

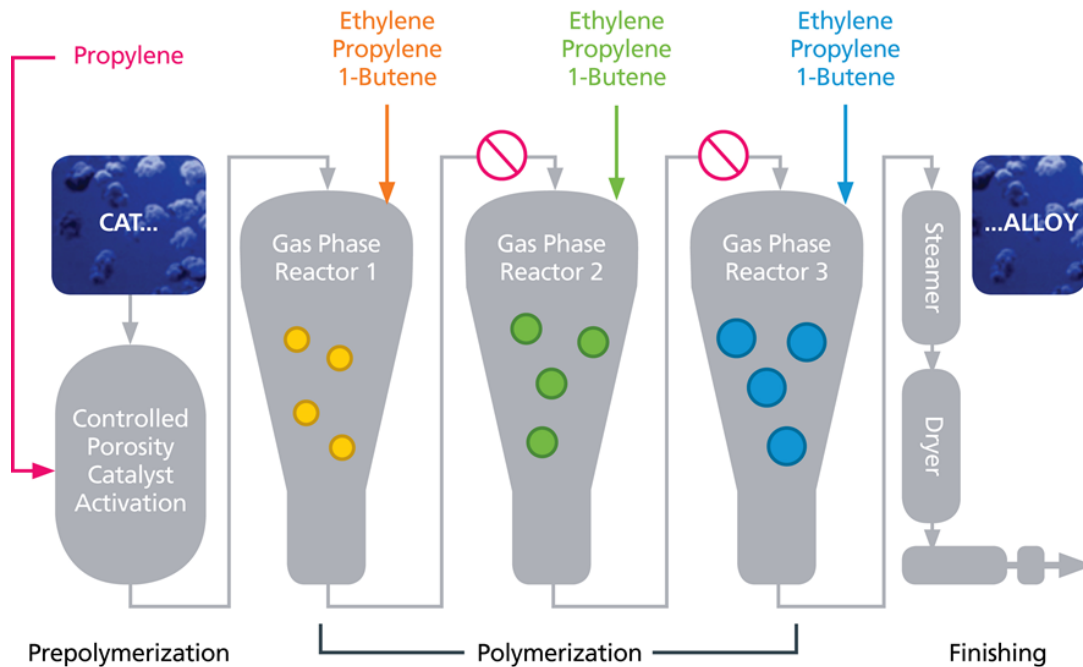
Catalloy Technology Process for Industrial applications

Products Properties

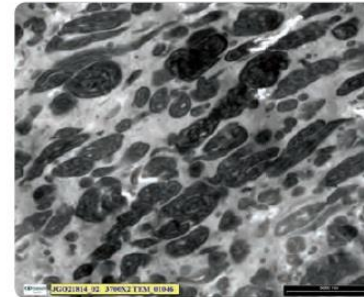
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08 2021

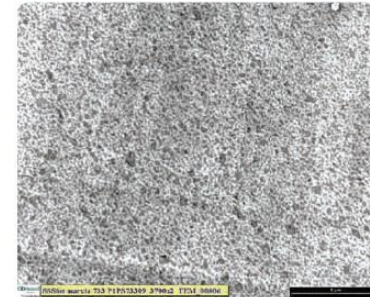
Catalloy process product – an ‘ALLOY’ not a blend



Ethylene Propylene Rubber Blend



Hifax CA10A



TEM (transmission electron microscopy) – 3700X

Grades from *Catalloy* technology, the rubber phase is evenly distributed within a co-continuous PP phase. An alloy such as this delivers superior properties when compared to a physical blend.

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

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).

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.

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!

