46	-35	58	94	110	163	Impact modifier, low shrinkage, low CLTE, high gloss	Injection molding, impact modifier for compounds
Hifax CA212A	0.88	8	80	10	>600	NB	105	4	30	-25	40	56	>85	142	High softness and flowability	Injection molding, softness and impact modifier
Hifax CA 7201 A	0.89	12	800	16	600	50	45	10	50	-45	65	120	32	163	Good impact, paintability, processability	Injection molding, impact modifier for auto compounds
Hifax CA7442A	0.89	12	1100	17	400	35	7.5	4.5	-	-48	86	121	55	163	Good impact stiffness balance, very low shrinkage	Injection molding, shrinkage modifier for auto compounds
Hifax CA 7271 A	0.89	11	800	16	600	60	>10	6	48	-50	70	105	45	163	Low gloss, CLTE, good paintability	Injection molding, impact modifier for auto compounds
Hifax CA 7378 A	0.89	13	1200	18	600	37	8	5	-	-50	95	138	70	163	Good impact stiffness balance	Injection molding
Hifax CA 60 A	0.88	15	80	10	>600	NB	105	2	30	-25	40	56	>85	142	High softness and flowability	Injection molding, softness and impact modifier in automotive compounds
Hifax CA 7153 S	0.9	20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	143	Porous PP	Carrier for liquid additives concentrates
Adflex Z101H	0.88	27	80	10	800	NB	100	2	30	-25	37	53	>85	142	High softness and very high flowability, high filler loading	Softness and impact modifier, color MB carrier, bitumen modification
Adflex X101H	0.88	8	100	NA	NA	NA	NA	NA	NA	-25	NA	NA	NA	142	Good chemical resistance, flexibility at low and high temperature	Bitumen modification

NB=No Break
NA=Not Applicable

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