

SK Chemicals

Copolyester in healthcare applications

(Source of figures: SK Chemicals)

Chemical background and polymers

- **Copolyester** = polyester + modification
- Modification → to **improve properties** and **balance processability** (CHDM and/or **bio-monomer**)
- Higher modification = higher properties & value
- Lower crystallization = higher transparency



PET material

- 2 main monomers
- Low level of modification reduces crystallization rate
- Also known as PET(g)

PETG and PCTG material

- 3 monomers
- 30-65% CHDM prevents crystallization

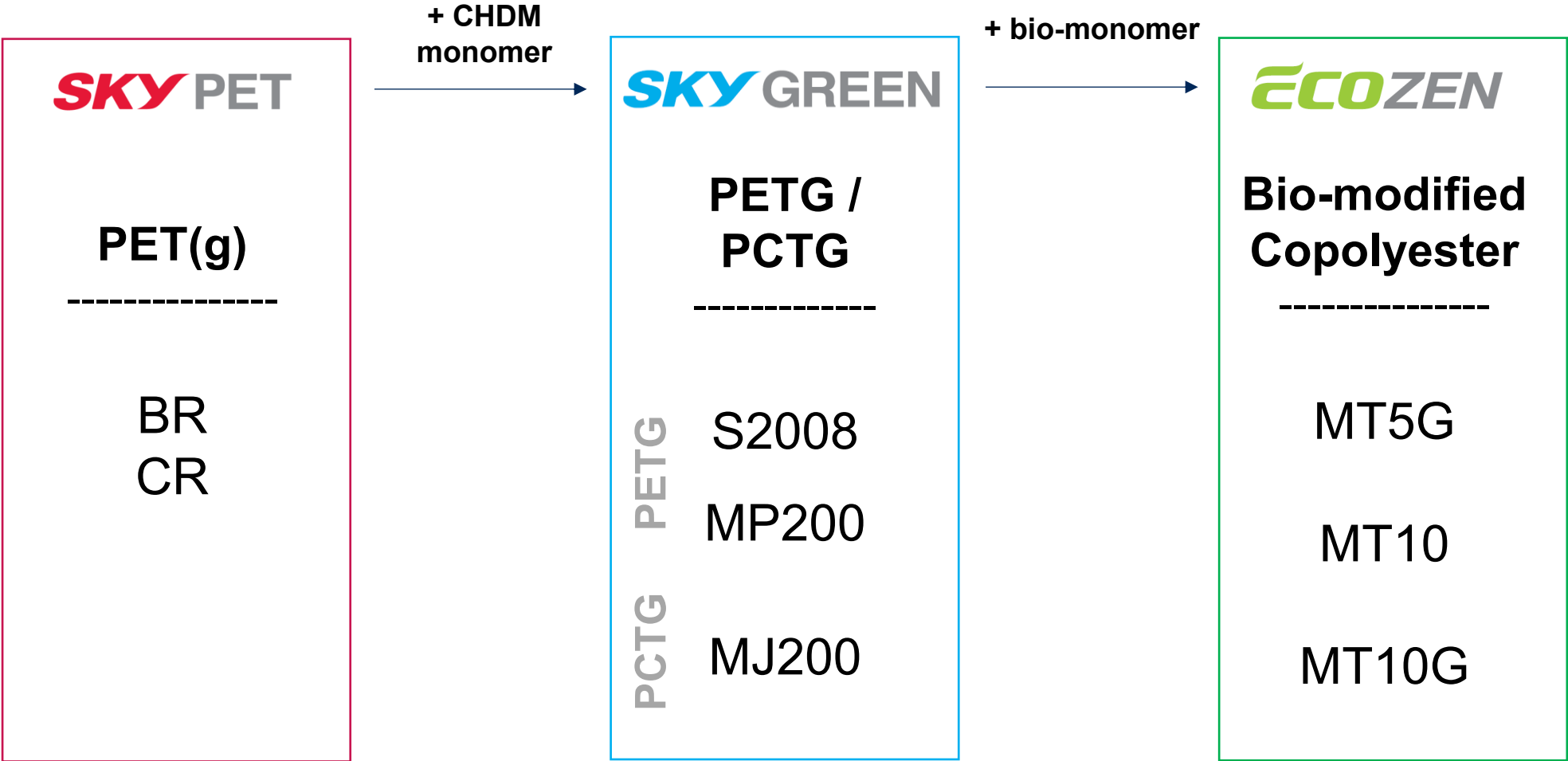
PCTG material

- Modified with **bio-sourced monomer**
- 4 monomers

PETG and PCTG material

- Containing MR **post-consumer recycled PET**
- Containing CR **post-consumer recycled PET**
- PET compatible – RIC-1 recycling stream

Portfolio overview : medical grade plastics¹



¹ According to VDI guideline 2017 Medical Grade Plastics



SKYPET BR is a semi-crystalline, low content CHDM modified PET material.

