



Modifying polyesters and supporting the design for recyclability

Dow offers high quality modifiers for polyesters to the automotive, electrical and electronics (E&E) and packaging industries, and compatibilizers to the recycling industry. A dedicated team is focusing on supporting innovation and growth through technical experience.

Our impact modifiers for polyesters (PBT, PET, PLA)

Tougheners are special copolymers and terpolymers used to improve the impact strength of polyesters. Dow offers reactive and non-reactive modifiers in the portfolio. Optimization of processing conditions may be required when using reactive modifiers, as they increase melt viscosity. ELVALOY™ PTW Copolymers are reactive modifiers providing impact modification, compatibilization and chain extension; while at the same time offering hydrolysis resistance, especially when used for PBT. ELVALOY™ AC Acrylate Copolymers and ENTIRA™ Polymer Modifiers are primarily non-reactive modifiers helping improve processability by modifying melt rheology (e.g. improving flow and/or melt strength). Main applications are E&E connectors, as well as a wide range of other industrial and consumer products.

Modifiers for packaging applications

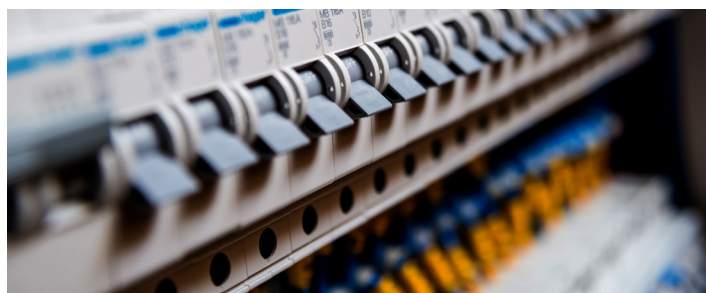
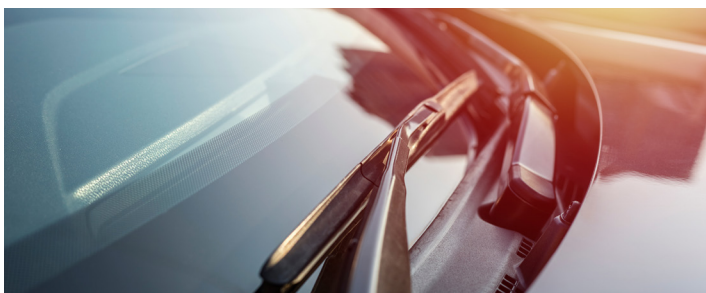
ENTIRA™ SG 1002 Polymer Modifier and ELVALOY™ AC Acrylate Copolymer are well established PET modifiers for the performance increase of packaging tapes and straps which are oriented during production. Increased melt strength helps enable higher orientation during processing (draw) and therefore better strength properties in

end-applications. ELVALOY™ PTW Copolymer, ENTIRA™ SG 1002, and ELVALOY™ AC help support increased productivity while achieving improved impact strength in PET-based cast sheet applications.

Compatibilizers and modifiers for the recycling industry

Compatibilizers are added to incompatible polymer blend systems, resulting in increased blend uniformity and enhanced mechanical properties such as increased elongation, impact strength, and reduced flexural modulus. ELVALOY™ PTW Copolymers differ from standard compatibilizers, as they can play a dual role in polyester systems. On one hand, they can act as compatibilizers at low loading; while at higher loading they act as an impact modifier and viscosity builder. ELVALOY™ PTW Copolymers enhance the impact strength and the elongation at break of PET blends with polyethylene. ELVALOY™ PTW increases the melt viscosity/strength of the recycled PET (rPET) thanks to the co-monomer glycidyl methacrylate (GMA), which acts as a reactive “hook” among PET chains. ELVALOY™ PTW can be combined with other modifiers such as ELVALOY™ AC Acrylate Copolymer and FUSABOND™ Functional Polymers to enhance flow or stiffness of the recycled plastic respectively.

Typical applications



Product overview

The table below provides an overview of the portfolio presenting chemistry, physical characteristics, and a brief description.

