



FKUR

plastics - made by nature!®

Bio-Flex[®] & Biograde[®]

Clearly the best for rigids!

Bio-Flex® and Biograde®

Increase sustainability with renewable resins for rigid parts



Mouse casing
made from Biograde®
Green IT is a trademark of Fujitsu



Cap and Spoon
made from Biograde®

Both **Bio-Flex®** and **Biograde®** offer a 100% biodegradable¹ and renewably based² material solution for rigid applications. In addition to fulfilling your demands for sustainability, they also offer unique surface and optical properties at the highest quality level whether in technical, packaging, single use and other applications. Natural colors, white and even transparent grades are available. The processability of **Bio-Flex®** and **Biograde®** is excellent on standard injection molding, sheet extrusion and thermoforming machines. Furthermore, these bioplastics offer outstanding heat resistance (> 100°C / 212°F Vicat A). If for any reason our current processing or technical properties do not meet your demands we are happy to offer our best technical support as well as material adaptations to provide tailor made solutions (if applicable).

The first generation of **Biograde®** was developed in 1998 and in the early 2000's the first **Bio-Flex®** resins followed. The FKUR Group, together with its development partner Fraunhofer UMSICHT, has been developing and improving its portfolio aimed at customer satisfaction and project requirements. FKUR is continuously increasing its product range and has now designed a new generation of bioplastic resins. These resins are characterized by a high content of renewable resources along with biodegradability and compostability. Moreover transparency, heat and chemical resistance are key focus areas today.

Bio-Flex® and **Biograde®** resins generate added value as they offer sustainable solutions of outstanding quality for your applications.

Bio-Flex® and **Biograde®** resins have the following strengths and properties:

- 100% drop in solution and ready to use resins
- 100% replacement for several standard polymers
- Recycling of sprues or scrap is possible and indeed recommended
- High content of renewable resource materials – up to 65% (depending upon blend)
- Processable on standard injection molding, sheet extrusion and thermoforming machines
- Wide window of processing temperatures within the range of 165°C (329°F) to 220°C (446°F)
- High heat resistance (> 100°C / 212°F Vicat A) meeting UL 94 HB standard requirements as well as glow wire test up to 550°C (1022°F)
- Excellent chemical resistance and low odor compared to other bioplastics
- Certified as compostable to EN 13432 and ASTM D 6400 (depending upon blend)
- Food Approved to EC Directives and FDA (depending upon blend)
- Multiple printing methods applicable (e.g. laser, offset, hot stamping etc.)

¹ Compostability dependent upon part's geometry; EN 13432 certificates available for many grades

² Renewable content up to 65% (depending upon blend)

Bio-Flex® and Biograde® – resins shaping your sustainable solutions

Bio-Flex® resins for rigid applications:

■ Bio-Flex® S 5630:

Bio-Flex® S 5630 excels due to the careful balance between stiffness and elasticity. Moreover, products made from **Bio-Flex® S 5630** are distinguished by their high quality and pleasant feel. Its high thermal resistance offers both increased residence times as well as short cycle times. Using a polished mold allows a polished flat and shiny part surface. This grade is particularly suitable for sheet extrusion with subsequent thermoforming as well as injection molding.

■ Bio-Flex® S 6540:

Bio-Flex® S 6540 stands out because of its high stiffness together with impact strength. Due to good thermal conductivity of the product it is possible to achieve short cycle times and increased residence time. This grade is recommended for injection molding, extrusion blow molding, as well as sheet extrusion with subsequent thermoforming.

■ Bio-Flex® S 1100:

Bio-Flex® S 1100 is a very flexible blend and a perfect supplement to other **Bio-Flex® S** grades. It can be used to adjust the mechanical properties of your product by dry blending the grades. Furthermore, it can be used as a second material for 2-K processes or to produce very elastic parts.

■ Bio-Flex® F 6510:

Bio-Flex® F 6510 is predominantly composed of natural resource raw materials. This more rigid grade of our **F** Series is ideally used for profile extrusion and blow molding applications. Sheet extrusion and subsequent thermoforming are also possible.

Bio-Flex® F 6510 is food contact approved and compostable according to EN 13432 standard.

Biograde® resins for rigid applications:

■ Biograde® C 9550:

Biograde® C 9550 is a white, opaque cellulose blend particularly applicable for injection molding. Composed with a content of natural resources of more than 70% and excellent heat resistance (Vicat A > 110°C / > 230°F), it offers outstanding thermal properties.

Biograde® C 9550 can be processed on standard injection molding equipment with a general purpose screw into disposable cutlery and other complex articles.

Biograde® C 9550 is food contact approved and certified as compostable according to EN 13432 and ASTM D 6400.

■ Biograde® C 6530:

Biograde® C 6530 offers improved melt rheology and medium stiffness, by using a combination of special additives and a high percentage of fillers. This grade is suitable for the production of injection molded rigid parts particularly those with thin walls and long flow paths. This material can be used to produce items such as heat-resistant cups and electrical articles.

Biograde® C 6530 is food contact approved.

■ Biograde® C 7500:

Biograde® C 7500 is a translucent cellulose blend and offers great properties compared to PS/ABS. This grade is 100% biodegradable and contains more than 50% renewable resources. In addition its Vicat A temperature exceeds 100°C (212°F). Furthermore, the surface of parts made from it can be smooth and shiny. This material has a certificate for EN 71-3 as well as the approval for food contact.