SKYPET BR

Properties

- High transparency
- Good chemical resistance
- Better crystallization rate and improved processibility (compared with standard PET)

Processing methods

- Injection Moulding
- Injection Blow Moulding
- Sheet & Film Extrusion

Typical Applications

- Medical bottles for pharma and biotechnology
- Medical packaging
- Blood tubes (BR-V = non-medical grade)



SKYGREEN is a product range of amorphous PETG / PCTG Copolyester

SKYGREEN PETG

SKYGREEN PCTG

Properties

S2008

- General grade
- Excellent processability

MP200

- High-melt flow
- Excellent transparency

MJ200

- Excellent impact strength
- High chemical resistance
- Dimensional stability
- Resistance to stress whitening

Processing methods

- Injection Moulding
- Injection Blow Moulding
- Sheet & Film Extrusion
- Profile Extrusion
- Extrusion Blow Moulding

- Injection Moulding
- Injection Blow Moulding

- Injection Moulding
- Injection Blow Moulding

ECOZEN is the world’s first transparent **bio-copolyester** modified with bio-monomer from renewable resources. This modification brings the following advantages:

Properties

- High temperature and resistance (HDT up to 100 °C)
- Increased chemical and stain resistance
- Inherently UL 94-V2
- Lower carbon footprint for Life Cycle Analysis (CO₂ reduction)
- Very good flowability

Bio-modified Copolyester

	MT5G	MT10	MT10G
Bio Content	6% (plus mould release)	14%	14% (plus mould release)
Processing methods	Injection Moulding Injection Blow Moulding	Sheet & Film Extrusion Injection Blow Moulding Extrusion Blow Moulding	Injection Moulding Injection Blow Moulding

Properties Overview Table



	Unit	Norm
Grade name		
Polymer		

Bio-content [%]		
Flexural Modulus	MPa	ISO 178
Flexural Strength	MPa	ISO 178
Tensile Strength @ Yield	MPa	ISO 527
Tensile Strength @ Break	MPa	ISO 527
Elongation @ Yield	%	ISO 527
Elongation @ Break	%	ISO 527
Izod Impact Strength (notched at 23°C)	kJ/m²	ISO 180/1A
HDT / B (0,45 MPa)	°C	ISO 75-1/-2
Density	kg/m³	ASTM D792
Mold Shrinkage	%	ASTM D955
UL94		
Transparenzy	%	ASTM D1003
Haze	%	ASTM D1003
Remarks		

SKYPET®
BR
PETg

-
1180
60,8
49,9
25,4
4,5
>50
3,6
66
1330
0,45
HB
89
1

SKYGREEN®		
S2008	MP200	MJ200
PETG	PETG	PCTG

-	-	-
1920	1890	1600
67	67	60
49	49	44
30	23	46
4,1	4,1	4,4
240	40	220
8,8	7	93
73	72	76
1270	1270	1230
0,3 bis 0,6	0,2 bis 0,5	0,2 bis 0,5
-	HB	HB / V2
90	90	90
<1	<1	<1
	Mould release	Mould release

ECOZEN®		
MT5G	MT10	MT10G
Bio-modified Copolyester		

6	14	14
1827	1800	1800
70	73	73
45	49	49
53	48	48
5,3	5,7	5,7
219	150	150
93	93	93
84	97	97
1250	1270	1270
0,2 bis 0,5	0,2 bis 0,5	0,2 bis 0,5
V2	V2	V2
90	86	86
<1	<1	<1
Mould release		Mould release

