

Eudragit®

Setting benchmarks in
oral solid dosage forms since 1954.



Eudragit®

Since 1954, Eudragit® has continually lived up to its status as the gold standard for functional coatings on oral solid dosage forms – an enduring success that comes from earning the pharmaceutical industry's trust through high quality, excellent service and collaborative partnership.



Since 1990:
A talent for versatility.

True to its pioneering spirit, Eudragit® is continually evolving beyond functional coatings to explore new polymer-based delivery systems and broaden application horizons for drug developers and formulators.

Eudragit® polymers – defining targeted drug release

The poly(meth)acrylate chemistry behind Eudragit® polymer systems provides formulators with an exceptionally versatile platform for designing drug delivery to match the specifics of individual pharmaceutical actives and treatments.

Depending on the functional groups used in the polymer, Eudragit® formulations can be precisely tuned to the type of drug release – immediate, delayed or sustained – desired by the formulator. With gastrointestinal targeting or time-controlled release, for instance, one key aspect is defining gradual release profile specifics. Here, the fact that Eudragit® polymers can be used individually as well as in combination – in one coat or by layering several films – broadens the spectrum of options even more. In addition, our polymers offer such a high degree of formulation versatility, i.e. they can be combined with a wide variety of other excipients, that virtually any imaginable release profile can be achieved. The ability to combine Eudragit® polymers also gives formulators more possibilities for ensuring, even within narrow parameters, that APIs ultimately unfold their full potential in the right location at the right time for maximum therapeutic effect.

Eudragit® polymers are available in various forms to facilitate handling and processing as well as maximize application-specific benefits:

- Aqueous dispersions
- Organic solutions
- Granules
- Powders

Eudragit® polymers present a number of formulation advantages that enable maximum design flexibility:

- High pigment binding capacity
- Reliable functionality also at very low coating levels
- Good compressibility
- Smooth coating surface
- Superb logo definition
- High yield
- High thermal stability
- Polymer combinations feasible
- Multiple layer coatings
- Excellent adhesion
- Wide formulation versatility

Our commitment to our customers goes beyond delivering product and process excellence. As the US Food and Drug Administration and the European Medicines Agency increasingly require pharmaceutical manufacturers to provide proof that the excipients used in their products are GMP-compliant, Eudragit® coating systems also come with the EXCiPACT™ certificate. Hence, Eudragit® customers don't need to conduct cost and time-intensive audits at our facilities to verify GMP compliance and can instead use the EXCiPACT™ certification audit report.

High quality, consistently. That is also a key advantage with Eudragit®. Other excipients derived from natural feedstock bear the risk of quality variations due to crop variety, growing conditions, location, etc. Higher natural feedstock variability can mean broader variations in functionalization, e.g. the degree of substitution of natural polymers. Because Eudragit® systems are based on synthetic polymers, they are far less exposed to source material-related variability risks. And that means consistent product functionality and quality – batch after batch.

Amino alkyl methacrylate copolymers

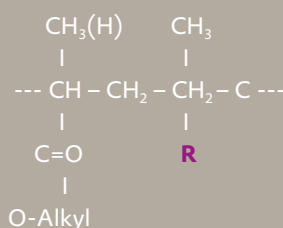
R = $-\text{CO}-\text{O}-\text{CH}_2-\text{CH}_2\text{N}(\text{CH}_3)_2$

