Your biomaterial solutions partner

Advanced biomaterials and application technology services
for bioresorbable implant devices

EVONIK
POWER TO CREATE

RESOMER® product range of bioresorbable polymers

	KEY PROPERTIES
POLY(L-LACTIDE)	• Semi-crystalline polymer • Good mechanical properties • Easy to process • Long degradation time (> 4 years)
POLY(L-LACTIDE-CO-D,L-LACTIDE) 70:30	• Amorphous polymer • Good mechanical properties • Easy to process • Intermediate degradation time (2–3 years)
POLY(L-LACTIDE-CO-GLYCOLIDE) 82:18	• Amorphous polymer • High initial strength • Fast degradation (~ 1.5 years)
POLY(L-LACTIDE-CO-GLYCOLIDE) 85:15	• Amorphous polymer • High initial strength • Fast degradation (~ 1.5 years)
POLY(L-LACTIDE-CO-ε-CAPROLCATONE) 70:30	• Semi-crystalline polymer with very low crystallinity • Medium strength • Intermediate degradation time • At body temperature in the rubbery state
POLY(DIOXANONE)	• Semi-crystalline polymer with low crystallinity • Low strength, is not sufficient for load bearing implants • Short degradation time (6 months) • At body temperature in the rubbery state
POLY(CAPROLACTONE)	• Semi-crystalline polymer • High elongation • Long degradation time (3–4 years)
POLY (L-LACTIDE-CO-TRIMETHYLENE CARBONATE)	• Soft and flexible polymer • At body temperature in the rubbery state • Can be used in blends to modify the properties of other polymers
POLY(L-LACTIDE) WITH CALCIUM PHOSPHATES ADDITIVES	• Good mechanical properties • RESOMER® bioresorbable polymers with osteoconductive additives • Supports bone formation

* Inherent viscosity is measured at 0.1 % w/v in $CHCl_3$ at 25 °C with an Ubbelhode size 0c glass capillary viscometer
** Inherent viscosity is measured at 0.1 % w/v in HFIP at 30 °C with an Ubbelhode size 0b glass capillary viscometer

AVAILABLE GRADES	TG [°C]	IV RANGE [DL/g]*
L 206 S L 207 S L 209 S L 210 S	60–65 60–65 60–65 60–65	0.8–1.2 1.5–2.0 2.6–3.2 3.3–4.3
LR 704 S LR 706 S LR 708	56 – 62 56 – 62 56 – 62	2.0–2.8 3.3–4.2 5.7–6.5
LG 824 S	54–60	1.7–2.6
LG 855 S LG 857 S	54–60 54–60	2.5–3.5 5.0–7.0
LC 703 S	32–42	1.3–1.8
X 206 S	–14 – –9	1.5–2.2**
C 209 C 212	–66 – –60 –66 – –60	0.8–1.2 1.13–1.38
LT 706 S	28 – 38	1.2–1.6
L 210 S + 25 % HA	60 – 65	3.0–4.0

30 YEARS

A 30 year record for efficacy, safety, biocompatibility and supply security

APPLICATIONS: orthopedic | cardiovascular | wound healing
STERILIZATION: γ-irradiation | e-beam | gas sterilization (EO)

RESOMER® Select

MONOMER RATIO

EXAMPLE
85 mole % L-lactide
15 mole % glycolide
Monomer ratios vary between 0:100 and 100:0 allowing for a broad range of polymer properties

TARGET IV DESIGNATOR

EXAMPLE
IV Spec 3.7 – 4.3 dL/g
Target IV: 4.0 dL/g

IV designator	IV Range*
15	1.2 – 1.8
20	1.7 – 2.3
25	2.2 – 2.8
30	2.7 – 3.3
35	3.2 – 3.8
40	3.7 – 4.3
45	4.2 – 4.8
50	4.7 – 5.3
60	5.7 – 6.3
70	6.7 – 7.4
80	7.0 – 8.3

* 0.1 % w/v in $CHCl_3$ at 25 °C
Custom polymers available up to 8 dL/g

POLYMER IDENTIFIER

EXAMPLE
L-lactide-co-glycolide

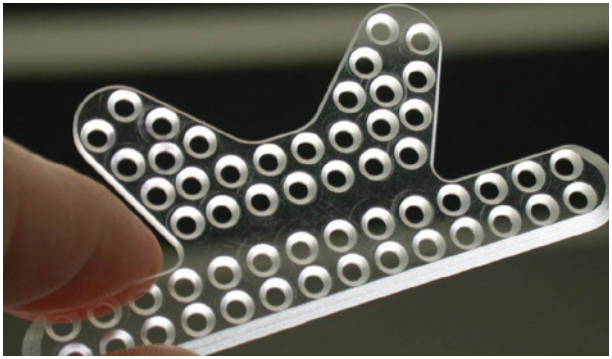
DLG	Poly(DL-lactide-co-glycolide)
DL	Poly D,L-lactide)
LD	Poly(L-lactice-co-D-Lactide)
LG	Poly(L-lacctide-co-glycolide)
Cl	Polycaprolactone
DLCl	Poly(D,L-lactide-co-caprolactone)
LCl	Poly(L-lactide-co-caprolactone)
G	Polyglycolide
L	Polylactide
X	Polydioxanone
PEG	Poly(ethylene glycol)
mPEG	Methoxy-poly(ethylene glycol)

Designed to meet your exact customization needs by making the impossible possible:

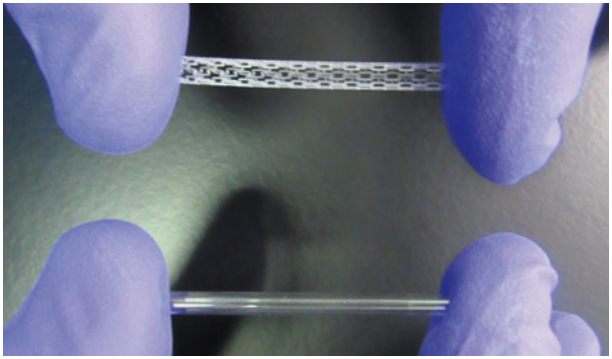
- Any polymer outside our standard range
- Customization – all products made to order:
  - Monomers, monomer ratios, end groups, inherent viscosities, etc.
  - Whatever you require, whatever you imagine
  - Batch sizes to reflect your needs

Application Technology Expertise

PRODUCT APPLICATION EXAMPLES:

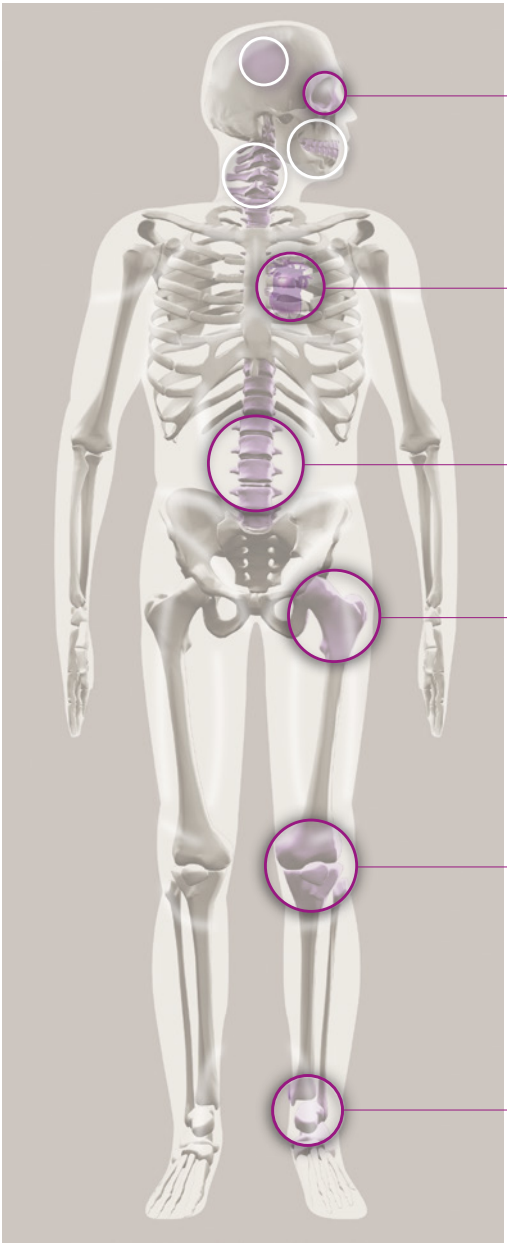


Cranio-Maxillofacial:
Screws or plates



Cardiovascular:
Stents or vascular grafts

Knee:
Interference screws, tacks, or sutures


Cranio-Maxillofacial
Cardiovascular
Spine
Orthopaedics
Knee
Extremities

Application Technology Services

Our Medical Device Competence Center in the U.S. and Application Laboratories in Germany and China specialize in reducing project risk and complexity during the design, development, scale-up and approval of your bioresorbable implant devices. Areas of customer support include:

POLYMER SYNTHESIS AND DESIGN

- Polymer selection to match physical and mechanical properties with target application
- Polymer synthesis design, development and customization for customer specific applications

POLYMER PROCESSING

- R&D labs and engineering expertise to develop materials, optimize techniques and fabricate specimens
- Injection molding, single and twin-screw extrusion (e.g., compounding, blending, co-extrusion)
- Electrospinning (micro and nano-scale fibers)
- Compression molding (film and plate preparation)
- CNC machining (sample and prototype preparation)
- Low temperature oven (drying and annealing)

FEASIBILITY SAMPLES

- A selection of advanced and conventional technologies for rapid testing and evaluation
- 3D printing systems include selective laser sintering, fused deposition modeling and bioplotters

ANALYSIS AND CHARACTERIZATION

- Additive distribution, inherent viscosity and degradation studies (IV, GPC)
- Analysis of thermal stability and transitions (DSC, TGA, DMA),
- Analysis of surface features (e. g. wettability, roughness) and morphology (e.g SEM, EDAX),
- Characterization, functionality testing and computational modeling of mechanical properties (tensile, impact, torsional, fatigue, flexural, DMA)

REGULATORY DATA AND SUPPORT

- Documentation and data generation support for product registrations (e. g master device file maintenance, technical dossiers)
- In vitro data support (e. g cytotoxicity, leachability, osteoconductivity, animal study guidance)

YOUR PREFERRED PARTNER FOR BIOMATERIAL AND APPLICATION TECHNOLOGY SOLUTIONS

HIGHLY SPECIALIZED

- A global market leader with a diversified customer base
- Breadth of technical knowledge and industry expertise
- Support from initial feasibility through to commercial scale-up
- Customer proximity of our technical and analytical services

QUALITY & REGULATORY

- ISO 9001 & 13485 Certification
- IPEC-GMP Good Manufacturing Practices Guide for Pharmaceutical Excipients, 2006
- Master Files & Technical Dossiers maintained
- Broad in house analytical capabilities

ADVANCED BIOMATERIALS

- A wide range of physical properties
- Highly customizable
- 30-year history of safety and efficacy
- Easy to process with standard manufacturing methods
- 5-year shelf life

SECURITY OF SUPPLY

- Full range of inventory maintained
- Safety stocks
- Dual sourcing capability

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EVONIK
POWER TO CREATE

EVONIK NUTRITION & CARE GmbH
Health Care Business Line
Pharma Polymers & Services

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