Polysciences
Chemistry beyond the ordinary

BIODEGRADABLE POLYMERS

A Sustainable Future for Research Applications

INFO@POLYSCIENCES.COM

Embark upon a realm of innovation and sustainability with biodegradable polymers, a groundbreaking class of materials designed to revolutionize industries while minimizing environmental impact. These biodegradable polymers, derived from renewable sources such as plant starches or synthesized to be eco-sensitive, exhibit the remarkable ability to naturally degrade over time. Beyond their ecological benefits, biodegradable polymers find application in diverse fields, ranging from packaging solutions that reduce single-use plastic waste to biomedical materials that facilitate controlled drug release.

Our goal is to unlock the potential for a more sustainable future, where cutting-edge technology harmonizes with environmental responsibility. We invite you to join this journey into a world where innovation meets eco-consciousness, and the applications of biodegradable polymers pave the way for a greener and more sustainable tomorrow. We offer a comprehensive catalog of high-quality biodegradable polymers for research applications:

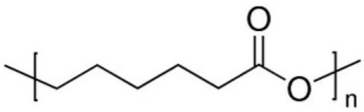
- **Medical Implants & Devices**
- **Dental Materials**
- **Drug Encapsulation and Delivery**
- **Tissue Engineering**
- **Biodegradable Sutures**
- **Hydrogel Engineering**
- **Orthopedic Devices**
- **Prosthetics**
- **Cosmetics**
- **Sanitation Products**
- **Specialty Coatings**
- **Nanosystems**

BIODEGRADABLE POLYMERS

Where Innovation Meets Environmental Sustainability

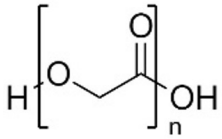
Biodegradable polymers or bioplastics are a revolutionary class of materials designed to address the growing concerns of traditional polymers' impact on our planet. Unlike conventional plastics that persist for centuries, biodegradable polymers are engineered to break down naturally, reducing their environmental footprint.

As we seek more socially responsible and environmentally conscious solutions, biodegradable polymers stand at the forefront of a green revolution in materials science. Below showcases our biodegradable polymer portfolio and its common application.



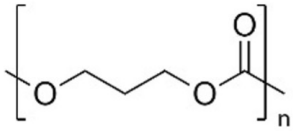
Polycaprolactone (PCL)

Polycaprolactone is a semi-crystalline, hydrophobic, biodegradable polyester noted for its ease of processing with melting point and glass transition temperature at~60°C. We offer various grades of PLC, as well as powder form.



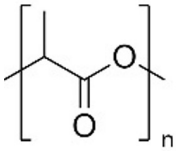
Polyglycolide (PGA)

Polyglycolide is an aliphatic polyester with moderate to high crystallinity and frequently used for its mechanical strength properties. The degradation rate of PGA is higher than most other biodegradable polymers.



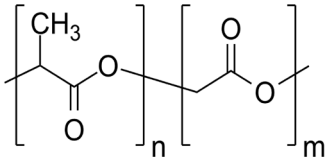
Poly(trimethylene carbonate) (PTMC)

Poly (trimethylene carbonate) is a highly amorphous, aliphatic polycarbonate with a higher degree of flexibility and greater resistance to hydrolytic degradation.



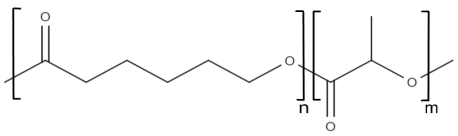
Poly(L-lactide) and Poly(DL-lactide) (PLA, PLLA, PDLLA)

Poly (Lactic acid) and its stereoisomers are well-researched and utilized polymers known for their strong mechanical properties such as tensile strength, stiffness, and impact resistance. PLA are known for slower degradation rates often on the order of several years which makes them useful for longer term applications.



Poly(lactide-co-glycolide) (PLGA)

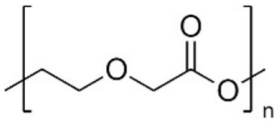
Poly (lactide-co-glycolide) combines the favorable mechanical properties of PGA and PLA with the longer degradation time of PLA. Increasing the ratio of PGA to PLA will increase the rate of biodegradation.



Poly(Caprolactone-co-L-lactide)

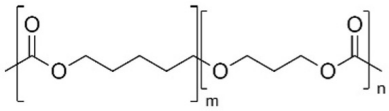
Poly (Caprolactone-co-L-lactide) offers greater mechanical strength properties compared to PCL homopolymer alone. Additionally, the biodegradation rate will increase with an increasing ratio of PLA.