Modifier	Chemistry	Melt index (190°C, 2.16kg) dg/min	Density (g/cm ³)	Melting peak (°C)	Features
ELVALOY™ PTW Copolymer	Ethylene, n-Butyl Acrylate, Glycidyl Methacrylate terpolymer (EnBAGMA)	12	0.94	72	Improves the toughness and impact strength of polyesters, e.g. PBT, GMA functional groups bond to acid ends of polyesters and this: (a) increases melt viscosity/strength of the polyester; (b) provides easy dispersion of ELVALOY™ PTW into polyesters and (c) improves hydrolytic resistance for polyesters due to chain extension. ELVALOY™ PTW works as a coupling agent, compatibilizer, impact modifier and chain extender in a recycling stream of polyesters (PET, PBT, LCP, PLA and similar) with polyolefins (PE and PP).
ELVALOY™ 4170 Copolymer	Ethylene copolymer	8	0.94	72	Product similar to ELVALOY™ PTW chemistry, with higher reactivity due to a higher GMA content.
BIOMAX™ SG 120 Resin Modifier	Ethylene terpolymer	12	0.94	72	Designed to modify polylactic acid (PLA) for improved toughness and impact strength, both in the amorphous and crystalline states. BIOMAX™ SG 120 improves cutting and trimming of PLA. BIOMAX™ SG 120 is suitable to be used for food-contact applications.
ENTIRA™ SG 1002 Polymer Modifier	Ethylene copolymer	2	0.94	91	Addition to polyester leads to improved toughness, improved hot hack, increased melt strength which in turn supports higher orientation during processing (draw) therefore better strength properties in end-applications like strapping tapes and filaments.
ELVALOY™ AC 1224 Acrylate Copolymer	Ethylene methyl acrylate copolymer (EMA)	2	0.944	91	Improves processability and toughness of polyesters. Can be used together with ethylene copolymers, where EMA is a toughener and ethylene copolymers offer coupling between EMA and polyester. ELVALOY™ AC 1224 is suitable to be used for food-contact applications, for example for APET and CPET modification.
ELVALOY™ AC 1330 Acrylate Copolymer	Ethylene methyl acrylate copolymer (EMA)	3	0.950	85	Improves processability and toughness of polyesters. Can be used together with ethylene copolymers, where EMA is a toughener and ethylene copolymers offer coupling between EMA and polyester.
ELVALOY™ AC 3427 Acrylate Copolymer	Ethylene butyl acrylate copolymer (EBA)	4	0.926	94	Improves processability and toughness of polyesters. Can be used together with ethylene copolymers, where EBA is a toughener and ethylene copolymers offer coupling between EBA and polyester.* It brings to polyesters a better low temperature flexibility to polyesters compared to ELVALOY™ AC 1330.
ELVALOY™ AC 34035 Copolymer	Ethylene butyl acrylate copolymer (EBA)	40	0.93	90	Improves processability and toughness of polyesters. Can be used together with ethylene copolymers, where EBA is a toughener and ethylene copolymers offer coupling between EBA and polyester.* It brings a better low temperature flexibility to polyesters compared to ELVALOY™ AC 1330.
SURLYN™ 8920 Ionomer	Na ionomer	0.9	0.95	90	Used as nucleant for PET. Offers equivalent to ELVALOY™ AC toughness in CPET and also promotes rapid nucleation. The nucleation is significantly improved compared to mineral crystallization promoters like talc. Can be used together with ELVALOY™ AC.

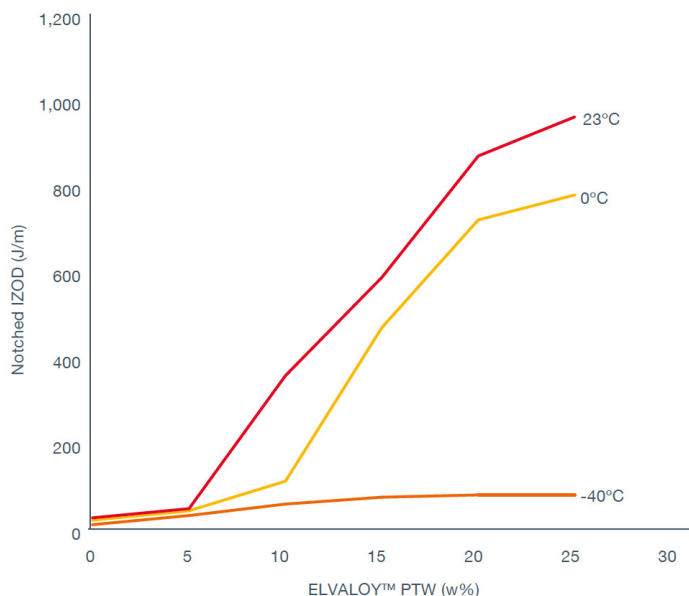
*These are typical properties, not to be construed as specifications.

