

Elastomers

DUTRAL[®] CO/TER/PM/OCP

EP(D)M

The elasticity
you need



versalis

Versalis EP(D)M Dutral® CO/TER/PM/OCP



Background

The first synthesis ever of an Ethylene Propylene elastomer copolymer was performed in the late '50s by Prof. Natta and his team based in Ferrara. In 1963, the trademarked product Dutral® was scaled-up to a production of 5 KTPY and eventually the capacity increased to 85 KTPY of NPC in order to support market demand.

Starting from 2018 a new line in Ferrara has further increased the NPC to 135 KTPY, Versalis becomes the 2nd european producer of EPR elastomers for nominal capacity.

Process

The Dutral® EPR is produced by slurry polymerisation process, which allows the production of a wide variety of grades. The process does not require solvent and solvent recovery equipment and, in addition, the low viscosity of the suspension helps temperature control and product handling. Moreover monomers are highly soluble in the reaction bulk, therefore high molecular weight polymers can be produced advantageously. The polymerisation is carried out by proprietary Ziegler-Natta catalyst and the unreacted monomers are recovered in the stripping section. Eventually, the crumbs are stabilised by means of a proper antioxidant and then washed, dried, baled and packaged.



Main properties

Dutral® grades are amorphous elastomers having saturated backbone. Due to their structural characteristics, vulcanised items based on Dutral® elastomers show the following properties:

- excellent resistance to ozone and ageing, in both static and dynamic conditions;
- good resistance to both high and low temperature, from -55 °C up to 150 °C;
- excellent dielectric properties (polymer dielectric constant at 20 °C = 2.2);
- low density (polymer density = 0.86-0.88 g/cm³);
- low permanent set values;
- outstanding and durable mechanical and elastic properties;
- good resistance to a large amount of chemicals (organic and inorganic acids, alkalis, amines, phosphoric esters, hydraulic fluids, antifreeze liquids and brines, bleaching agents, biodegradable detergents);
- waterproof.

Grade selection

The most important characteristics of Dutral® elastomers are listed below:

- average molecular weight which can be roughly related to Mooney Viscosity and has an effect on processability, shape stability, and mechanical properties;
- molecular weight distribution (MWD) that impacts on processability, cure rate, shape stability and mechanical properties;
- ethylene/propylene ratio; affecting low temperature performance, green strength, filler loading and mechanical properties;
- third monomer content (ENB) ensures the unsaturation level that influences the curing behaviour and vulcanised elasticity. Dutral® CO have a completely saturated back bone, while Dutral® TER have controlled quantity of unsaturation. Dutral® CO and Dutral® TER sets of letters are followed by other numbers, as shown below:

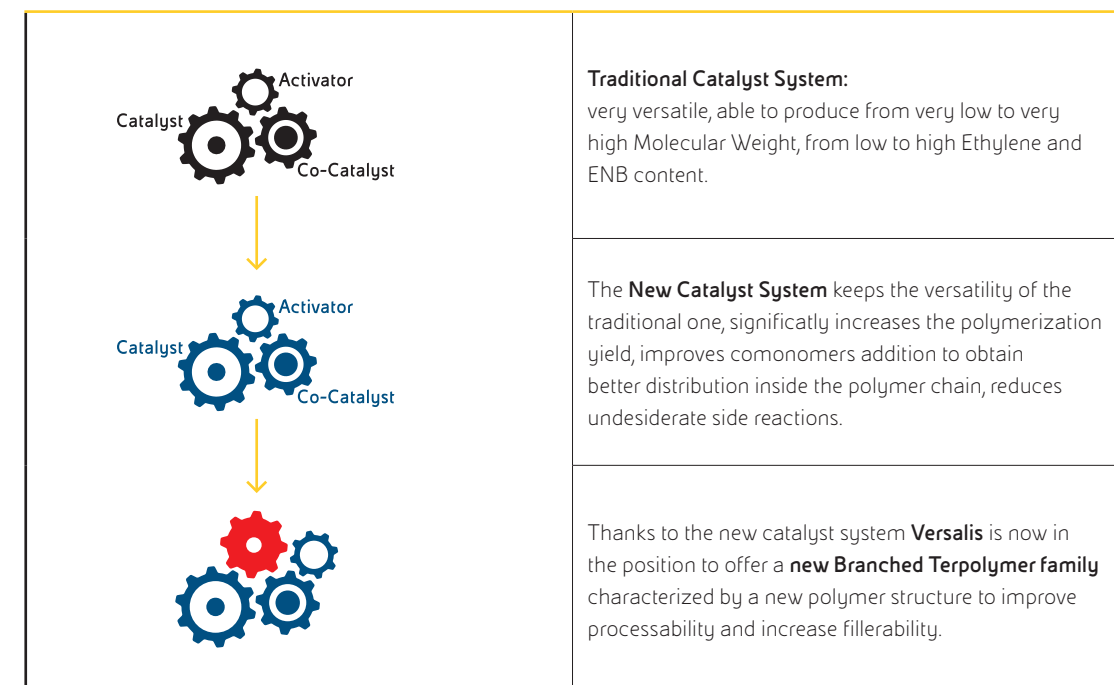
	Dutral® CO	Dutral® TER
1 st digit	% oil (decades)	% ENB
2 nd digit	% propylene (decades)	% oil (decades)
3 rd digit	ML (1+4) 100 °C (decades)	% propylene (decades)
4 th digit	-	ML (1+4) 100 °C (decades)