Biodegradable Polymers



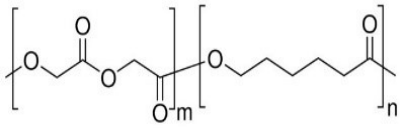
Polydioxanone (PDO)

Polydioxanone is a polylactone ester with high degrees of crystallinity known for its strong safety profile and high elongation at break and flexural strength properties.



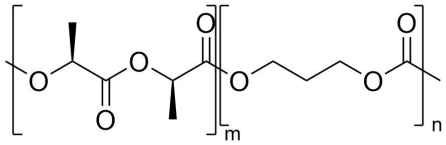
Poly(trimethylene carbonate-co-caprolactone)

Poly (trimethylene carbonate-co-caprolactone) is a copolymer that blends the elasticity of PTMC with the ease of processing of PCL, offering versatile mechanical properties.



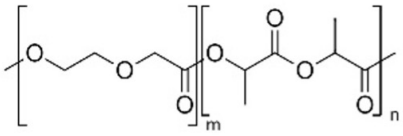
Poly(Caprolactone-co-glycolide)

Poly (Caprolactone-co-glycolide) combines the flexibility of PCL with the mechanical strength of PGA. Increasing the ratio of PGA will increase the structural stiffness and rate of biodegradation.



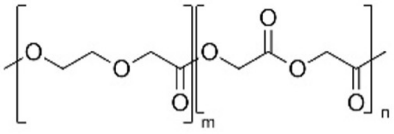
Poly(trimethylene carbonate-co-L-lactide)

Poly (trimethylene carbonate-co-L-lactide) combines the elasticity of PTMC with the tensile strength and stiffness of PLA, yielding a strong yet flexible polymer with a longer degradation time than PTMC alone.



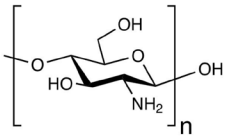
Poly(Dioxanone-co-lactide)

Poly(Dioxanone-co-lactide) combines the flexural strength and high elongation at break of PDO with the tensile strength, impact resistance, and stiffness of PLA. The addition of PLA also imparts a longer degradation profile than PDO alone.



Poly(Dioxanone-co-glycolide)

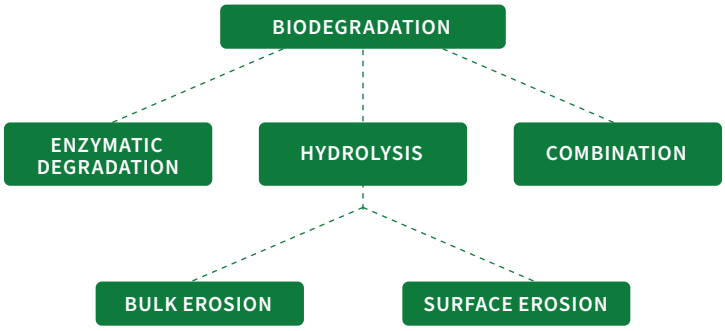
Poly(Dioxanone-co-glycolide) blends the flexibility of PDO with the mechanical strength and faster degradation of PGA. A higher ratio of PGA will enable greater stiffness and load bearing ability.



Chitosan

Chitosan, poly(D-glucosamine), is a highly pure multifunctional cationic polymer prepared by deacetylation of chitin. It has an excellent non-cytotoxicity profile, biocompatibility, non-allergenicity, mucoadhesive property and ease of modification. It is soluble in acid. # 21161

BIODEGRADATION OVERVIEW



Enzymatic Degradation

Enzymatic degradation stands as another common mechanism in the lifecycle of biodegradable polymers, contributing to their eco-friendly nature. In this process, specialized enzymes catalyze the breakdown of polymer chains into smaller and digestible fragments. Microorganisms produce enzymes tailored to break down specific types of polymers, allowing for the efficient assimilation of the degraded material into the surrounding ecosystem. This mechanism ensures that biodegradable polymers can be metabolized by nature.

Hydrolysis

Hydrolysis is a fundamental degradation mechanism for biodegradable polymers, involving the chemical breakdown of polymer chains through water-induced reactions. In this process, water infiltrates the polymer matrix, catalyzing the cleavage of polymer chains and leading to the formation of smaller fragments. Particularly crucial for polymers derived from natural sources or engineered to be water-sensitive, hydrolysis renders these materials more susceptible to microbial digestion and eventual assimilation into the environment. This environmentally friendly degradation pathway underscores the significance of hydrolysis in enhancing the sustainability of biodegradable polymers as eco-conscious alternatives to traditional plastics, aligning with the global push for greener materials.