Individual products listed in this table may comply with Regulation (EU) No 10/2011 on plastic materials and articles intended to come into contact with food, as amended. For product-specific information, including Technical Data Sheets and Regulatory Data Sheets, please visit <https://www.dow.com/en-us/search.html> or contact [Dow support](#).

Our portfolio: Polyester modification (PBT, PET)

ELVALOY™ PTW Copolymers are the elastomeric phase introduced in the matrix that gives the toughness and impact strength to polyesters. ELVALOY™ PTW being added to polyesters causes the blend to be opaque, thus ELVALOY™ PTW is not suitable for clear, amorphous PET containers or films. ELVALOY™ PTW can also be used to toughen PC and other polyesters.

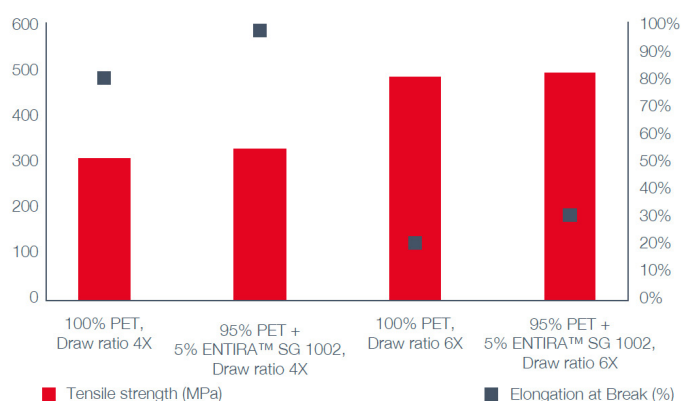
Improved impact strength of PBT with ELVALOY™ PTW at different temperatures ranging from -40°C to 23°C.



* Typical values, not to be construed as specifications. Users should confirm results by their own tests.

ENTIRA™ SG 1002 Polymer Modifier leads to good toughness to PET strap tapes at low addition levels and provides the added benefit of enhanced flow.

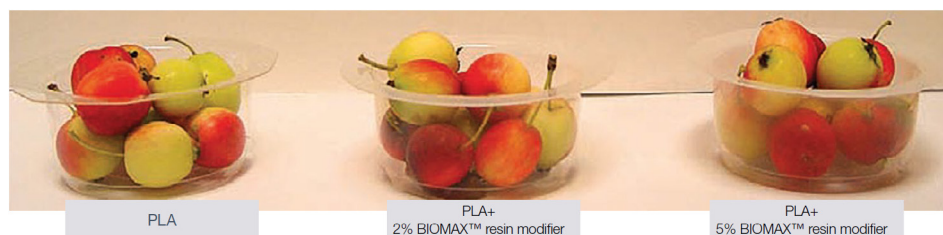
Composition	Draw	Tensile strength (MPa)	Elongation at break (%)
100% PET	4X	310.3	79
95% PET + 5% ENTIRA™ SG 1002	4X	333.2	95
100% PET	6X	488.7	22
95% PET + 5% ENTIRA™ SG 1002	6X	496.3	29



PET with inherent viscosity of 0.58. Tapes were drawn in a tensile testing machine fitted with an oven maintained at 75°C, at a rate of 2,000% per minute to 4x and 6x the original length. Tensile properties were then measured by stretching at room temperature at 100% per minute.

Our portfolio: Polylactic acid (PLA) modification

BIOMAX™ SG 120 Resin Modifier is an ethylene terpolymer designed to modify polylactic acid (PLA) for improved toughness properties in packaging and industrial applications. Some of the attributes of BIOMAX™ SG 120 in PLA include: Special chemistry for PLA. Even small amounts provide toughness benefits; Engineered for PLA, rapid melt-dispersion, even with single screw extruders; Pelletized, efficient extruder feeding; separately or as a pellet-bend with PLA.



Blends containing 5% (wt.) or less modifier maintain contact clarity similar to clarified polypropylene (PP), while blends in the 5% to 15% range presents different degrees of translucence, similar to unclarified PP.