SKYGREEN / ECOZEN - Typical applications

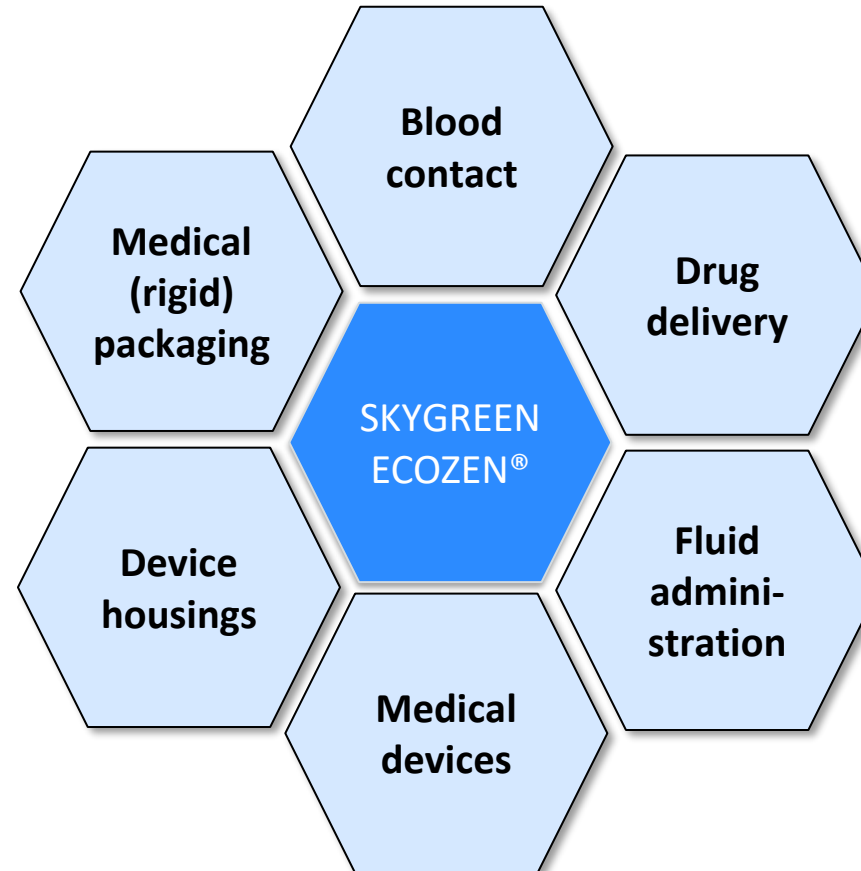


- Rigid packaging
- Primary packaging API's



- Electronic medical devices
- Incubator housings

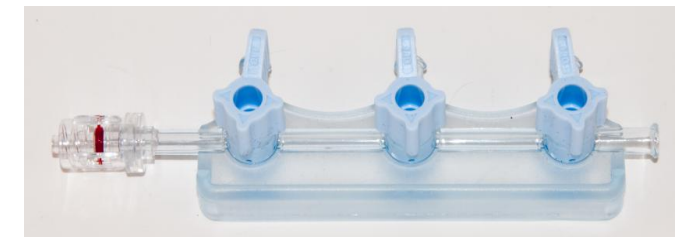
- Dialysis equipment
- Blood test tubes



- Trocars
- Biosensor



- Insulin pumps
- Drug delivery devices



- Connectors
- IV systems

Technical and Regulatory Support

Materials for healthcare applications must fulfill multiple requirements: **SKYPET®**, **SKYGREEN®** and **ECOZEN®** Medical Grade Plastics¹ addressing these needs.



¹ According to VDI guideline 2017 Medical Grade Plastics

Sterilisation

	Sterilisation Method			
Material	Gamma ¹	E-Beam ²	ETO ³	Steam/Autoclaving
SKYPET BR	-	-	-	-
SKYGREEN S2008	✓	✓	✓	✗
SKYGREEN MP200	✓	✓	✓	✗
SKYGREEN MJ200	✓	✓	✓	✗
ECOZEN MT5G	✓	✓	✓	✗
ECOZEN MT10	✓	✓	✓	✗
ECOZEN MT10G	✓	✓	✓	✗