Bulk Erosion

This typically occurs when water penetrates the polymer structure, enabling hydrolysis and therefore reduction of molecular weight and mechanical properties. Autocatalysis may happen if the degradation products don't diffuse out of the interior structure, further weakening the overall structure.

Surface Erosion

It primarily occurs at the outer surface of the polymer structure, leading to a gradual reduction in material thickness over time. Since the breakdown occurs on surface layers, the resulting degradation products disperse away from the structure, which prevents autocatalytic degradation. The rate of surface erosion is typically proportion to the surface area of the polymer structure.

PRODUCT OFFERINGS

ITEM CODE	ITEM DESCRIPTION	INHERENT VISCOSITY (dL/g)	APPROX. MOLECULAR WEIGHT (Da)	APPROX. DEGRADATION TIMEFRAME [1-3]	DEGRADATION MECHANISM	Tm (°C)	Tg (°C)
50001	Polycaprolactone, IV 0.2 dL/g	0.10 - 0.30	10,000	6 - 12 months	Enzymatic, Hydrolysis	56 - 72	-65 – -30
50002	Polycaprolactone, IV 0.4 dL/g	0.30 - 0.60	25,000	1 - 2 years	Enzymatic, Hydrolysis	56 - 72	-65 – -30
50003	Polycaprolactone, IV 0.8 dL/g	0.5 - 1.0	75,000	> 2 years	Enzymatic, Hydrolysis	56 - 72	-65 – -30
50004	Polycaprolactone, IV 1.2 dL/g	1.00 - 1.40	150,000	> 2 years	Enzymatic, Hydrolysis	56 - 72	-65 – -30
50005	Polycaprolactone, IV 1.7 dL/g	1.3 - 1.7	250,000	> 2 years	Enzymatic, Hydrolysis	56 - 72	-65 – -30
50006	Polycaprolactone, IV 2.0 dL/g	1.9 - 2.2	300,000	> 2 years	Enzymatic, Hydrolysis	56 - 72	-65 – -30
50007	Polycaprolactone, IV 2.2 dL/g	2.1 - 2.3	325,000	> 2 years	Enzymatic, Hydrolysis	56 - 72	-65 – -30
50008	Polycaprolactone, IV 2.6 dL/g	2.4 - 3.0	350,000	> 2 years	Enzymatic, Hydrolysis	56 - 72	-65 – -30
50310	Polycaprolactone, IV 0.2 dL/g, Powder	0.16 - 0.24	15,000	6 - 12 months	Enzymatic, Hydrolysis	56 - 72	-65 – -30
50311	Polycaprolactone, IV 0.6 dL/g, Powder	0.50 - 0.70	50,000	1 - 2 years	Enzymatic, Hydrolysis	56 - 72	-65 – -30
50312	Polycaprolactone, IV 1.0 dL/g, Powder	0.90 - 1.20	120,000	> 2 years	Enzymatic, Hydrolysis	56 - 72	-65 – -30
50313	Polycaprolactone, IV 1.5 dL/g, Powder	1.30 - 1.70	220,000	> 2 years	Enzymatic, Hydrolysis	56 - 72	-65 – -30
50009	Poly(Caprolactone-co-glycolide), 95:5, IV 1.4 dL/g	1.0 - 2.0	-	Months to years	Enzymatic, Hydrolysis	50 - 58	-60 – -50
50010	Poly(Caprolactone-co-glycolide), 90:10, IV 0.8 dL/g	0.5 - 1.0	-	Months to years	Enzymatic, Hydrolysis	50 - 58	-60 – -50
50011	Poly(Caprolactone-co-glycolide), 90:10, IV 1.6 dL/g	1.2 - 2.0	-	Months to years	Enzymatic, Hydrolysis	50 - 58	-60 – -50
50012	Poly(Caprolactone-co-glycolide), 85:15, IV 1.7 dL/g	1.0 - 1.8	-	Months to years	Enzymatic, Hydrolysis	50 - 58	-60 – -50
50013	Poly(Caprolactone-co-glycolide), 85:15, IV 1.8 dL/g	1.5 - 2.0	-	Months to years	Enzymatic, Hydrolysis	50 - 58	-60 – -50
50014	Poly(Caprolactone-co-L-lactide), 95:5, IV 2.1 dL/g	1.6 - 2.4	-	Months to years	Enzymatic, Hydrolysis	35 - 55	-60 – -50