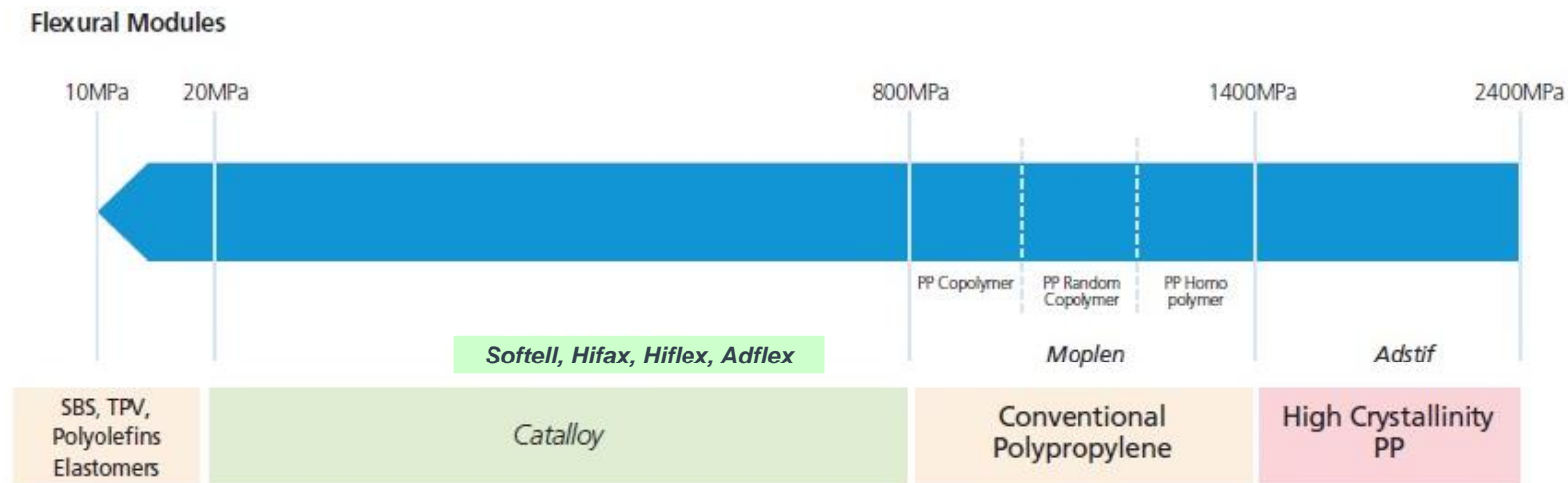
Adflex—Very soft, flexible polyolefins.

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



Applications At A Glance: Building & Construction (extrusion process)

Roofing Membranes



Source: Imper

Soft Profiles



Flexible Pipes and Hoses



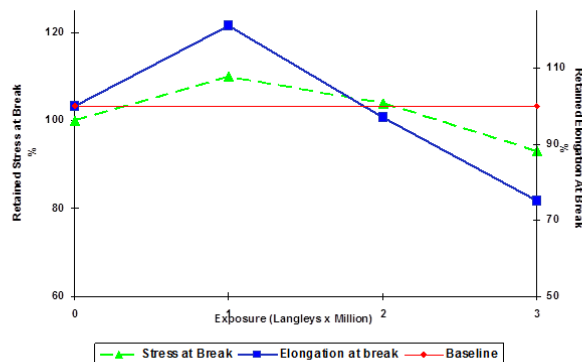
Source: LyondellBasell

■ Grades from *Catalloy* Technology Offering Functionality And Long-lasting Performance In Single-ply Roofing

LyondellBasell's grades from *Catalloy* technology have been specified by customers for waterproofing membranes for more than 20 years; including the Olympic Stadium in London.

Grades from *Catalloy* technology replacing alternative roofing materials, such as PVC, EPDM and Bitumen-membranes. It reduce environmental impact. Grades from *Catalloy* technology do not contain plasticizers, chlorine or heavy metals. It is suitable for "Green roofs" reducing summer temperatures in city areas. Also suitable for "White roofs" reducing temperatures in buildings. Membranes produced using grades from *Catalloy* technology are well proven waterproofing systems that allow excellent long term performance.