Further specification may be given by the following initials

EP	easy processing, the bale is soft and friable
PL	pellets physical form
WO	heavily purified paraffinic oil extended

Development of a new catalyst system

After years of internal development Versalis is ready to scale up an improved Z-N catalyst.



New Catalyst System benefits

Higher polymerization yield	Cleaner products
Better monomer distribution and side reactions control	Gel content: low to none
	Better consistency
	Better curing efficiency
Widening the polymer design	New polymer structures
	Improved processability

Grade list

Copolymers

Grades	Propylene content %wt	Mooney viscosity ML (1+4) 125 °C	Oil content %wt	Physical form ⁽²⁾	Unsaturation level	Pack. n°
Dutral® CO 033	28	30 ⁽¹⁾	-	B	-	1
Dutral® CO 034	28	44 ⁽¹⁾	-	B, PL	-	1 - 6
Dutral® CO 038	28	60	-	B, FB, PL	-	1 - 2 - 6
Dutral® CO 043	45	33 ⁽¹⁾	-	B	-	3
Dutral® CO 054	41	44 ⁽¹⁾	-	B	-	1
Dutral® CO 058	48	80 ⁽¹⁾	-	B	-	4
Dutral® CO 059	41	79	-	B	-	1

(1) ML (1+4) 100 °C (2) B = bales; PL = pellets; FB = friable bales



Terpolymers*

Grades	Propylene content %wt	Mooney viscosity ML (1+4) 125 °C	Oil content %wt	Physical form ⁽²⁾	Unsaturation level	Pack. n°
Dutral® 2038 PL	28	57	-	PL	1.5	6 - 10
Dutral® TER 4033	25	30 ⁽¹⁾	-	FB	5	2
Dutral® TER 4038 EP	27	60	-	EP, FB, PL	4.4	5 - 2 - 6
Dutral® TER 4039	27	77	-	FB	4.4	2
Dutral® TER 4044	35	44 ⁽¹⁾	-	B	4	1
Dutral® TER 4047	40	55	-	B	4.5	1
Dutral® TER 4049	40	76	-	B	4.5	1
Dutral® TER 4334	27 ⁽⁴⁾	28	30	B	4.7 ⁽⁴⁾	1
Dutral® TER 4436	28 ⁽⁴⁾	43	40	B	5.5 ⁽⁴⁾	1
Dutral® TER 4437	32 ⁽⁴⁾	57	40	B	4.5 ⁽⁴⁾	1
Dutral® TER 4437 WO	32 ⁽⁴⁾	57	40 ⁽³⁾	B	4.5 ⁽⁴⁾	1
Dutral® TER 4535	32 ⁽⁴⁾	32	50	B	3.4 ⁽⁴⁾	1
Dutral® TER 4548	36 ⁽⁴⁾	47 ⁽⁴⁾	50 ⁽³⁾	B	4.5 ⁽³⁾	1
Dutral® TER 6235	32 ⁽⁴⁾	33	23	B	7.4 ⁽⁴⁾	1
Dutral® TER 6537	32 ⁽⁴⁾	43	50	B	8 ⁽⁴⁾	1
Dutral® TER 7040	40	87	-	B	6.5	1
Dutral® TER 9046	31	67 ⁽¹⁾	-	B	8.9	1

*Diene monomer ENB

(1) ML (1+4) 100 °C (2) B = bales; EP = friable easy processing bales; PL = pellets; FB = friable bales (3) Pure paraffinic oil

(4) Referred to polymer matrix



Polyolefin Modifiers

Grades	MFI (230 °C - 5kg) g/10 min	Volatiles wt max %	Ash wt max %	Physical form ⁽²⁾	Pellet/size g/30 pellets	Pack. n°
Dutral® PM 06 PLE	1.8	0.2	0.3	PL	0.45	7
Dutral® PM 8273	2.4	0.2	3.0	PL	0.45	7