50015	Poly(Caprolactone-co-L-lactide), 90:10, IV 2.0 dL/g	1.0 - 2.0	-	Months to years	Enzymatic, Hydrolysis	35 - 55	-60 – -50
50016	Poly(Caprolactone-co-L-lactide), 85:15, IV 1.8 dL/g	1.5 - 2.5	-	Months to years	Enzymatic, Hydrolysis	35 - 55	-60 – -50
50017	Poly(Caprolactone-co-L-lactide), 85:15, IV 1.6 dL/g	1.0 - 2.0	-	Months to years	Enzymatic, Hydrolysis	35 - 55	-60 – -50
50018	Poly(trimethylene carbonate), IV 0.5 dL/g	0.3 - 0.8	-	Weeks to months	Enzymatic, Hydrolysis	38 - 50	-30 – -15
50019	Poly(trimethylene carbonate), IV 1.0 dL/g	0.8 - 1.2	-	Weeks to months	Enzymatic, Hydrolysis	38 - 50	-30 – -15
50020	Poly(trimethylene carbonate), IV 1.3 dL/g	1.2 - 1.4	-	Weeks to months	Enzymatic, Hydrolysis	38 - 50	-30 – -15
50021	Poly(trimethylene carbonate), IV 1.5 dL/g	1.5 - 2.0	-	Weeks to months	Enzymatic, Hydrolysis	38 - 50	-30 – -15
50022	Poly(trimethylene carbonate-co-caprolactone), 90:10, IV 1.1 dL/g	1.0 - 2.0	-	Weeks to months	Enzymatic, Hydrolysis	Amorphous	-30 – -20
50023	Poly(trimethylene carbonate-co-caprolactone), 80:20, IV 1.5 dL/g	1.0 - 2.0	-	Weeks to months	Enzymatic, Hydrolysis	Amorphous	-30 – -20
50024	Poly(trimethylene carbonate-co-L-lactide), 90:10, IV 0.7 dL/g	0.5 - 1.0	-	Weeks to months	Enzymatic, Hydrolysis	Amorphous	-30 - 5
50025	Poly(trimethylene carbonate-co-L-lactide), 80:20, IV 0.9 dL/g	0.7 - 1.2	-	Weeks to months	Enzymatic, Hydrolysis	Amorphous	-30 - 5
50026	Poly(trimethylene carbonate-co-L-lactide), 80:20, IV 1.1 dL/g	1.0 - 2.0	-	Weeks to months	Enzymatic, Hydrolysis	Amorphous	-30 - 5
50027	Poly(trimethylene carbonate-co-L-lactide), 60:40, IV 1.0 dL/g	0.8 - 1.2	-	Weeks to months	Enzymatic, Hydrolysis	Amorphous	-30 - 5
50028	Poly(trimethylene carbonate-co-L-lactide), 60:40, IV 1.2 dL/g	1.0 - 2.0	-	Weeks to months	Enzymatic, Hydrolysis	Amorphous	-30 - 5
50029	Poly(trimethylene carbonate-co-L-lactide), 50:50, IV 0.9 dL/g	0.5 - 1.0	-	Weeks to months	Enzymatic, Hydrolysis	Amorphous	-30 - 5
50030	Poly(trimethylene carbonate-co-L-lactide), 50:50, IV 1.1 dL/g	1.0 - 1.5	-	Weeks to months	Enzymatic, Hydrolysis	Amorphous	-30 - 5
50031	Poly(trimethylene carbonate-co-D,L-lactide), 50:50, IV 1.1 dL/g	0.8 - 1.4	-	Weeks to months	Enzymatic, Hydrolysis	Amorphous	20 - 30
50032	Poly(trimethylene carbonate-co-D,L-lactide), 50:50, IV 0.9 dL/g	0.5 - 1.0	-	Weeks to months	Enzymatic, Hydrolysis	Amorphous	20 - 30
50033	Polyglycolide, IV 0.5 dL/g	0.3 - 0.8	30,000	Weeks	Enzymatic, Hydrolysis	220 - 230	35 - 45
50034	Polyglycolide, IV 1.2 dL/g	0.9 - 1.4	100,000	Weeks	Enzymatic, Hydrolysis	220 - 230	35 - 45
50035	Polyglycolide, IV 1.6 dL/g	1.4 - 1.8	150,000	Weeks	Enzymatic, Hydrolysis	220 - 230	35 - 45
50036	Polyglycolide, IV 2.0 dL/g	1.8 - 2.2	175,000	Weeks to months	Enzymatic, Hydrolysis	220 - 230	35 - 45
50037	Polyglycolide, IV 2.5 dL/g	2.2 - 2.7	200,000	Weeks to months	Enzymatic, Hydrolysis	220 - 230	35 - 45

