DEGALAN® and DYNAPOL®

SOLUTIONS FOR FLEXIBLE PACKAGING APPLICATIONS AND PRINTING INKS

DEGALAN®

DYNAPOL®

EVONIK
POWER TO CREATE

ONE PARTNER. MANY EXPERTS.

With DEGALAN® and DYNAPOL®, Evonik offers a wide range of methacrylic resins and polyesters for multiple uses in flexible packaging applications. This brochure conveniently combines relevant information about both brands as a service for our customers.

Evonik, the creative industrial group from Germany, is one of the world leaders in specialty chemicals. Its activities focus on the key megatrends health, nutrition, resource efficiency and globalization. Profitable growth and a sustained increase in the value of the company form the heart of Evonik's corporate strategy. Evonik benefits specifically from its innovative process and integrated technology platforms.

ABOUT DEGALAN®

DEGALAN® – FOR A VARIETY OF USES

Evonik offers a wide range of standard and specialty binders under the DEGALAN® trademark.

Ever since the early 1930s, Evonik has been developing polymer solutions, dispersions and solid products on an acrylic and methacrylic base for this segment, which have been used in the coatings industry for more than 70 years. DEGALAN® products offer convincing benefits in all applications where the main priorities are unsurpassed weather resistance, colorfastness, high brilliance, hardness and scratch resistance. Together with its customers, Evonik develops new products for innovative applications. The result are complete solutions for end users that are ready for serial production. With production sites in Darmstadt, Shanghai and Wesseling, Evonik belongs to one of the largest producers of methacrylate-based coating raw materials in Europe and Asia.

APPLICATION AREA: PRINTING INKS

THE RIGHT DEGALAN® PRODUCT FOR EVERY SUBSTRATE

DEGALAN® methacrylic resins from Evonik have proved their worth for many years as binders for formulating printing inks.

Universal solubility, excellent chemical resistance, lightfastness and good compatibility with other paint raw materials and pigments are special characteristics of the DEGALAN® products. Their good adhesion to various substrates such as plastics, paper, textiles and metal, and as co-binders in UV printing inks makes it possible to process DEGALAN® methacrylic resins in different printing processes.

DEGALAN® has proven to be particularly suitable for for printing inks for packaging material, but can also be used for hot stamping application.

DEGALAN® is used as a binder in a large number of different applications, such as marine paints and container coatings, concrete paints, metal coatings, plastics coatings, PVC top coats, printing inks, heat sealing and exterior paints. Flexible packaging is a constantly growing segment within the printing inks market. The preferred printing technologies are flexo and gravure printing, with regional preferences for the one or the other. Regarding the ink technology, solvent-borne inks have the highest market share, while radiation-curing and water-borne ink systems are also readily available on the market, but not as widely used. The segment is divided into two main drivers:

- Regulatory topics such as the Swiss Ordinance
- Commercial topics like price-performance ratio and total cost of formulation

And methacrylic binders like DEGALAN® M825 and DEGALAN® 66/02 N provide excellent pigment wetting, low ink viscosity, good printability, and enable the fast drying of inkjet inks.

Choose the right DEGALAN® type for your substrate

Plastic Substrates (PVC, PS, PC, PMMA, ABS etc.)

DEGALAN® M 825 **DEGALAN® M 748** **DEGALAN® M 345** **DEGALAN® MB 319** **DEGALAN® LP 53/13** **DEGALAN® LP 66/02** **DEGALAN® 66/02 N*** **DEGALAN® VP 1034 F**	These hard methacrylic resins that dissolve particularly well in esters are distinguished by their good chemical resistance (to grease and gasoline), good adhesion and lightfastness. The good plasticizer barrier effect when coating plasticized PVC is particularly noteworthy. Combination of the printing inks with DEGALAN® MB 319 makes it possible to vary their hardness and flexibility without negatively influencing the plasticizer barrier effect. DEGALAN® M 748, for example, can be usefully combined with PVC copolymers resins to improve chemical resistance. Formulation: V 1129, V 1130, V 315, V 316, V 338, V 1032, V 1134, V 314, V 329, V 1261, V 1262
DEGALAN® N 742 N	This resin is characterized by good solubility in alcohol. A combination with cellulose derivatives and alcohol-soluble nitrocellulose is also possible. Formulation: V 1124, V 1126
DEGALAN® PM 381 N **DEGALAN® LP 64/12** **DEGALAN® P 24** **DEGALAN® P 26** **DEGALAN® P 24 N***	These methacrylic resins of medium hardness, readily soluble in esters and blendable with alcohol, are distinguished by their good hardness, elasticity and lightfastness. They can often be used without adding plasticizers. They are compatible with ester-soluble nitrocellulose. Formulation: V 1056, V 1272