Immediate release

Methacrylic acid copolymers

R = COOH

Delayed release



Methacrylic ester copolymers

R = $\text{CO}-\text{OCH}_3$

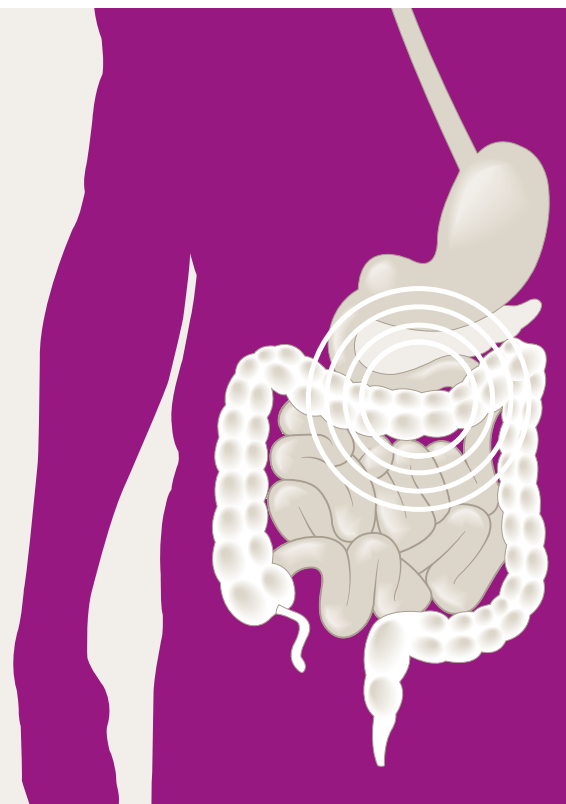
Time-controlled release

Ammonioalkyl methacrylate copolymers

R = $\text{CO}-\text{OCH}_2-\text{CH}_2\text{N}(\text{CH}_3)_3^+ \text{Cl}^-$

Time-controlled release

Delayed release



Eudragit® offers key benefits for your enteric coatings:

- Gastro resistance
- pH-controlled drug release
- Gastrointestinal targeting
- Colon delivery
- Protection of acid-sensitive actives
- Protection of gastric mucosa from aggressive actives
- Increased drug effectiveness
- Excellent storage stability

Gastric resistance and gastrointestinal targeting

When a drug must be protected from the gastric fluids in the stomach's acidic environment until it reaches the intestine for delivering maximum efficacy, Eudragit® L and S polymers are the preferred choice of coating polymers.

Part of a broad family of anionic Eudragit® grades that only dissolve above a specific trigger pH, these polymers enable formulators to target specific areas of the intestine. They can also be combined with each other to dial in a specific dissolution pH for additional precision in gastrointestinal targeting.

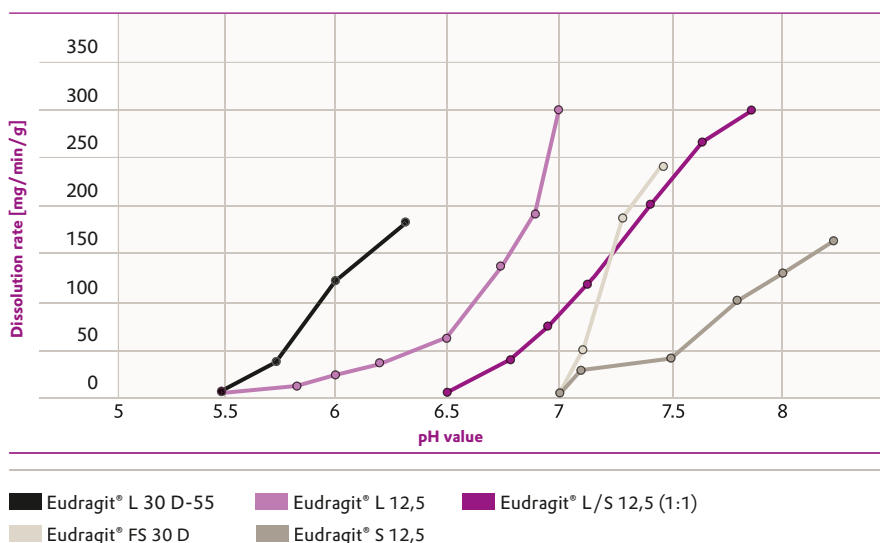
This is especially helpful for therapies that rely on targeted drug release in the high-pH colon area, i. e. for the local treatment of intestinal disorders such as Crohn's disease, ulcerative colitis or intestinal cancer.

Product	Availability	Dissolution property
Eudragit® L 100-55	Powder	Dissolution above pH 5.5
RTU Acryl-EZE® (functional polymer: Eudragit® L 100-55)	Ready-to-use color matched powder mixture	
Eudragit® L 30 D-55	Aqueous dispersion	-
ETU PlasACRYL™ HTP20	Easy-to-use glidant and plasticizer premix, specifically designed for Eudragit® L 30 D-55 formulations	
Eudragit® L 100	Powder	Dissolution above pH 6.0
Eudragit® L 12,5	Organic solution	
Eudragit® S 100	Powder	Dissolution above pH 7.0
Eudragit® S 12,5	Organic solution	
Eudragit® FS 30 D	Aqueous dispersion	-
ETU PlasACRYL™ T20	Easy-to-use glidant and plasticizer premix, specifically designed for Eudragit® FS 30 D formulations	

RTU ready-to-use

ETU easy-to-use

Dissolution rates of anionic Eudragit® polymers and mixtures



Boost efficiency with PlasACRYL™

Designed specifically with Eudragit® polymers in mind, PlasACRYL™ is an easy-to-use additive that improves coating efficiency and reduces processing times. PlasACRYL™ is available in two grades: PlasACRYL™ HTP20 for Eudragit® L 30 D-55 applications, and PlasACRYL™ T20 for use in Eudragit® FS 30 D coatings. Both grades consist of 20% aqueous suspensions with glycerol monostearate as anti-tacking agent, TEC as plasticizer and stabilizer. With PlasACRYL™ lowering production costs has never been easier.