Biograde® C 7500 can be printed easily as well as colored with masterbatches. It can be processed on standard injection molding machines, in most cases without any adjustment to the tooling. Hot runners should not be used without prior technical discussion as bioplastics tend to degrade if exposed to long dwell times and high temperatures. However, hot runners can be used if the process is adjusted accurately.

■ Biograde® C 6509 CL:

Biograde® C 6509 CL is our latest development offering transparency and higher MFR for thin walled parts and long flow paths. Its flexibility and mechanical properties are better than general purpose PS and offer opportunities for high quality parts.

Biograde® C 6509 CL is food contact approved.

Bio-Flex® and Biograde® injection moulding processing guide:

Recommended Trial Procedure

Before Production:

- The process should be started with the standard material.
- When the process runs properly the temperature should be decreased to the level given in the “processing advice” or, at least, to its minimum.
- If a hot runner system is being used the flushing must be tested with standard material (e.g. PP).

During Production:

- After feeding the machine with bioplastic resin, the barrel should be flushed several times to clean it properly.
- After flushing the barrel the regular process should be started.
- If the cavity cannot be filled completely, the injection speed and pressure should be increased to the maximum before increasing the temperature.

After Production:

- We recommend purging out the extruder with a standard material after production. You should not allow material to remain hot inside the injection unit for extended periods as the material will degrade.

The key to success is to keep the process running when changing the materials.

General Hints

The temperature given in our “processing advice” is meant to be a guideline. Higher temperatures may not affect the material if the dwell time is very short (residence time with given temperature profile max 5 minutes).

You may increase the temperature in small steps. When the material starts degrading (smoke, smell, black color) the maximum has been exceeded.

The melt cushion should be as small as possible to decrease the residence time.

The usage of the smallest screw possible for the appointed application decreases the residence time and the risk of periodic material defects (e.g. degradation).



Cosmetic sample case:

a variety of products made from FKUR's bioplastics

[using injection molding, thermoforming and blow molding]

Note

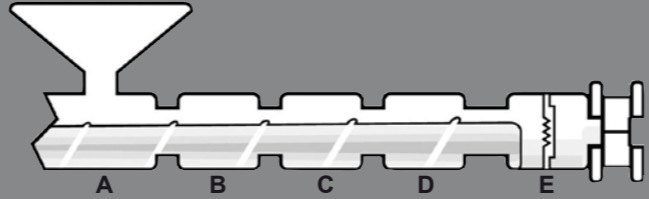
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Physical and mechanical properties

Product	Color	Density	MFR	Shrinkage	Modulus of Elasticity	Tensile Strength	Elongation at Break	Impact Strength		Melting Temperature	Vicat A	Compostability	Biodegradable	Food contact
		ISO 1183	ISO 1133					ISO 179-1/1 eA/U	ISO 527					
		[g/cm ³]	[g/10min]	[%]	[MPa]	[MPa]	[%]	notched [kJ/m ²]	unnotched [kJ/m ²]	[%]	[%]			to be confirmed for each application
Bio-Flex® resins														
Bio-Flex® F 6510	beige	1.3	2.5 - 4.5	0.3 - 0.5	2600	47	19	7	no break	150 - 170	60	yes	100%	yes
Bio-Flex® S 1100	beige-violet	1.23	9 - 13		600	28	395	12	no break	> 155	104		100%	
Bio-Flex® S 5630	white	1.55	10 - 12	0.3 - 0.5	2160	32	9	3	51	140 - 160	105		100%	yes
Bio-Flex® S 6540	beige	1.62	8 - 10	0.3 - 0.5	2800	31	7	3	36	110 - 150	105		100%	yes
Biograde® resins														
Biograde® C 6509 CL	transparent	1.31	37 - 41	0.2 - 0.4	3050	61	5.5	3.4	19	> 180	105		100%	yes
Biograde® C 6530	white	1.49	27 - 31	0.2 - 0.4	3150	46	9	3.5	35	> 180	107		100%	yes
Biograde® C 7500	translucent	1.31	17 - 21	0.2 - 0.4	3000	66	12.5	6.5	no break	> 180	110		100%	yes
Biograde® C 9550	white/grey	1.67	10 - 15	0.2 - 0.4	4200	41	6.5	2	37	> 180	118	yes	100%	yes

Processing Guide

Product	Process BM = Blow Molding IM = Injection Molding PE = Profile Extrusion SE = Sheet Extrusion TF = Thermoforming						Cooling Time (Injection Molding) [sec.]	Mold Temperature (Injection Molding) [C°]
		A [C°]	B [C°]	C [C°]	D [C°]	E [C°]		
Bio-Flex® resins								
Bio-Flex® F 6510	BM, PE, SE, TF	45 - 65	150	160	180	190	10 - 60	20 - 40
Bio-Flex® S 1100	BM, IM	130 - 160	160	165	170	170	15 - 60	30 - 65
Bio-Flex® S 5630	IM, SE, TF	130 - 150	150 - 170	170 - 180	170 - 185	170 - 180	15 - 60	30 - 65
Bio-Flex® S 6540	BM, IM, PE	130 - 150	150 - 170	170 - 180	170 - 185	170 - 180	10 - 60	30 - 65
Biograde® resins								
Biograde® C 6509 CL	IM	60	160	190	210	220	5 - 15	30 - 75
Biograde® C 6530	IM, SE, TF	60	160	190	200	205	5 - 15	30 - 75
Biograde® C 7500	BM, IM, SE, TF	60	160	190	210	220	5 - 15	30 - 75
Biograde® C 9550	IM, PE, SE, TF	60	160	190	200	205	5 - 15	30 - 75

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