Metal Substrates

DEGALAN® 64/12 N* **DEGALAN® PM 381 N** **DEGALAN® LP 64/12** **DEGALAN® LP 65/12** **DEGALAN® PM 709**	These medium-hard methacrylic resins provide films that adhere well to metal. To improve the adhesion to metal, it is advisable to use a combination of epoxy resins, PVC copolymers and additional external plastification.

Polyolefinic Substrates like PP, PE etc.

DEGALAN® P 28 N **DEGALAN® M 748** **DEGALAN® LP 64/12** **DEGALAN® LP 66/02** **DEGALAN® 64/12 N*** **DEGALAN® 66/02 N***	It is useful to treat the substrates by corona pretreatment and apply a primer to obtain adequate adhesion. Acrylic resins show not sufficient adhesion on these untreated substrates. To formulate a primer onto these difficult substrates it is proven to combine methacrylic resins with chlorinated polyolefins such as Trapylen 128 S, Trapylen 186 S, Trapylen 187 S und Eastman CPO 343 -3.

Paper Substrates

DEGALAN® N 742 N **DEGALAN® P 24** **DEGALAN® P 28 N** **DEGALAN® PQ 611 N** **DEGALAN® P 24 N***	Suitable grades for these are the alcohol-soluble acrylic resins DEGALAN® N 742 N, DEGALAN® P 24, DEGALAN® P 24 N or the equally alcohol-soluble DEGALAN® P 28 N. DEGALAN® PQ 611 N, which is soluble in pure aliphatic solvents, is another option.

Special Applications

	DEGALAN® M 726, a crosslinked methacrylic resin that is insoluble in solvents, can be used as a flatting agent and antiblocking additive. It is particularly recommended for use as additive in finishing lacquer for PVC as antiblocking additive.
DEGALAN® M 726	Formulation: V 1184
DEGALAN® PQ 611 N	DEGALAN® PQ 611 N is soluble in mineral oil and can therefore be used for newspaper printing (offset inks).
	Highly heat-resistant acrylic resin for IMD screen printing inks.
DEGALAN® VP 1018 F	Formulation: V 1270
	For gravure printing inks, especially for PET substrates. Co-binder to enhance the adhesion on variety of plastic substrates.
DEGALAN® 1040 L	Formulation: V 1270

UV Printing Inks

DEGALAN® PQ 611 N **DEGALAN® MB 319** **DEGALAN® LP 64/12** **DEGALAN® 64/12 N** **DEGALAN® P 28 N** **DEGALAN® PM 381 N**	DEGALAN® PQ 611 N, DEGALAN® MB 319, DEGALAN® P 28 N, DEGALAN® LP 64 / 12, DEGALAN® 64/12 N* and DEGALAN® PM 381 N have proved suitable as additives to UV-curable lacquers. They improve adhesion to metals and plastics and successfully reduce shrinkage of the coating films. To improve adhesion on BOPP substrates DEGALAN® PQ 611 is recommend. For metal substrates use DEGALAN® LP 65/12. For universal use DEGALAN® LP 64/12 is advisable.

* Available in Asia-Pacific region only

APPLICATION AREA: UV-CURING

USING ACRYLIC RESINS TO ENHANCE PROPERTIES OF UV-CURING COATINGS

Evonik Industries offers high-quality polymers that are suitable for modifying UV-curing coatings. UV-curing coatings, known as 100 % systems, are ideal for coating paper, wood and metal substrates, as well as plastic films. Rapidly soluble polymers are the key to success. The polymer is first dissolved in monomers. The solution thus obtained is then homogenized with oligomers, initiators, additives and optionally with pigments. After application, this liquid paint film cures within fractions of a second upon exposure to short-wave UV light. This curing process releases no volatile constituents such as solvents, and the resulting homogeneous paint film adheres mostly better than conventional coating systems.