(2) PL = pellets

Oil Modifiers

Grades	Propylene content %wt	Mooney viscosity ML (1+4) 100 °C	MFI (190 °C - 2.16 kg) g/10 min	Ash wt max %	Volatiles wt max %	Physical form ⁽²⁾	Pack. n°
Dutral® OCP 2530 PL	34	-	8.5 ⁽³⁾	0.4	0.2	PL*	8
Dutral® OCP 2550	48	-	8.3	0.4	0.2	B	9
Dutral® OCP 3550	48	-	2.9	0.4	0.2	B	9
Dutral® OCP 4530	28	-	0.5	0.3	0.7	B, P	1-6
Dutral® OCP 5050	48	60	-	0.3	0.7	B	4

(2) B = bales; *PL= non-free flowing pellets

(3) MFI (230 °C - 2.16 kg)

Experimental grades with non staining antioxidant

Grades	Propylene content %wt	Mooney viscosity ML (1+4) 125 °C	Oil content %wt	Physical form ⁽²⁾	Unsaturation level	Pack. n°
Dutral® TX 1401 (TER 8148)	39	68	17.5	B	8.5	1
Dutral® TX 1502 (BTR 4049)	40	76	-	B	4.5	1

(2) B = bales

(3) MFI (230 °C - 2.16 kg)

Grades	Main applications	Key features
Dutral® TX 1401 (TER 8148)	Automotive sponge and solid profiles, building, mechanical goods	High loading capacity, easier dispersion of ingredients during mixing, good dimensional stability and low temperature elasticity; the high ENB content ensure a very fast curing.
Dutral® TX 1502 (BTR 4049)	Building, automotive compact profiles, mechanical goods	High loading capacity, good mechanical properties and good collapse resistance.

Storage and packaging

Dutral® grades have to be stored in vented, dry areas at temperature between 20 °C and 30 °C, avoiding direct sunlight.

Pack. n°	Packaging description	Crate dimension (mm)	Nominal net weight	Bale (bag) weight (kg)	Bale (bag) dimension (mm)	Bales (bags) total	Bales (bags) x layers
1	Cardboard box	1050x1250x1050	750	25	550x350x170	30	5x6
2	Cardboard box	1130x1210x1050	600	25	550x350x220	24	6x4
3	Cardboard box	1050x1250x1050	500	25	550x350x170	20	5x4
4	Cardboard box	1050x1250x1050	625	25	550x350x170	25	5x5
5	Cardboard box	1000x1200x2090	875	25	550x350x260	35	5x7
6	PE bags on wooden pallet	1050x1250x1550	1000	20	-	50	5x10
7	PE bags on wooden pallet	1050x1250x1950	1250	25	-	50	5x10
8	PE bags in cardboard box	1000x1200x2090	800	20	-	40	5x8
9	Cardboard box	1050x1250x1050	500	20	-	25	5x5
10	Octabin cardboard box	1050x1250x1100	500	-	-	-	-