Catalloy TPO waterproofing membrane
EMMAQUATM Accelerated Weathering
Test Results



"Durability: more than 20 years of proven performance"

- Cost-Effective production and installation.
- Flexible for easy detailing
- High filler absorption
- High dimensional stability
- Heat resistant
- Good chemical resistance
- Durability more than 20 years of proven performance (with suitable stabilization)
- Flexibility WITHOUT plasticizers at low temperatures
- Weight Reduction / Low Specific Gravity
 - TPO membranes density: 0.89-1.15 g/cc
 - EPDM membranes: 1.17-1.22 g/cc
 - PVC membranes: 1.23-1.30 g/cc
- Recyclable

Applications At A Glance: Automotive (Compounding - Injection Molding Process)

Interior



- Compounds based on *Hifax* grades from *Catalloy* technology are used in various Interior and Exterior Applications

Controllable gloss, good aesthetics, grain retention. Ductile behavior in impact tests and low CLTE are typical requirements for components found on the interior compartment.

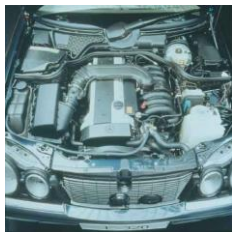
The high softness and the excellent behaviour at both high and low temperatures, combined with haptic (low gloss, soft touch) make the grades from *Catalloy* technology in the product of choice for the development of compounds dedicated to automotive interior parts like consoles, pillar trims, interior flooring, soft grip knobs and skins for dashboard and door panels.

Exterior



Due to their specially designed compositions, *Hifax*, *Softell* and *Hiflex* resins are well known in the industry for their excellent impact resistance at room temperature and low temperature resistance, flow mark free (anti-tiger striping) surface and low shrinkage in applications such as bumpers, side cladding and front grills.

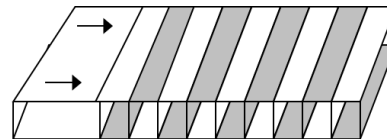
Under-the-Hood



Note: PP/Elastomer/Talc compound including HX X 1956 A



Note: PP/Elastomer/Talc compound without HX X 1956 A



MFR: 1.2 g/10 min Izod 23°C: NB Flex mod: 850 MPa

“Flow Marks - Asynchronous “Tiger Stripes”

- Flow Marks - Asynchronous “Tiger Stripes”
- Caused by unstable melt front, either “slip-stick” or melt fracture (shear-induced crystallization)
- Can be reduced with slower injection speeds or clearly improved by the addition of *Hifax X1956 A* (See Image 1).

Key Features:

- Maintain the impact performance of the compound
- Improve drastically the aesthetic of the molded part
- Improvement already visible from addition of 10%

Applications At A Glance: Automotive (Compounding - Injection Molding Process)

Interior



- *Softell* grades from *Catalloy* technology replacing engineering plastics for use in demanding customer applications

Softell grades from *Catalloy* technology are LyondellBasell's advanced polyolefins which offer an outstanding combination of performance and processing characteristics and are designed for use in demanding technical applications such as automotive interior parts.

Due to the outstanding properties of *Softell* grades from *Catalloy* technology, manufacturers are able to produce interior parts with exceptional haptic qualities without the additional need for painting, giving a pleasing aesthetic look to automotive interiors. PP compounds based on *Softell* grades from *Catalloy* technology containing glass fibres offer a unique low gloss surface finish without the need for additional decoration, further enhancing the qualities of the components.

The *Softell* product family combines exceptional performance with the easy processing characteristics of polyolefins. Due to an outstanding property profile, the *Softell* grades enable the production of finished parts with high-quality surface aesthetics and excellent properties using only one injection molding step.