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50038	Poly(glycolide-co-lactide), 95:5, IV 1.7 dL/g	1.0 - 2.0	-	Weeks to months	Enzymatic, Hydrolysis	200 - 215	35 - 45
50039	Poly(glycolide-co-lactide), 90:10, IV 1.7 dL/g	1.0 - 2.0	-	Weeks to months	Enzymatic, Hydrolysis	200 - 215	35 - 45
50040	Poly(glycolide-co-lactide), 80:20, IV 1.8 dL/g	1.0 - 2.0	-	Weeks to months	Enzymatic, Hydrolysis	200 - 215	35 - 45
50041	Poly(glycolide-co-caprolactone), 75:25, 1.6 dL/g	1.4 - 2.0	-	Weeks to months	Enzymatic, Hydrolysis	Amorphous	-20 – -5
50042	Poly(glycolide-co-caprolactone), 60:40, 1.4 dL/g	1.4 - 1.8	-	Weeks to months	Enzymatic, Hydrolysis	Amorphous	-20 – -5
50043	Poly(glycolide-co-caprolactone), 60:40, 1.3 dL/g	0.8 - 1.4	-	Weeks to months	Enzymatic, Hydrolysis	Amorphous	-20 – -5
50044	Poly(glycolide-co-caprolactone), 55:45, 1.5 dL/g	1.0 - 1.8	-	Weeks to months	Enzymatic, Hydrolysis	Amorphous	-20 – -5
50045	Poly(L-lactide), IV 1.6 dL/g	1.0 - 2.0	120,000	> 3 years	Enzymatic, Hydrolysis	170 - 180	50 - 60
50046	Poly(L-lactide), IV 2.0 dL/g	1.8 - 2.3	175,000	> 3 years	Enzymatic, Hydrolysis	170 - 180	50 - 60
50047	Poly(L-lactide), IV 2.4 dL/g	2.2 - 3.0	200,000	> 3 years	Enzymatic, Hydrolysis	170 - 180	50 - 60
50048	Poly(L-lactide), IV 3.2 dL/g	3.0 - 3.6	300,000	> 3 years	Enzymatic, Hydrolysis	170 - 180	50 - 60
50049	Poly(L-lactide), IV 3.8 dL/g	3.6 - 4.2	350,000	> 3 years	Enzymatic, Hydrolysis	170 - 180	50 - 60
50050	Poly(D,L-lactic acid), IV 0.4 dL/g, acid terminated	0.2 - 0.8	20,000	Months to years	Enzymatic, Hydrolysis	170 - 180	50 - 60
50051	Poly(D,L-lactic acid), IV 0.5 dL/g	0.3 - 0.6	30,000	Months to years	Enzymatic, Hydrolysis	170 - 180	50 - 60
50052	Poly(D,L-lactic acid), IV 0.6 dL/g	0.6 - 0.8	40,000	Months to years	Enzymatic, Hydrolysis	170 - 180	50 - 60
50053	Poly(D,L-lactic acid), IV 0.9 dL/g	0.8 - 1.1	60,000	Months to years	Enzymatic, Hydrolysis	170 - 180	50 - 60
50054	Poly(D,L-lactic acid), IV 1.2 dL/g	1.1 - 1.4	80,000	1 - 2 years	Enzymatic, Hydrolysis	170 - 180	50 - 60
50055	Poly(D,L-lactic acid), IV 1.6 dL/g	1.4 - 1.8	120,000	1 - 2 years	Enzymatic, Hydrolysis	170 - 180	50 - 60
50056	Poly(L-lactide-co-D,L-lactide), 70:30, IV 2.4 dL/g	2.0 - 2.5	-	2 - 3 years	Enzymatic, Hydrolysis	Amorphous	35 - 45
50057	Poly(L-lactide-co-D,L-lactide), 70:30, IV 2.6 dL/g	2.5 - 2.7	-	2 - 3 years	Enzymatic, Hydrolysis	Amorphous	35 - 45
50058	Poly(L-lactide-co-D,L-lactide), 70:30, IV 2.8 dL/g	2.7 - 3.4	-	2 - 3 years	Enzymatic, Hydrolysis	Amorphous	35 - 45