ADVANTAGES OF ADDING DEGALAN® PRODUCTS TO UV-FORMULATIONS:

- Increased adhesion, especially on plastic and metal surfaces
- Reduced shrinking of the coating
- Reduced cost of the formulation
- Low increase in viscosity of the UV-coating lacquers
- Good compatibility with oligomers

MANY DEGALAN® TYPES ARE SOLUBLE IN MONOMERS WITH GOOD VISCOSITY

Optimal results are attained by using low molecular types containing a low proportion of methyl methacrylate. The following table shows the viscosity of DEGALAN® types combined with the most widely used monomers. The values are based on a 30 wt.% polymer solution and viscosity expressed in mPas.

Viscosity (mPas) of DEGALAN® – Types in Monomers (30 wt.%)

Monomer / DEGALAN®	PQ 611 N	P 28 N	PM 381 N	PM 602	N 742 N	P 24 N	64/12 N*
Isobornyl acrylate	2100	4600	3800	5700	11000	8600	4500
Trimethylolpropan triacrylate	not soluble	not soluble	not soluble	not soluble	not soluble	not soluble	not soluble
Tripropylen glykol diacrylate	4600	8800	6000	9500	18300	37500	8200
Hexandiol diacrylate	950	1700	1400	2000	3200	4400	1600

Monomer / DEGALAN®	LP 64 / 12	LP 64 / 11	P 67 / 11	LP 63 / 11	LP 65 / 11	MB 319	
Isobornyl acrylate	3600	1500	not soluble	700	1200	20600	-
Trimethylolpropan triacrylate	75400	24500	not soluble	not soluble	19200	105000	-
Tripropylen glykol diacrylate	5500	1900	7800	950	1600	17200	-
Hexandiol diacrylate	1300	500	1700	300	450	750	-

* These products are only availalbe in Asia Pacific

EXAMPLES OF GUIDELINE FORMULATIONS

To improve the adhesion of UV-curing inks on plastic substrates add 10 % to 40 % of the following solution:

- 40 parts DEGALAN® LP 64/1
- 60 parts Tripropylene Glycol Diacrylate

PRIMER FOR BOPP-FOILS:

- 20 to 40 parts DEGALAN® PQ 611 N
- 80 to 60 parts Hexandiol Diacrylate
- 2 to 8 parts initiator
- 0.6 parts defoamer

DYNAPOL® – ESTABLISHED AND PROVEN SPECIALTY RESINS FOR PACKAGING APPLICATIONS

Specially designed saturated copolyester resins from Evoniks brand DYNAPOL® have been used for many years as binder for food packaging applications.

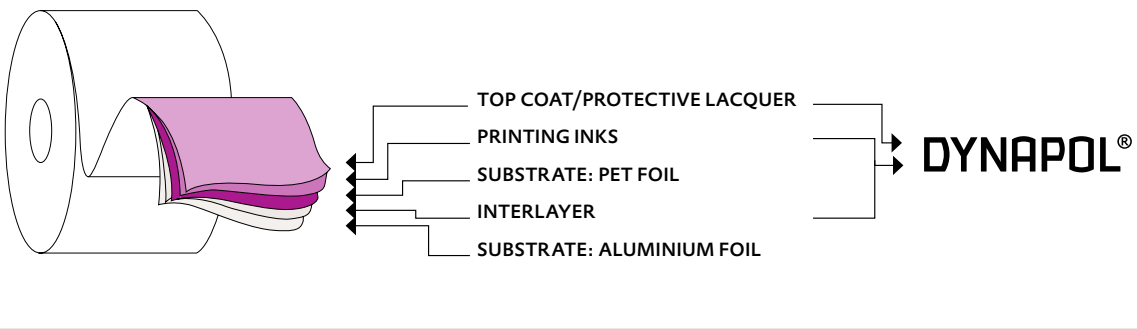
DYNAPOL® polyesters are well known in the manufacture of flexible packaging. They are used wherever good adhesion to polar substrates with flexibility is required. All DYNAPOL® resins are formulated without BPA or PVC.

Most of the grades are in compliance with FDA §175.300, which enables the products to be used in application with direct food contact.