Save development and production time with Acryl-EZE®

Acryl-EZE®, a ready-to-use delayed release coating product from Colorcon powered by Eudragit® L 100-55, combines all the advantages of a fully formulated coating system with the functionalities and performance of a proven enteric polymer. The result: an optimized one-step, pigmented, aqueous acrylic system for applying an enteric film coating. With a dispersion time of just 30 minutes, Acryl-EZE® translates into significant time savings in both drug development and production.

Since 1955:

Targeted pH-controlled release.

Derived from methacrylate chemistry, the first fully synthesized gastro-resistant polymer coating by far surpasses natural materials in terms of quality constancy.





Since 1959:
Keeping what counts dry.

Coatings based on the innovative cationic Eudragit® E polymer offer a significant improvement over hydrocolloid polymers when it comes to protection against ambient moisture.

Reliable moisture protection and taste/odor masking made easy

Does your active need protection from moisture? Is low patient compliance weighing down treatment effectiveness? Eudragit® E polymers encapsulate sensitive actives, masking drug taste and odor, and thus neutralizing the patient's reticence to take the medicine. They further enhance patient compliance by ensuring a smooth and glossy surface that facilitates swallowing. In addition, excellent color coating means the drug is always clearly identifiable. The desired functionality can be delivered with a coating thickness of just 10 to 20 micrometers, and that makes Eudragit® E polymers extremely cost-effective to use.

Proven Eudragit® functionalities, ready-to-use

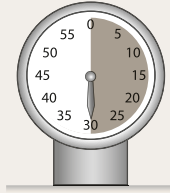
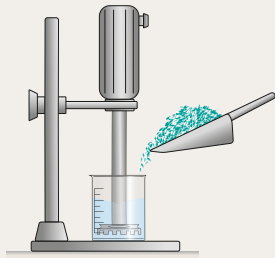
More important, besides saving time and costs, is that with Eudragit® E PO ReadyMix (developed in cooperation with BIOGRUND GmbH), you are in complete control of the process. Customized to your specific product, pigment and process requirements, Eudragit® E PO ReadyMix comes with everything you need for a colored coating that delivers on your promise. Just add water and what you get is consistent batch-to-batch quality and perfect color reproducibility.

Eudragit® E PO is the functional polymer that determines the properties of ReadyMix coatings. In addition to masking taste without delaying drug release, the coating is insoluble in the mouth, but readily soluble in the stomach. Eudragit® E PO also combines smooth texture and appearance with a pleasant mouth feel and improved swallowability. The practical advantages are clear, too: excellent film adhesion on the substrate combined with high pigment load capacity not only ensures color uniformity and superb logo definition, but also easy and economical application. Not to mention the reliable functionality and quality that are designed into Eudragit® products from the start.

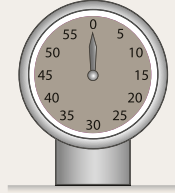
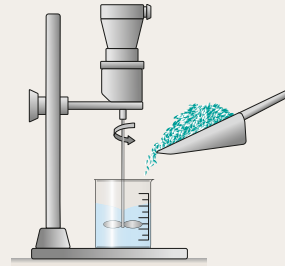
Product	Availability	Dissolution property
Eudragit® E 100	Granules	Soluble in gastric juice up to pH 5.0 Swellable and permeable above pH 5.0
Eudragit® E 12,5	Organic solution	
Eudragit® E PO	Powder	
RTU Eudragit® E PO ReadyMix*	Custom-made powder blend, ready-to-use	

RTU ready-to-use

Eudragit® E PO ReadyMix preparation times:



High-shear mixer: ~30 mins.



Propeller mixer: ~60 mins.

Take advantage of protective Eudragit® coatings:

- Safe taste masking through insolubility in saliva
- Effective taste and odor masking in thin layers
- Moisture protection adjustable to API specifics
- Cost-effective application
- Improved gastrointestinal transit
- Smooth and glossy surfaces excellent coloration
- Available as customized ready-to-use powder blend



Time-controlled release



Since 1968:
Taking controlled release further.