“*Softell* CA7413A provides excellent haptic properties such as low gloss and soft touch”

Key Features:

- High Flexibility and low Shore hardness
- High Grip effect
- Good haptic, soft touch
- Low Gloss
- Good compatibility with PP, PE

Catalloy process Hifax, Hiflex reactor TPO resin Properties

Properties	Low Temperature		Low Modulus				Low Shrink
	CA7320A	CA12A	CA10A	CA7700A	CA212A	CA 60 A	CA207A
Melt Flow (ISO 1133)	2.5	0.8	0.6	1,4	8	14	9
Flexural Modulus *	200	330	90	170	80	80	550
Tensile Strength at Yield *	0	9	0	8	0	0	14
Elongation at Break *	500	550	500	450	450	400	650
Charpy Impact Notched -20°C *	100	100	110	NB	NB	NB	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 (Int. LYB)	0.6	-	1.7	-	0.8	0.8	0.5

Key Features

Low temperature impact
Excellent stiffness-impact balance
Low gloss
High thermal resistance



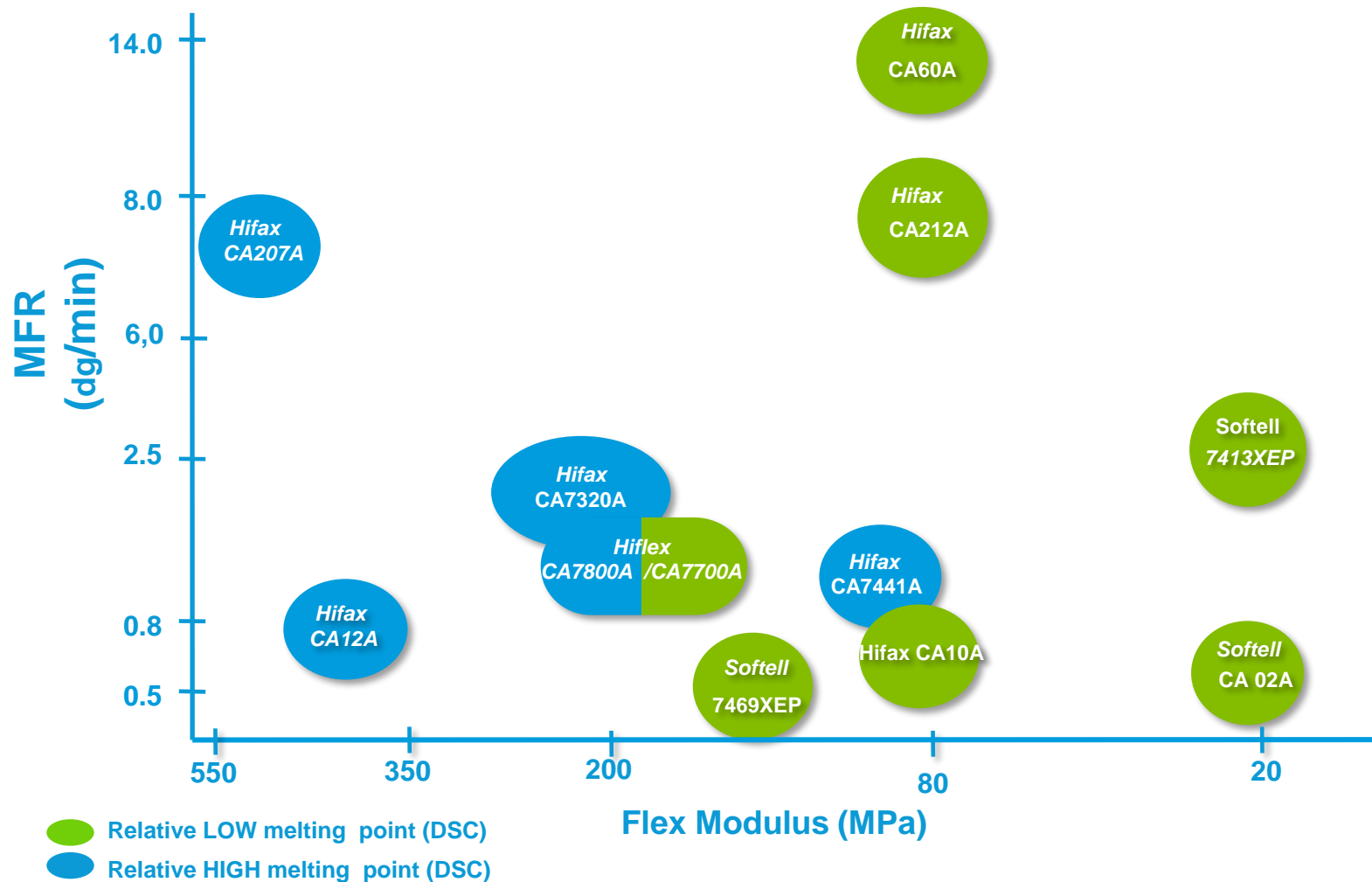
Softness
Flexibility
Broad MFR range
Low temperature impact