ADVANTAGES OF DYNAPOL® POLYESTERS

- excellent flexibility and adhesion
- adjustable properties/tailor made products
- low migration
- BPA-NI
- free of taste and smell
- compliant with FDA §175.300

Target Applications for DYNAPOL® Polyesters



APPLICATION AREA: PRIMERS/COATINGS

THE RIGHT CHOICE OF DYNAPOL® GRADE FOR EVERY APPLICATION

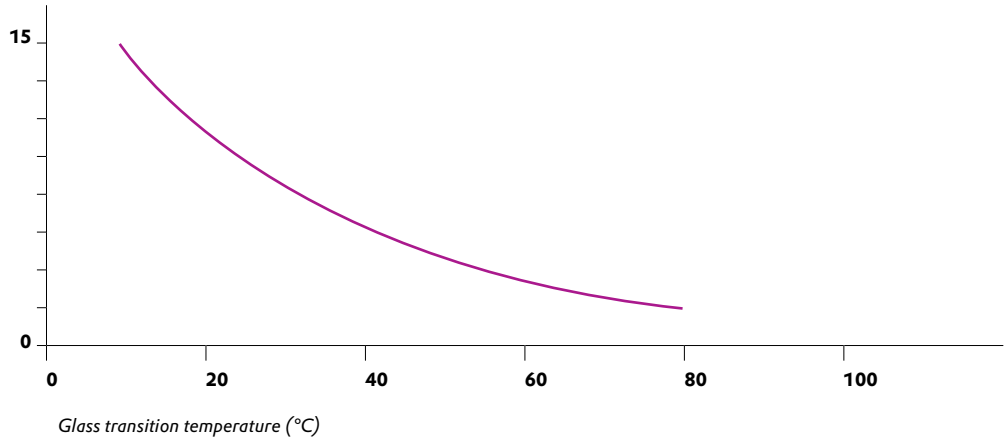
DYNAPOL® polyesters resins from Evonik are used as raw material in many flexible packaging applications.

DYNAPOL® polyesters have no smell or taste and that is why they are very good suitable for food packaging coatings. Especially the high molecular weight DYNAPOL® L polyester have a good balance of flexibility and hardness. These resins show excellent adhesion to a variety of different foils substrates made of aluminum, PET, PC and PA. Furthermore, they are produced from non-toxic chemical monomers (diglycols and diacids) and offer low migration properties. That is very important for the customers and brand owners in the food packaging market.

DYNAPOL® polyesters are used as raw materials in many flexible packaging applications, for example: foil primer, pre-print primer, printing ink, overprint varnish, foil coatings, heat-seal lacquers and interlayers.

Furthermore, DYNAPOL® polyesters are also used as additive in different flexible packaging formulations to improve properties like printability, adhesion (interlayer), flexibility and hardness. DYNAPOL® L 411 is a universal grade special suitable as primer for aluminum foil. DYNAPOL® L 323 offers excellent flexibility and very good adhesion especially to PET-foils.

SCHEMATIC ILLUSTRATION OF THE PEEL STRENGTH AS A FUNCTION OF THE GLASS TRANSITION TEMPERATURE OF THE POLYESTER



The peel strength depends on the surface character and the kind of substrate. Usually polyesters with lower glass transition temperature feature a higher peel strength.