New insoluble coatings only a few microns thick can delay and control drug release over many hours, clearing the path for innovative once-a-day multiple unit dosage forms.

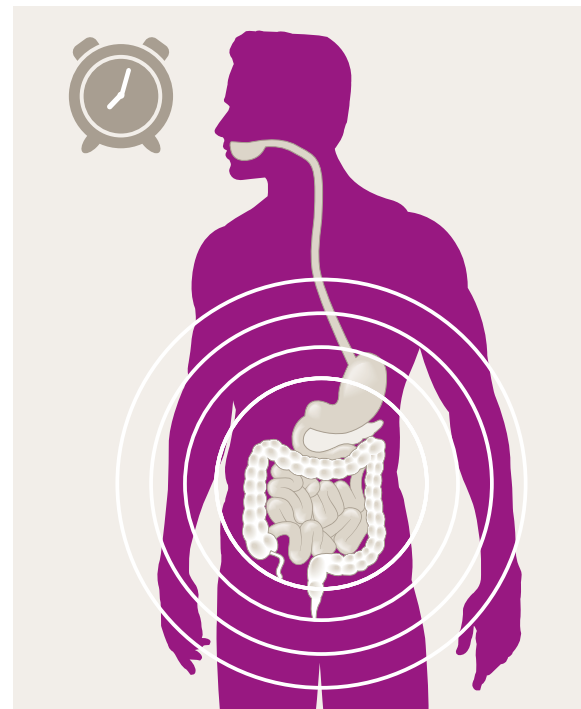
Time-controlled drug release

Whether you require custom timed drug release or the benefits of multiparticulate or matrix formulations, Eudragit® can help you achieve the desired release profile. Drug delivery can be controlled throughout the entire gastrointestinal tract to increase therapeutic effect and improve patient compliance. Various polymer combinations of Eudragit® RL and RS grades with other ingredients variations enable custom-tailored release profiles to obtain the desired drug delivery performance. Eudragit® NE and NM grades are neutral ester dispersions that do not require additional plasticizers.

Product	Availability	Dissolution property
Eudragit® RL 100	Granules	Insoluble High permeability pH-independent swelling
Eudragit® RL PO	Powder	
Eudragit® RL 30 D	Aqueous dispersion	
Eudragit® RL 12,5	Organic solution	
Eudragit® RS 100	Granules	Insoluble Low permeability pH-independent swelling
Eudragit® RS PO	Powder	
Eudragit® RS 30 D	Aqueous dispersion	
Eudragit® RS 12,5	Organic solution	
Eudragit® NE 30 D	Aqueous dispersion	Insoluble, low permeability pH-independent swelling No plasticizer required Highly flexible
Eudragit® NE 40 D	Aqueous dispersion	
Eudragit® NM 30 D	Aqueous dispersion	

Benefit from Eudragit® coatings with sustained release:

- Reliable time-controlled release of active ingredients
- Therapeutically customized release profiles
- Improved patient compliance
- Cost-effective processing
- Safe and highly efficient equipment cleaning through Chematic®



Chematic® RL/RS & Chematic® NE/NM Cleaners

Cleaning your equipment after processing Eudragit® RL/RS and Eudragit® NE/NM formulations can be an efficient and safe process.




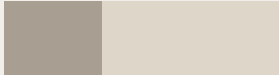
Two detergents developed by Dober, USA, in close cooperation with Evonik provide optimized cleaning results with minimum effort.

Benefits:

- For WIP and CIP processes
- For manual cleaning
- Mild chemistry
- Low processing temperature

Cleaning efficiency

The optimal combination of Time, Action, Chemistry and Temperature in Chematic® RL/RS Cleaner and Chematic® NE/NM Cleaner provides best in class cleaning results.

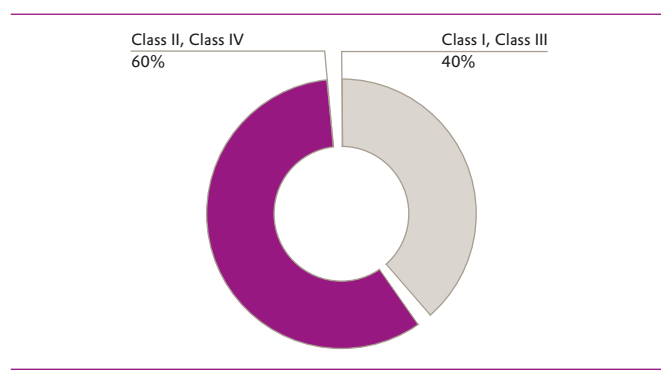
T		Less T ime No scrubbing, less cleaning cycles
A		Less A ction Applicable for automated WIP / CIP processes
C		Mild C hemistry Optimized for EUDRAGIT® polymers
T		Low T emperature Cleaning at temperatures below 60 °C. Applicable for manual processes

Solubility enhancement

Eudragit® – a versatile and robust platform

A clever solution to bioavailability issues comprises the right combination of functional excipients, process technology and formulation know-how. Evonik brings these assets together and focuses them on optimizing your formulation.