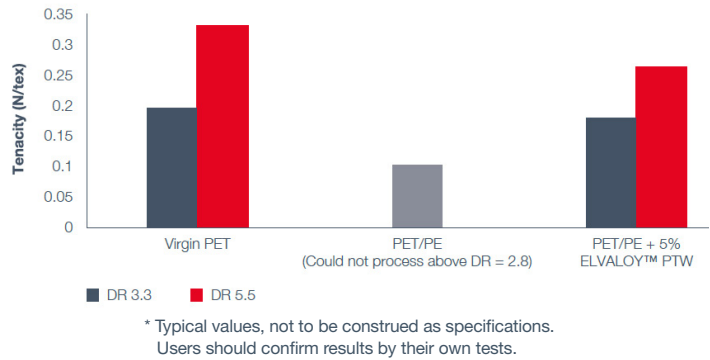
BIOMAX™ SG 120 Resin Modifier greatly improves the cutting and trimming of PLA. While unmodified PLA exhibits breakage at the edge of the sheet, blends with 2% to 5% wt. of BIOMAX™ SG 120 show no breakage. There is also a marked improvement of "pinning". While unmodified PLA breaks at the edge of the sheet, there is no breakage once BIOMAX™ SG 120 is added.

BIOMAX™ SG 120 does not hinder the biodegradability of PLA upon an addition of 5%.

Our portfolio: Compatibilization of PET/PE blends (PET-rich)

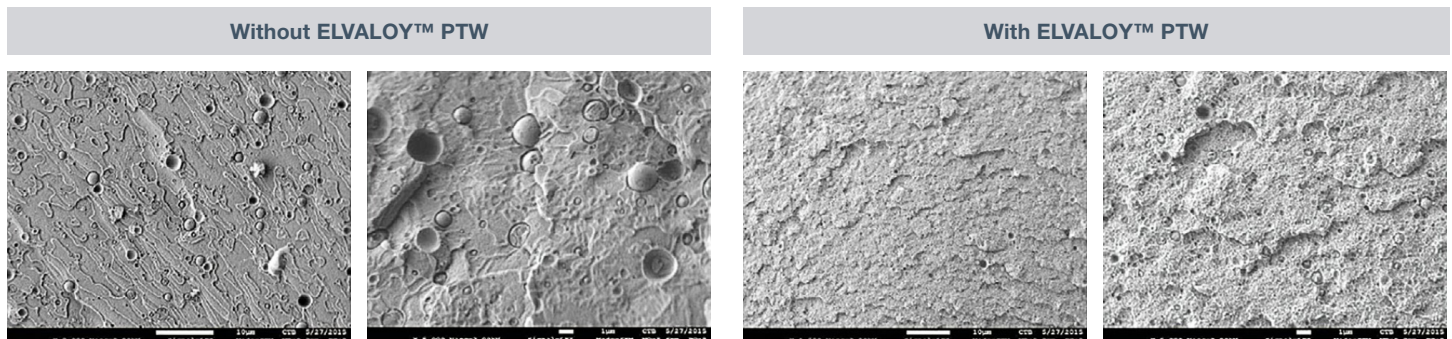
The addition of ELVALOY™ PTW Copolymers help enable the processing of PET/PE waste in the fabrication of fibers, even at high draw ratio (DR). The fibers' tenacity is significantly improved thanks to ELVALOY™ PTW.

In blends of PET with polyethylene contamination, e.g. from the recycling of PET trays, ELVALOY™ PTW works as a coupling agent and compatibilizer for the contaminants, as an impact modifier and chain extender for the polyester matrix, allowing the recycling of such polyester rich waste into higher value applications.



Scanning electron microscope picture of blend PET/PE 92.5%/7.5% shows a much more homogeneous structure for the blend containing ELVALOY™ PTW Copolymers.

ELVALOY™ PTW can be combined with our ELVALOY AC Acrylate Copolymers modifiers in order to obtain an optimized performance/cost balance in recycled PET solutions, we are supporting the efforts of PET users in different industries for an increasing use of recycled materials, advancing a circular economy.



*The graphic representations are presented here for illustrative purposes only and should not be construed as product specifications.

Contact and more information

Contact your Dow representative or visit [Dow.com](https://www.dow.com) to learn more about how our modifier and compatibilizer solutions for engineering polymers can help meet challenging requirements in automotive, consumer and E&E applications.

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