



Processing Guidelines
Cardia Compostable B-F

Blown Film Resin
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ABOUT THESE PROCESSING GUIDELINES

Cardia Compostable B-F is a biodegradable resin and as such needs to be processed somewhat different to the conventional film resins, like polyethylene. This document highlights the areas that are different. If a topic is not discussed in here then a standard PE film set-up would be an appropriate approach. For further information, any questions, suggestions or comments please contact Cardia Bioplastics' technical support.

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PRODUCT DESCRIPTION

Cardia Compostable B-F is a compostable and biodegradable resin based on a blend of thermoplastic starch (TPS), biodegradable polyesters and natural plasticizers. This grade of resin is compatibilised to offer a high level of mechanical strength, outstanding elongation properties and toughness. The resin is based on corn starch which is an annually renewable material.

Product Properties

Parameter	Test Method	Typical Value / Unit
Melt Flow Index	ASTM D1238	2 g/10 min (150°C(302°F)/ 5 kg)
Density	ASTM D792	1.2 g/cm ³
Melting Temperature Range	ASTM D3418	90 - 130 °C (194-266°F)
Tensile strength at yield	ASTM D883	> 20 MPa
Tensile strength at break	ASTM D883	> 15 MPa
% Elongation at break	ASTM D883	> 500 % at low strain rates
Impact Resistance - Dart Drop	ASTM D1709	0.25 kg
Tear propagation - Elmendorf	ASTM D1922	2.9 N
Oxygen transmission rate	ASTM F1927	1175 (cc/m ² .day)
Seal Strength		comparable to polyethylene

Moisture Content

Cardia Compostable B-F resin is sensitive to moisture absorption, due to the hydrophilic nature of its thermoplastic starch component. Excessive moisture in the resin could lead to hydrolytic decomposition of the biodegradable polyester component during processing. In the Cardia Bioplastics factory Compostable B-F resins are adjusted to the optimum moisture content and immediately packed and sealed in aluminium foil lined bags. The liner is a perfect barrier and prevents any moisture exchange.

It is important that Cardia Bioplastics' resins are processed soon after a new bag is opened. Any open bag should be properly sealed before storage. Any non-sealed bag that is stored for more than 24 hrs should be discarded. Cardia Compostable B-F resin should not be dried.

Transport, Storage and Handling

Due to the degradable nature of the resin it is important not to expose Cardia Compostable B-F material to temperatures above 25°C (77°F) for an extended period of time. In locations where outside temperatures seasonally or permanently exceed 30°C (86°F) we recommend refrigerated transport and storage of the

material. In areas where outside daytime temperatures are usually not very high (<30°C/86°F) a protected warehouse is sufficient, provided a few conditions and precautions are observed:

- good insulation
- good ventilation
- no direct sunlight
- at least 1 meter away from walls that are exposed to sunlight
- as low as possible, close to the ground, not directly under the roof
- strict stock rotation
- temperature data logger attached (recommended).

Likewise, transport of the material, if not refrigerated, should only take place in enclosed, but well ventilated trucks that efficiently prevent build-up of heat.

PROCESSING OF CARDIA COMPOSTABLE B-F RESIN

Cardia Compostable B-F resin can be processed on most standard LDPE or LLDPE blown film equipment. However, due to the different nature of Cardia Compostable B-F, the machine set-up and processing conditions need to be adjusted to ensure a stable process and to optimise quality and output of the product. The following sections discuss these adjustments based on previous successful trials and production campaigns.

Equipment Considerations

Screw / Barrel Design

Most standard LDPE or LLDPE screw designs with typical L/D between 24 and 32 will plasticate Cardia Compostable B-F well and should work without any issues. A preferred design would have a distributive mixing head installed to provide a well homogenised melt.

Very aggressive, high shear screws should be avoided, since they tend to thermally damage the resin from local overheating.

In some instances grooved barrels can also cause significant shear heating and thermal damage. Their suitability for processing Compostable B-F resin should be individually confirmed in an initial processing trial.

Melt Filter

A clean melt filter should be used every fresh start-up to ensure small particles do not break/split the bubble.

Die

A die gap of 0.8 - 1.5 mm is recommended for Cardia Compostable B-F.

Tower

The height from die orifice to the nip roll should be at least 2.5 m to ensure full cooling and prevent film blocking and should be higher for thick gauges.

Processing Conditions

Process Temperatures:

Cardia Bioplastics B-F resin is thermally sensitive. Therefore, the temperature should be carefully adjusted and monitored.

Overheating can lead to degradation. Signs of degradation are:

- brownish colouring of extrudate
- increased tackiness of extrudate
- intensified odour, sweet smell, like caramel, as starch degrades into sugars.

Note: During processing the material releases a light starch odour, like popcorn, which is perfectly normal.

The following table recommends a starting point for optimisation and a range in which the optimised temperature should fall:

Zone	Starting Point Temperature		Temperature Range	
	°C	°F	°C	°F
Hopper (water cooling)	10 - 25	50 - 77	10 - 25	50 - 77
Feed	135	275	120 – 150	248 – 302
Compression	145	293	130 – 160	266 – 320
Metering/mixing	155	311	140 – 165	284 – 329
Adaptors	155	311	140 – 165	284 – 329
Die	150	302	135 – 165	275 – 329

Purging

Before introducing Cardia Compostable B-F it is recommended to purge the extruder with a standard LDPE of high melt flow (MFI 2-6) and adjust the process temperatures close to the starting point as in the table above. Depending on the design of the extrusion line purging to a clean and streak-free bubble of Cardia Compostable B-F should take between 20-60 minutes. This needs to be considered when planning material requirements for a trial.

After a Cardia Compostable B-F production run it is recommended to purge the extrusion line with polyethylene or a similar polymer to minimise the risk of thermal decomposition of the melt. Cardia Compostable B-F resins should not be left in a hot extruder barrel when the machine is shut down.

Screw Speed / Line Speed

The screw speed should be slow at start-up and then slowly be increased in parallel with the haul-off/line speed.

Blowing a Bubble

Cardia Compostable B-F melt at processing temperature is relatively sticky and it can be a bit tricky to get a bubble started until the operator has got some experience with the material. Once the material expands and gets cooling it solidifies quickly and is not sticky anymore.

The inside and outside aeration should be gradually changed from weak to strong. Cold aeration is preferred; 10-15 °C (50-59 °F) works best to avoid film blocking problems.

The preferred blow-up ratios are between 2.5:1 and 3.5:1 higher blow-up ratios may lead to bubble instability problems and film creasing.

Depending on equipment design and set-up film thicknesses between 15 µm and 120 µm can be achieved for Cardia Compostable B-F.

ADDITIVES

Cardia Compostable B-F resin can be coloured using a biodegradable colour masterbatch based on starch, PLA or a bio-degradable polyester. Please contact Cardia Bioplastics for further information and a list of accredited suppliers of such biodegradable colorants or additives.

IN-LINE RECYCLING

The biodegradable trim waste can be re-processed and recycled as long as it is kept segregated (i.e. not mixed with polyethylene) and kept dry. The film edge trim and bag handle "punch-outs" can be processed through film re-processing unit (e.g. Erema, PlasMac) into pellets or through an agglomerator or compactor to produce agglomerated/compacted pellets. The regrind pellets can be fed into the main film process at a maximum addition rate of 10 percent.

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