60% of all new chemical entities show poor solubility



American Pharmaceutical Review, December 2012

The unique properties of Eudragit® polymers predestine them for solubility enhancement applications:

- Amorphous carrier with good thermoplastic properties and high thermostability
- Optimal glass transition temperature (T_g) of the formulated system
- Soluble in common solvents
- High miscibility with APIs and excipients
- Soluble at gastric or intestinal conditions
- Ability to form hydrogen bonds and/or ionic interactions
- Optimal molecular weight (M_w), melt and solution/gel viscosity
- Excellent powder flow and mechanical properties
- Excellent moisture protection
- Synthetic polymers with excellent batch-to-batch consistency
- Low toxicity (comprehensive toxicology packages available)

Solid solutions with Eudragit® polymers

Used as amorphous carriers, Eudragit® polymers effectively address the challenges of poorly soluble APIs.

Eudragit® polymers can dissolve APIs at the molecular level and form physically stable, solid solutions to enhance drug bioavailability. The drug is stabilized via hydrogen bondings or ionic interactions, which in turn precludes recrystallization. This also translates into superior storage stability.

Working with Eudragit® not only means having a broad range of polymers for solid dispersions to choose from. MemFis™*, a tool developed specifically for Evonik customers, enables formulators to identify and validate individual polymers and polymer combinations as well as set drug loads and processing parameters – in advance and without the need for costly trials. The added benefit: MemFis™* can be applied to any polymers, not just the Eudragit® family.

Solid dispersions based on Eudragit® consistently show a significant improvement in solubility.

Hot-melt extrusion and spray drying are proven technologies for preparing solid solutions. Combining different Eudragit® polymers in one formulation allows both specific functional effects and improved storage stability. Eudragit® E PO for immediate release or taste-masking formulations with enhanced bioavailability, for instance, works well with Eudragit® NE 30 D in preventing both drug precipitation (from over-saturation) and recrystallization.

* MemFis™ (Melt extrusion modeling and Formulation information system): a proprietary application for in-silico formulation modeling and process optimization that includes screening for excipients, drug loading and processing parameters.

Hot-melt extrusion & spray drying

The same reliability and cost-effectiveness that hot-melt extrusion and spray drying have consistently proved in other manufacturing industries, Evonik systematically achieves for pharmaceutical applications. The choice of process depends on the properties of the formulated active.

The entire range of Eudragit® grades is suitable for hot-melt extrusion and spray drying.

Hot-melt extrusion with Eudragit® polymers delivers both bioavailability enhancement and process efficiency gains as a result of:

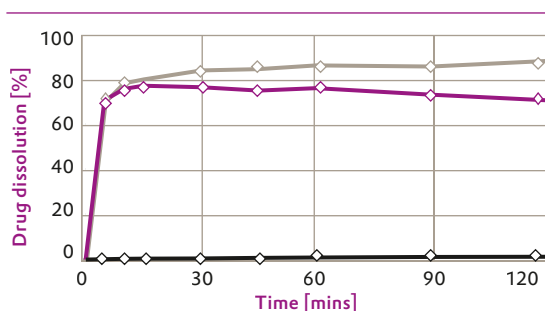
- Excellent thermoplastic properties
- Low glass transition temperatures
- High thermostability
- High miscibility with APIs and other excipients.

Where APIs with thermo-sensitivity or with a high melting point are concerned, spray drying with Eudragit® reveals itself as the method of choice for a number of key reasons:

- Good spray-dried powder compressibility
- Easy dissolution in common solvents
- Easy dissolution in gastric or intestinal environment.