Low shrink
Good clarity
High gloss
Low Tg



Grades from *Catalloy* technology Properties



Soft profiles, Gaskets, Wire and Cables



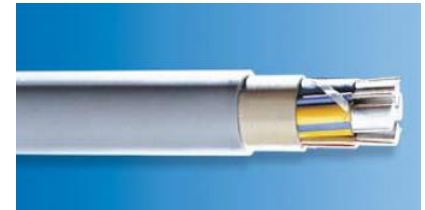
Soft profiles and sheets

Grades from *Catalloy* technology are suitable for the extrusion, calendaring and extrusion blow molding of very soft film and sheet as well as for injection molded parts. They combine:

- low stiffness
- excellent low Shore Hardness
- very good impact resistance

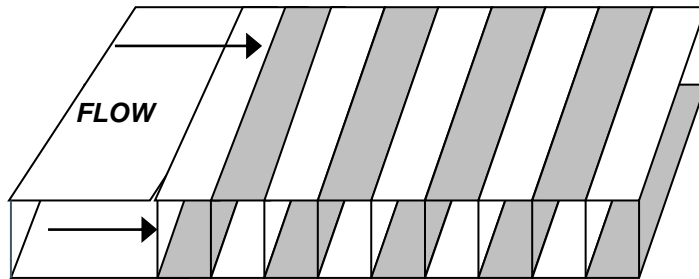
Wire & Cable

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



Injection molded part, Flow Marks Solution: *Hifax X 1956 A*

- Flow Marks – Asynchronous “Tiger Stripes” known defect during the injection molding of large parts process.
- Flow marks be reduced with slower injection speeds or clearly improved by the addition of *Hifax X1956 A* as functional modifier



- *Hifax X 1956 A* :
 - maintain the impact/stiffness balance of the compound
 - improves drastically the aesthetic of the moulded part
 - the improvement is already visible from at 10% addition
 - performs for low defect surfaces due to low intrinsic gels content



Functional modifier for advanced aesthetics in compounding

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* resins

In soft compounds (TPO, TPV and TPE):

Softness and impact strength optimisation

Weathering enhancement

In masterbatches and concentrates:

Improved temperature resistance

Mold shrinkage and process ability improvement

Increased toughness

Gloss control

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

Soft-touch enhancement

Cost Optimisation

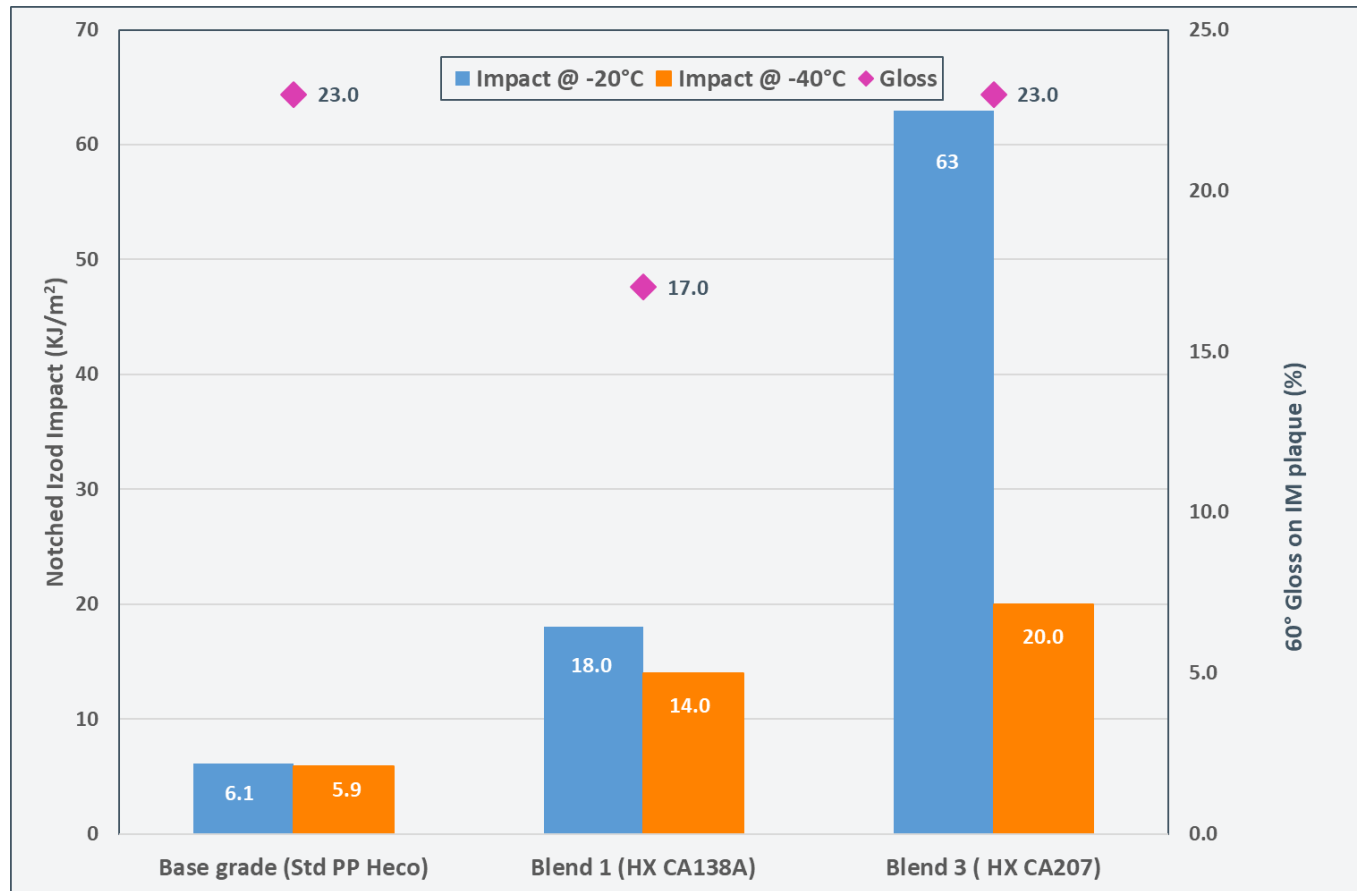
TPO - Thermoplastic Polyolefins blends with outstanding properties.