50059	Poly(L-lactide-co-D,L-lactide), 70:30, IV 3.8 dL/g	3.4 - 4.5	-	2 - 3 years	Enzymatic, Hydrolysis	Amorphous	35 - 45
50060	Poly(L-lactide-co-D,L-lactide), 70:30, IV 6.0 dL/g	4.5 - 6.5	-	2 - 3 years	Enzymatic, Hydrolysis	Amorphous	35 - 45
50061	Poly(L-lactide-co-D,L-lactide), 80:20, IV 3.8 dL/g	3.0 - 4.5	-	2 - 3 years	Enzymatic, Hydrolysis	Amorphous	35 - 45
50062	Poly(L-lactide-co-D,L-lactide), 80:20, IV 5.8 dL/g	4.5 - 6.0	-	2 - 3 years	Enzymatic, Hydrolysis	Amorphous	35 - 45
50063	Poly(L-lactide co-Caprolactone), 60:40, IV 1.8 dL/g	1.0 - 2.0	-	1 - 3 years	Enzymatic, Hydrolysis	Amorphous	0 - 10
50064	Poly(L-lactide co-Caprolactone), 70:30, IV 1.5 dL/g	1.0 - 2.0	-	1 - 3 years	Enzymatic, Hydrolysis	Amorphous	0 - 10
50065	Poly(DL-lactide co-Caprolactone), 80:20, IV 2.0 dL/g	1.0 - 3.0	-	1 - 3 years	Enzymatic, Hydrolysis	Amorphous	0 - 10
50066	Polydioxanone, IV 1.7 dL/g	1.0 - 1.8	90,000	< 6 months	Enzymatic, Hydrolysis	110 - 120	-15 – -5
50067	Polydioxanone, IV 1.9 dL/g	1.5 - 2.2	100,000	< 6 months	Enzymatic, Hydrolysis	110 - 120	-15 – -5
50068	Polydioxanone, IV 2.5 dL/g	2.2 - 3.0	130,000	6 - 12 months	Enzymatic, Hydrolysis	110 - 120	-15 – -5
50069	Polydioxanone, dyed, IV 1.6 dL/g	1.0 - 1.8	85,000	< 6 months	Enzymatic, Hydrolysis	110 - 120	-15 – -5
50070	Polydioxanone, dyed, IV 2.0 dL/g	1.8 - 2.1	105,000	< 6 months	Enzymatic, Hydrolysis	110 - 120	-15 – -5
50071	Polydioxanone, dyed, IV 2.2 dL/g	2.1 - 2.7	120,000	< 6 months	Enzymatic, Hydrolysis	110 - 120	-15 – -5
50072	Polydioxanone, dyed, IV 3.1 dL/g	2.7 - 3.5	160,000	6 - 12 months	Enzymatic, Hydrolysis	110 - 120	-15 – -5
50073	Poly(Dioxanone-co-glycolide), 90:10, IV 1.9 dL/g	1.5 - 2.0	-	Weeks to months	Enzymatic, Hydrolysis	110 - 120	0 - 5
50074	Poly(Dioxanone-co-glycolide), 90:10, IV 2.1 dL/g	2.0 - 2.5	-	Weeks to months	Enzymatic, Hydrolysis	110 - 120	0 - 5
50075	Poly(Dioxanone-co-lactide), 95:5, IV 1.9 dL/g	1.5 - 2.5	-	6 - 12 months	Enzymatic, Hydrolysis	100 - 115	-5 - 5
50076	Poly(Dioxanone-co-lactide), 92:8, IV 1.3 dL/g	1.0 - 1.5	-	7 - 12 months	Enzymatic, Hydrolysis	100 - 115	-5 - 5
50077	Poly(Dioxanone-co-lactide), 90:10, IV 2.0 dL/g	1.5 - 2.5	-	8 - 12 months	Enzymatic, Hydrolysis	100 - 115	-5 - 5
50078	Poly(Dioxanone-co-lactide), 85:15, IV 2.1 dL/g	1.5 - 2.5	-	9 - 12 months	Enzymatic, Hydrolysis	100 - 115	-5 - 5
50079	Poly(Dioxanone-co-lactide-co-glycolide), 90:5:5, IV 2.2 dL/g	1.5 - 2.5	-	Months	Enzymatic, Hydrolysis	95 - 105	-10 – 0

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Further Readings

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