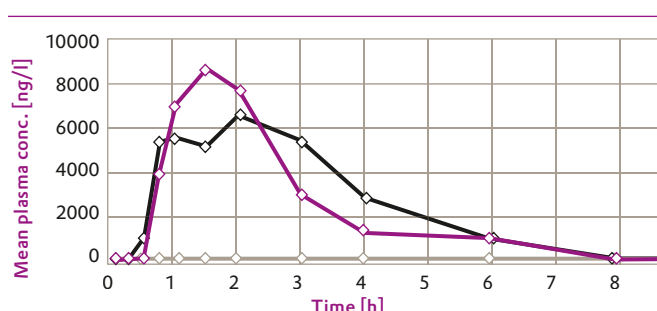
Felodipine case study

In-vitro dissolution test



- Crystalline felodipine
- ◆— Extrudate with Eudragit® E PO and 5% Eudragit® NE 30 D
- ◇— Spray-dried powder with Eudragit® E PO

In-vivo bioavailability study in dogs



- Extrudate with Eudragit® E PO
- ◆— Extrudate with Eudragit® E PO and 5% Eudragit® NE 30 D
- ◇— Physical mixture with Eudragit® E PO

Since 1999:
Meeting new solubility challenges.

Eudragit® spearheads pharmaceutical hot-melt extrusion and spray drying to enhance the bioavailability of next-generation – poorly soluble APIs.



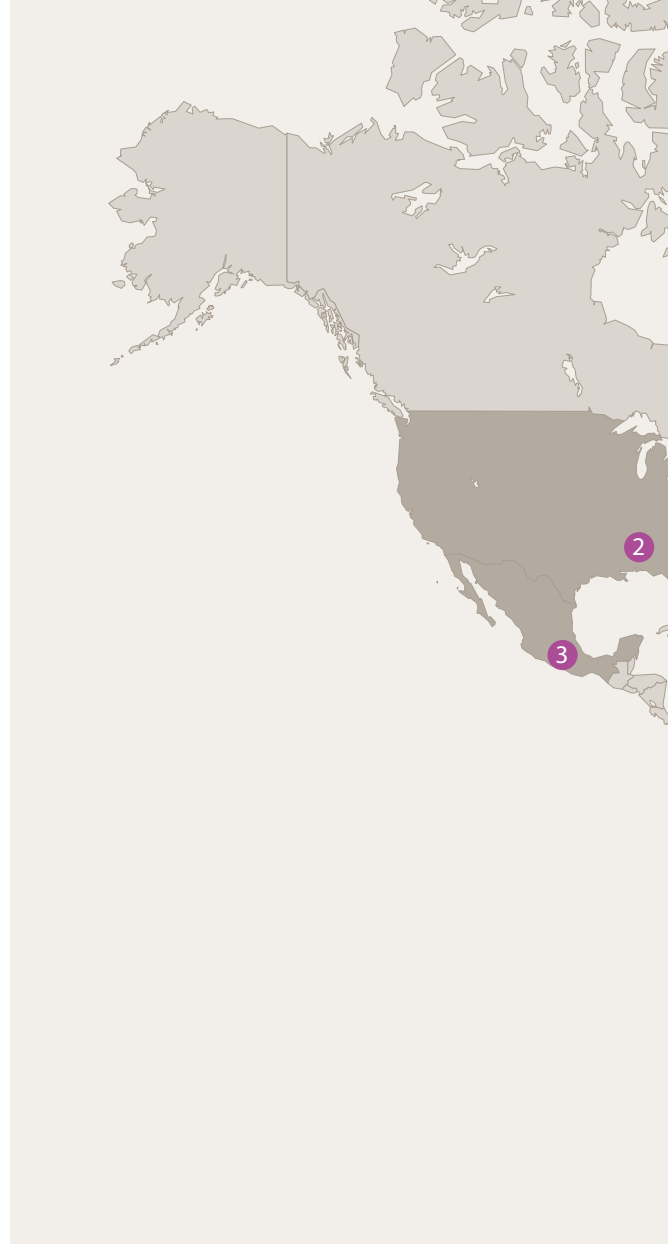
Value-adding services

When partnership boosts speed to market

Over the past six decades, Eudragit® has grown from a polymer coating solution to a family of products and services that continually evolves to set benchmarks for oral drug delivery systems. State-of-the-art technical capabilities and highly qualified teams, coupled with deep polymer know-how and broad expertise in all drug development stages – including formulation development, process optimization and clinical trial supply – have earned us a sterling reputation and lasting partnerships around the world. Beyond off-the-shelf and customized solid oral dosage forms for matching specific targeted drug release profiles, our aim is to further add value as a strategic resource to speed up drug development and ensure sustainable market success.