PRINTING INKS FOR FLEXIBLE PACKAGING APPLICATIONS

		Characteristics										
Product	Physical form	Glass transition temeprature (Tg) according to DIN EN ISO 11357-1 [°C]	Molecular Weight (Mw) according to DIN 55672-1 [g/mol]	Viscosity Number according to DIN EN ISO 1628-1 [cm³/g]	Dynamic Viscosity according to DIN EN ISO 3219 [mPa.s]	Solid content in MEK [%]	Acid Value according to DIN EN ISO 2114 [mg KOH/g]	Solubility**	Solid Content [%]	Solvent	Dynamic Viscosity according to DIN EN ISO 3219 [mPa.s]	Dilutability
DEGALAN® 1040 L	Solution Polymer	25	34.000	15			0.6		49	n-Propyl acetate	250	A, Ar, E, G, K
DEGALAN® PQ 611 N	Granulated Bulk Polymer	31	120.000	38	140	40		Ar, E, G, K, Pa				
DEGALAN® P 24	Bead Polymer	43	180.000	55	450	40		Ar, E, G, K				
DEGALAN® P 24 N*	Granulated Bulk Polymer	43	150.000	55	470	40		Ar, E, G, K				
DEGALAN® 4800 L	Solution Polymer	44	100.000	39					44	ethyl acetate	10.000	Ar, E, G, K
DEGALAN® PM 709	Solution Polymer	49	60.000	30					40	xylene	350	A, Ar, E, G, K
DEGALAN® MB 319	Bead Polymer	50	160.000	55	500	40		Ar, E, G, K				
DEGALAN® N 742 N	Granulated Bulk Polymer	57	80.000	39	245	40		A, Ar, P, E, G, K				
DEGALAN® PM 381 N	Granulated Bulk Polymer	57	65.000	29	230	40	7	Ar, E, G, K				
DEGALAN® LP 65/12	Bead Polymer	57	60.000	30	150	40	9	Ar, E, G, K				
DEGALAN® 64/12 N*	Granulated Bulk Polymer	58	68.000	30	180	40	7,5	A, Ar, E, G, K				
DEGALAN® P 28 N	Granulated Bulk Polymer	61	110.000	40	175	40		A, Ar, E, G, K				
DEGALAN® LP 64/12	Bead Polymer	63	60.000	30	180	40	8	A, Ar, E, G, K				
DEGALAN® P 26	Bead Polymer	66	180.000	55	350	40		Ar, P, E, G, K				
DEGALAN® LP 66/02	Bead Polymer	82	60.000	30	470	40		Ar, E, G, K				
DEGALAN® 66/02 N*	Granulated BulkPolymer	75	60.000	31	370	40		Ar, E, G, K				
DEGALAN® VP 1034 F	Bead Polymer	99	110.000	50	2.100	40		Ar, E, G, K				
DEGALAN® M 345	Bead Polymer	104	180.000	55	14.000	40		Ar, E, G, K				
DEGALAN® M 825	Bead Polymer	105	80.000	37	1.500	40		Ar, E, G, K				
DEGALAN® M 748	Bead Polymer	105	73.000	43	4.400	40	2	Ar, E, G, K				
DEGALAN® LP 53/13	Bead Polymer	112	96.000	50	680	30	3,5	Ar, E, K				
DEGALAN® VP 1018 F	Granulated Bulk Polymer	123	165.000	70	925	40	80	Ar, E, G, K				
DEGALAN® M 726	Spray-Dried Emulsion Polymer	not measurable	not measurable	not measurable	not measurable	not measurable	E, G, K					

* These products are only availalbe in Asia Pacific
** A = alcohols, Ar = aromatics, P = petroleum spirit, E = esters, G = glycol ether (ester), K = ketones, PA = pure aliphatics
*** Please be aware that typical properties are approximate reference values

POLYESTERS FOR FLEXIBLE PACKAGING APPLICATIONS

		Characteristics										
Product	Physical form	Glass transition temeprature (Tg) DSC [°C]	Molecular Mass calculated [g/mol]	Viscosity Number according to DIN 53 728 [cm^3/g]	Structure[1)]	OH Value according to DIN EN ISO 4629-2 [mg KOH/g]	Acid Value according to DIN EN ISO 2114 [mg KOH/g]	Melt flow rate [g/10 min @190°C][2)]	Solubility Methylethylketon	Solubility Ethyl acetate	FDA status §175.105	FDA status §175.300
DYNAPOL® L 952	Granules	70	18.000	56	L	6	2	26	+	+	+	+*
DYNAPOL® L 206	Granules	67	20.000	63	L	5	2	17	+	+	+	+*
DYNAPOL® L 208	Granules	67	20.000	70	B	6	6	30	+	+	+	+*
DYNAPOL® L 205	Granules	67	15.000	55	L	6	2	35	+	+	+	+*
DYNAPOL® L 411	Granules	47	16.000	61	L	5	2	66	+	+	+	+*
DYNAPOL® L 651	Granules	40	15.000	64	L	5	2	85	+	+	+	+*
DYNAPOL® L 658	Granules	40	20.000	65	B	8	4	151	+	+	+	+*
DYNAPOL® L 850	Granules	40	15.000	62	L	4	2	100	+	+	+	-
DYNAPOL® L 490	Granules	40	15.000	60	L	9	3	88	+	+	+	+**
DYNAPOL® L 323	Granules	30	15.000	65	L	6	2	84	+	+	+	+*
DYNAPOL® LS 415	Solidified Resin	12	25.000	80	L	5	3	250	+	+	+	+*

1) L=linear, B=branched
2) Measured with a force of 21,6 N.
* in compliance with FDA §175.300 (restriction: only for non alcoholic goods)
** in full compliance with FDA §175.300

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02/2017/HSP

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