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

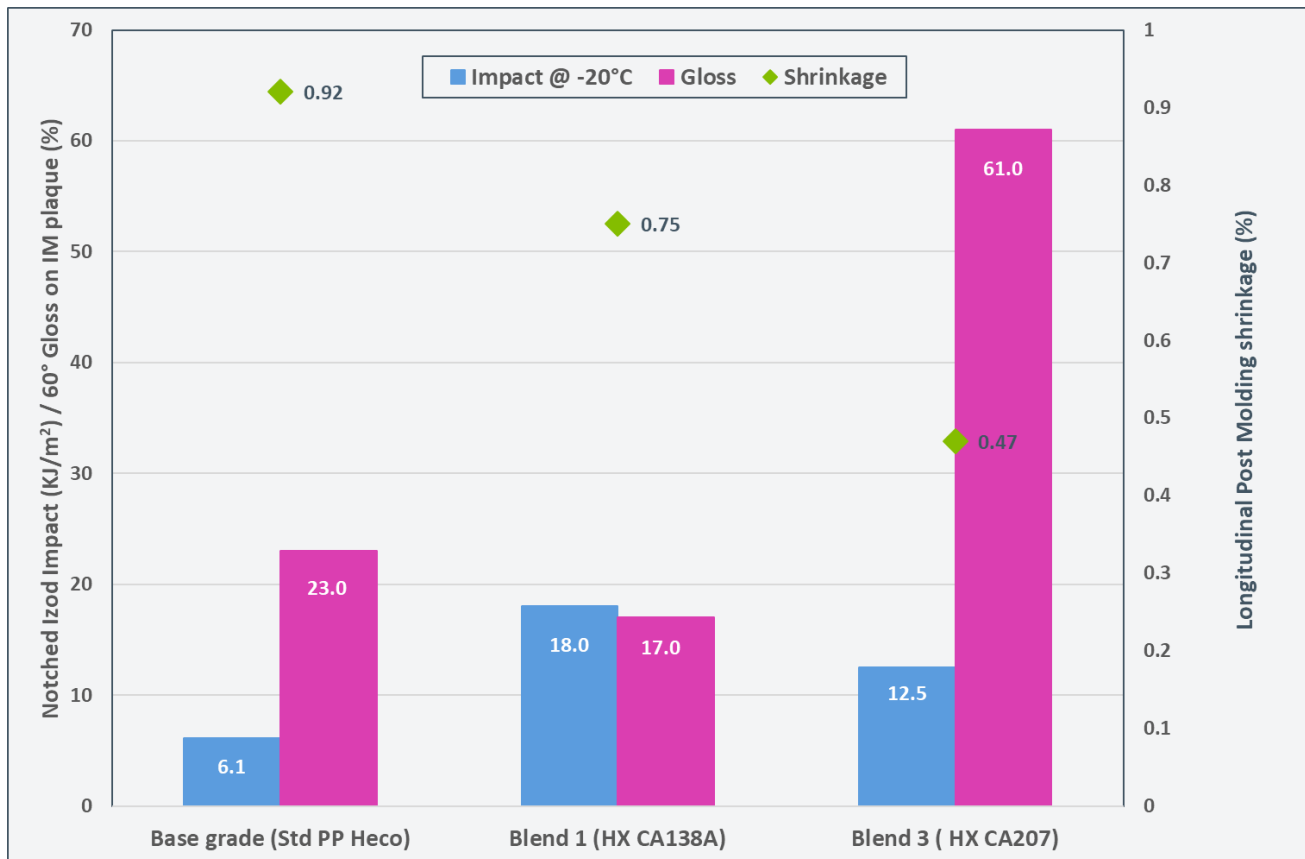
Heco PP + 12% talc + 35% *Hifax* impact modifier



- The addition of *Hifax* CA138A or *Hifax* CA7320A drastically improve the impact resistance and aesthetic properties of filled (or unfilled) compounds
- Depending on our customers' specifications, the *Catalloy* product portfolio offers adaptable solutions

Low Temperature Impact Modification of Filled Compound

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



- *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

Grades from *Catalloy* technology properties

■ Main characteristics

- Easy handling and storage (free flowing pellets)
- Broad Process ability (extrusion, injection molding, calandring, 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
- Recyclability

PROPERTIES	PHYSICAL		MECHANICAL						THERMAL			OPTICAL		SPECIFIC PROPERTIES FEATURES	TYPICAL APPLICATIONS & TECHNOLOGY FEATURES	
	Density	MFR 230°C, 2,16kg	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					23 °C	-20 °C	-40 °C								
Test Method	ISO 1183	ISO 1133	ISO 178	ISO 527-1,-2	ISO 527-1,-2	ISO 179			ISO 868	Internal Method	ISO 75B-1,-2 (0.45 MPa)	ISO 306/ A50	ASTM D2457	ISO 11357-3		
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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