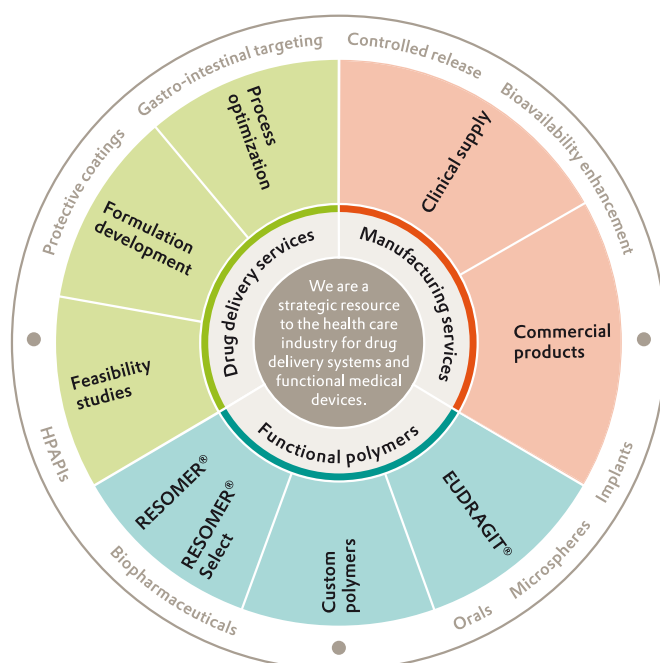
Our customers can count on:

- Efficiency gains in R&D processes
- Access to innovative and powerful drug delivery technologies
- Shorter time-to-market
- Professional product lifecycle management
- Reliable large scale manufacturing processes
- Collaborative development of enabling technologies and proprietary solutions