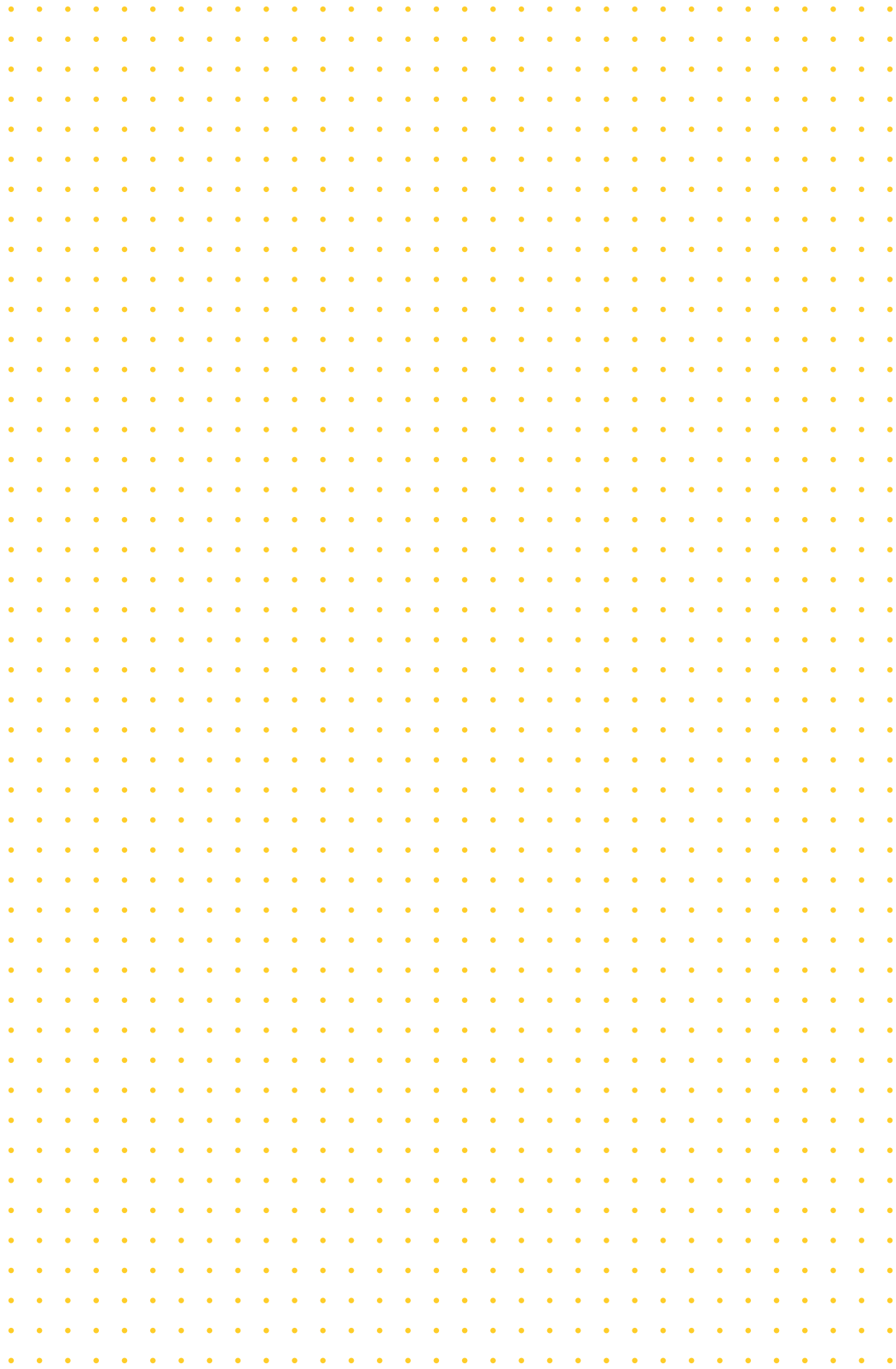
Versalis in the world

Versalis is focused on establishing itself as a solution provider, offering a range of increasingly market-oriented products at an international level.

The company is present in the APAC region through its Shanghai-based subsidiary, Versalis Pacific Trading; in Mumbai, India; in Singapore; and in South Korea through LVE, a joint venture with Lotte Chemical.

Versalis can also count on subsidiaries Versalis Americas – with offices in Houston, Texas – and Versalis Mexico. Furthermore, Versalis serves the oil and gas industry with offices in Ghana and in Congo, with its portfolio of oilfield chemicals. Thanks to a widespread sales network, distributors and sales agents, Versalis can serve all markets worldwide.

Headquarters	Sales network	Plants	UK
San Donato Milanese, Milan (Italy)	Austria Belgium China Congo Czech Republic Denmark France Germany Ghana Greece Hungary India Italy Mexico Poland Portugal Romania Russian Federation Slovak Republic South Korea Spain Taiwan USA Venezuela	<u>Italy</u> Brindisi: - Steam cracking - Aromatics - Polyethylene Crescentino: - Bio-ethanol Ferrara: - Elastomers - Polyethylene Mantua: - Intermediates - Styrene - Styrenics Porto Marghera: - Steam cracking - Aromatics Porto Torres: - Elastomers - Renewable chemistry Priolo: - Steam cracking - Aromatics Ragusa: - Polyethylene EVA - Butadiene Ravenna: - Elastomers	<u>UK</u> Grangemouth: - Elastomers <u>France</u> Dunkerque: - Steam cracking - Polyethylene EVA <u>Germany</u> Oberhausen: - Polyethylene EVA <u>Hungary</u> Százhalombatta: - Styrenics <u>South Korea</u> Yeosu (LVE, a joint venture with Lotte Chemical): - Elastomers
Licensing Algeria Brazil China Egypt India Iran Japan Malaysia Portugal Qatar Romania Russian Federation Slovak Republic South Korea Spain Taiwan USA Venezuela	R&D <u>Italy</u> Ferrara Mantua Novara Porto Torres Ravenna Rivalta Scrivia		





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Social accountability system of Versalis S.p.A.
complies with the requirements of SA8000



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