¹ Gamma Radiation @Max: 50kGy 30mins

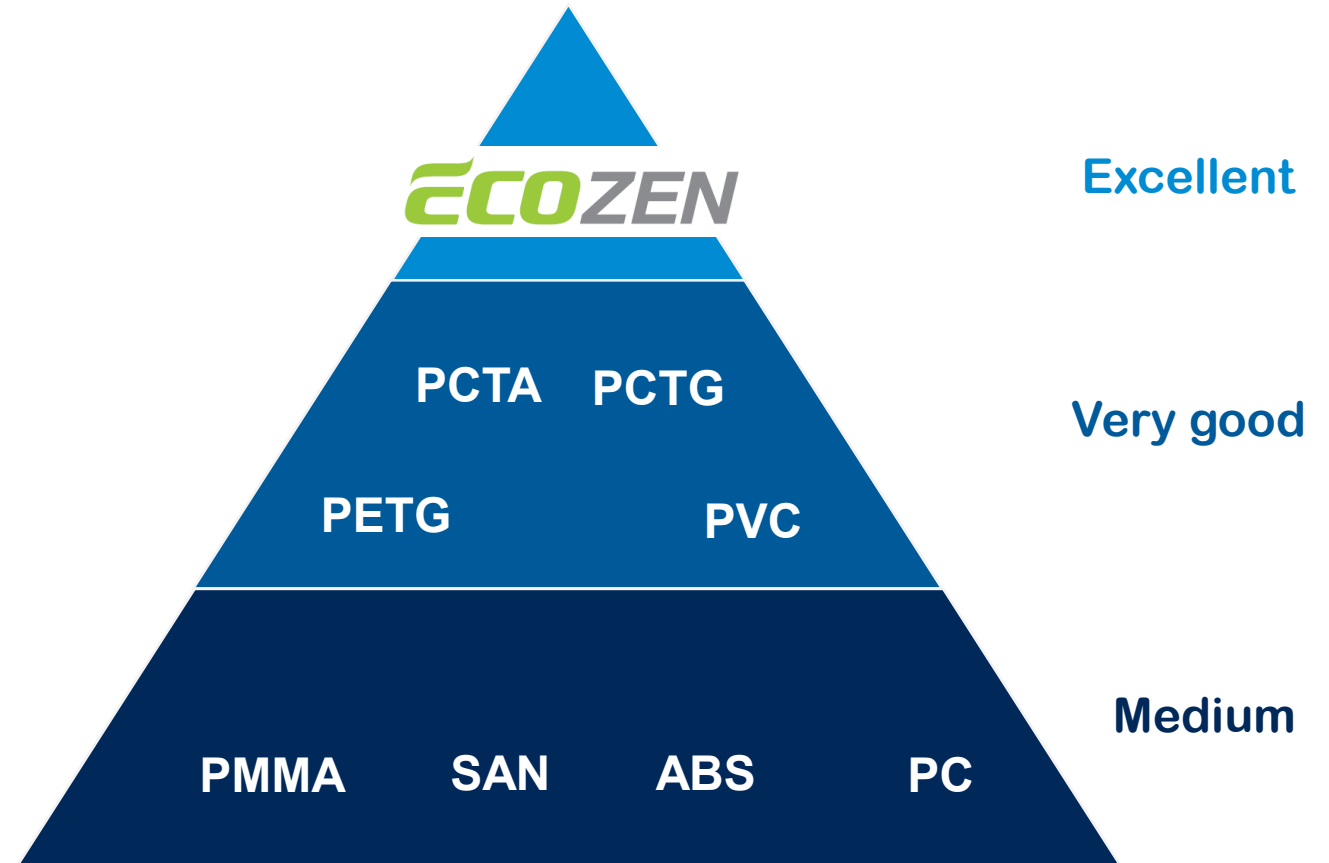
² Electron Beam @Max: 50kGy 24 hours

³ ETO Sterilization @ 50°C, 50% humidity 5hours

Chemical resistance

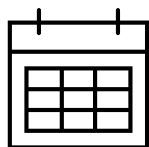
Chemical resistance plays an important role for specific application areas like fluid management, housings and drug delivery.

- Resistance against disinfectants
- Resistance against aggressive drugs like in oncological treatment
- Reduced Environmental Stress Cracking (ESC) and prevention of leaking, breaking and contamination of the fluids



Chemical resistance of various polymers

Service support offering



Product

Grade name

Notification of Change (NoC)

12 months

Regulatory Support

USP (U.S. Pharmacopeia) Class VI¹

ISO10993 (various parts²)

Drug Master File

European Pharmacopeia

SKYPET®	SKYGREEN®			ECOZEN®		
BR	S2008	MP200	MJ200	MT5G	MT10	MT10G
X	X	X	X	X	X	X
X	X	X	X	X	X	X
-	X	-	-	-	-	-
X	X	-	-	-	-	-
X	-	-	-	-	-	-

¹ USP <87>; <88>

² ISO 10993-5 Cytotoxicity; -10 Sensitization; -10 Irritation & Intracutaneous; -11 Systemic toxicity; -11 Subacute & Subchronic toxicity; -3 Genotoxicity; -4 Haemocompatibility

Environmental & Sustainable Aspects

Certifications



The material health category helps to ensure products are made using chemicals that are as safe as possible for humans and the environment by leading designers and product developers through a process of inventorying, assessing and optimizing material chemistries. As a step towards full certification, manufacturers may also earn a separate Material Health Certificate for products that meet Cradle to Cradle Certified™ material health requirements.

Gold grade of Material Health Certificate (Cradle to Cradle Certified)



disposable Pen injector

Products that have achieved GREENGUARD Certification are scientifically proven to meet some of the world’s most rigorous third-party chemical emissions standards, helping to reduce indoor air pollution and the risk of chemical exposure.

Gold grade of UL GREENGUARD Certificate

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