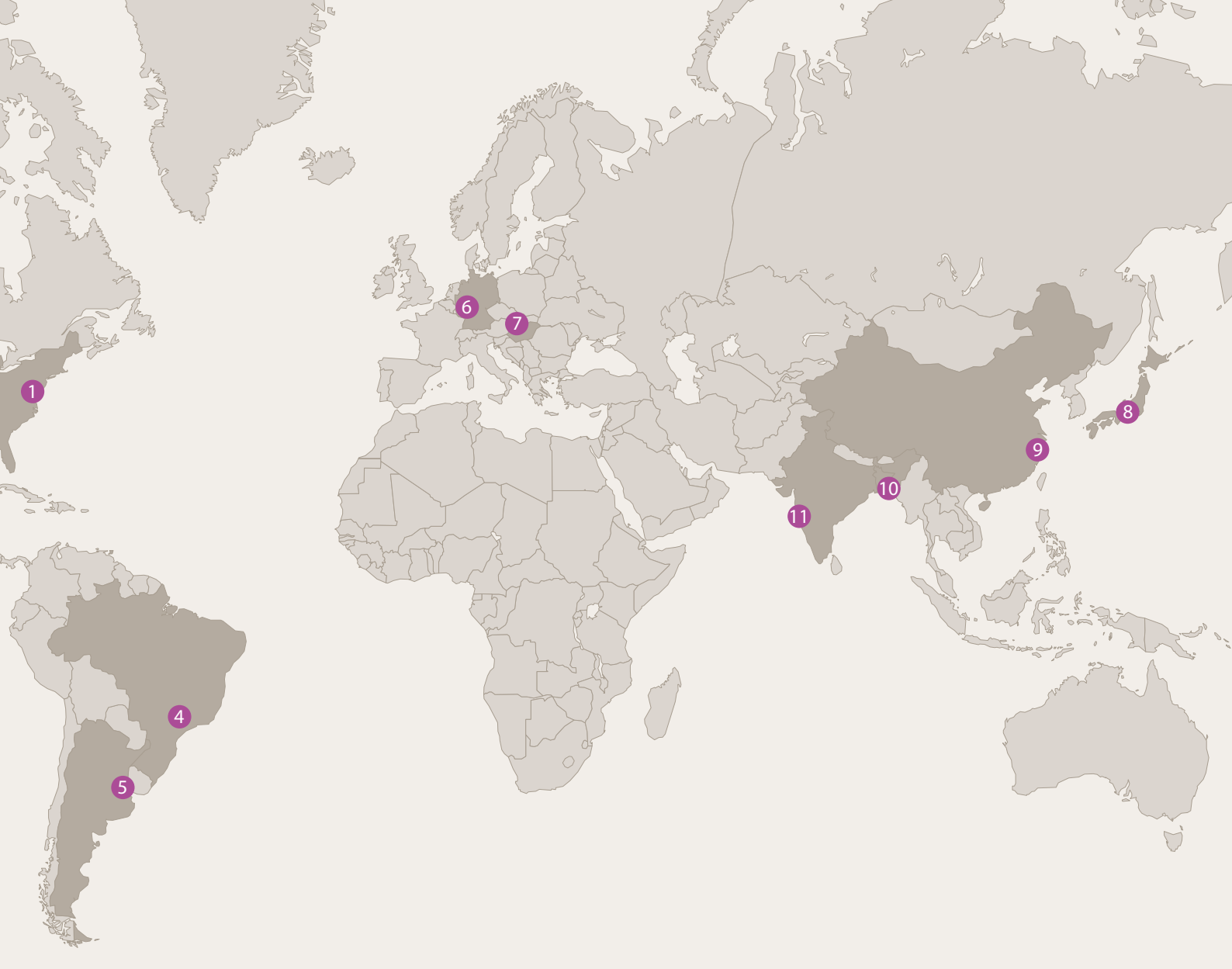


The bigger picture

The Eudragit® range of coating polymers for oral solid dosage forms is one spoke of Evonik's Pharma Polymers & Services hub. It is part of a comprehensive portfolio dedicated to meeting the product or process challenges you face with a pragmatic, collaborative approach. Take advantage of our experience and expertise and apply it to just one specific aspect or work with us from drug concept to manufacturing scale-up. Regardless of the scope of your project, our contribution will always be straightforward, cost-effective and in sync with your value chain.



Evonik – a unique platform of enabling products and services as a strategic resource to the pharma industry.



At the doorstep of our customers

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Evonik's expertise for more than 60 years

Immediate release:

Eudragit® E 100	(Granules)
Eudragit® E 12,5	(Organic solution)
Eudragit® E PO	(Powder)
Eudragit® E PO	(Powder)
ReadyMix RTU	

- Taste and odor masking, light and moisture protection
- Soluble in gastric fluid up to pH 5.0
- Swellable and permeable above pH 5.0
- Low viscosity
- High pigment binding capacity
- Excellent adhesion
- High effectiveness in thin coatings

Delayed release:

Duodenum pH above 5.5:

Eudragit® L 100-55	(Powder)
Eudragit® L 30 D-55	(Aqueous dispersion)
Acryl-EZE® RTU	(Powder)
• Ready-to-use enteric coating based on Eudragit® L 100-55	

Value-adding products:

PlasACRYL™ HTP20 **ETU**

- Easy-to-use glidant and plasticizer premix, specifically designed for Eudragit® L 30 D-55 formulations

Jejunum pH 6-7:

Eudragit® L 100	(Powder)
Eudragit® L 12,5	(Organic solution)

Ileum, colon delivery pH above 7.0:

Eudragit® S 100	(Powder)
Eudragit® S 12,5	(Organic solution)
Eudragit® FS 30 D	(Aqueous dispersion)

Value-adding product:

PlasACRYL™ T20 **ETU**

- Easy-to-use glidant and plasticizer premix, specifically designed for Eudragit® FS 30 D formulations

Time-controlled release

Eudragit® RL PO	(Powder)
Eudragit® RL 100	(Granules)
Eudragit® RL 30 D	(Aqueous dispersion)
Eudragit® RL 12,5	(Organic solution)

- Insoluble, high permeability, pH-independent swelling
- Customized release profiles by combining with Eudragit® RS at different ratios

Eudragit® RS PO	(Powder)
Eudragit® RS 100	(Granules)
Eudragit® RS 30 D	(Aqueous dispersion)
Eudragit® RS 12,5	(Organic solution)

- Insoluble, low permeability, pH-independent swelling
- Customized release profiles by combining with Eudragit® RL at different ratios

Eudragit® NE 30 D	(Aqueous dispersion)
Eudragit® NE 40 D	(Aqueous dispersion)
Eudragit® NM 30 D	(Aqueous dispersion)

- Insoluble, low permeability, pH-independent swelling
- Highly flexible, suitable as matrix formers

Value-adding products:

Chematic® RL/RS Cleaner & Chematic® NE/NM Cleaner

- Especially developed for cleaning equipment after processing insoluble Eudragit® formulations, suitable for WIP, CIP and manual cleaning procedures.

Monographs and DMFs are available
for all polymers upon request.

RTU ready-to-use

ETU easy-to-use

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* = registered trademark

Eudragit = reg. trademark of Evonik Industries AG and its subsidiaries

Acryl-EZE = reg. trademark of BPSI Holdings LLC.

PlasACRYL = Trademark of Emerson Resources, Inc., Norristown, PA, USA

CHEMATIC = reg. trademark of Dober Group, Woodridge, IL, USA



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