Specialty Additives for Biopolymers

Improved handling and processing of biopolymers

Cargill™

Specialty Polymer Additives for Biopolymers

The biopolymers market has seen a rapid growth in recent years. Whilst increasingly popular, these materials bring a set of challenges during processing and use. Cargill offers a range of products to improve the handling and processing in many different biopolymer types. From slip and friction control additives for polymer processing, to static control additives for improved conversion and use, Cargill is well positioned to help you find the right additive to suit your needs.

Challenges of biopolymer production

Whilst there are many benefits to switching from a petrochemical based polymer to a biopolymer, polyester-based biopolymers in particular can exhibit high friction or adhesion which can cause problems during film and sheet manufacturing and injection molding such as:

- Issues with processability
- Articles stuck in the mold during injection molding
- Poor scratch resistance
- Issues when handling materials in the end application

Biopolymers are also prone to high static buildup, which can lead to issues in dust attraction, contamination, and poor processability.

Cargill offers a range of additives that can help with the processing and handling issues caused by high friction and static control when using polyester based biopolymers.

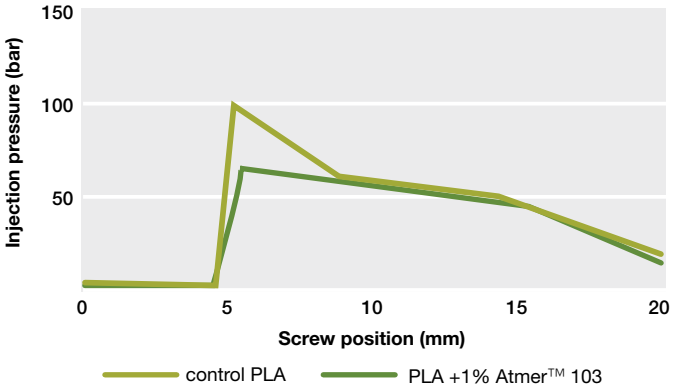
Key benefits of using Cargill Polymer Additives

- **Easier processing and handling of polymer films and sheets**
- **More efficient injection molding, with better mold release and faster cycle times**
- **Improved scratch and scuff resistance**
- **Improved static control for various applications**
- **Anti-fogging to maintain transparency in biopolymer films**

Processing aids for shorter cycle times

As shown in figure 1, during the injection molding of Polylactic acid (PLA) and PLA blends, a 1% addition of Atmer™ 103 additive works as a processing aid by improving the polymer flow. This can allow a reduction in injection pressure or a reduction in injection temperatures and speeds which in turn allows a reduction in cycle time. It is also effective at improving the processability during film extrusion.

1. *Injection pressure when injection molding PLA with and without Atmer™ 103 additive*

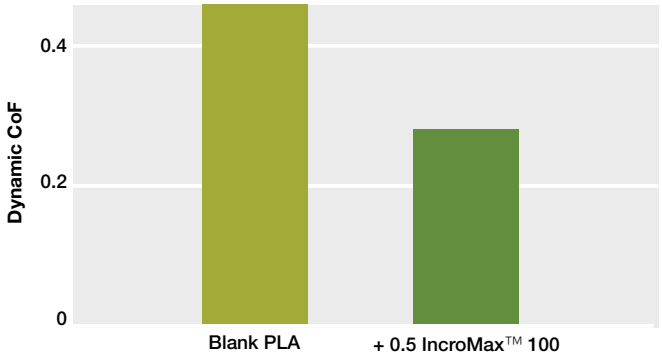


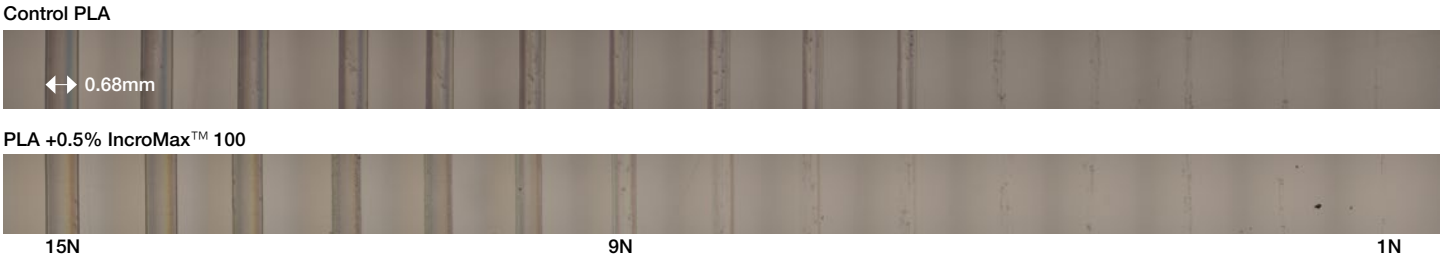
Friction control and anti-scratch

IncroMax™ 100 additive can be incorporated into PLA and PLA blends via masterbatch or compounding to reduce the coefficient of friction at the surface. In cast extruded PLA films, 0.5% of IncroMax™ additive has been shown to reduce the coefficient of friction (CoF) by up to 40% as shown in figure 2, which leads to easier processing of the polymer.

IncroMax™ 100 additive also offers improved scratch resistance in PLA and PLA blends, especially up to a 9N load. Scratches on the surface of injection molded plaques are shown to be less visible, and slightly narrower when 0.5% of IncroMax™ 100 additive is incorporated into the polymer.

2. *Dynamic CoF of 50 µm cast extruded PLA film*

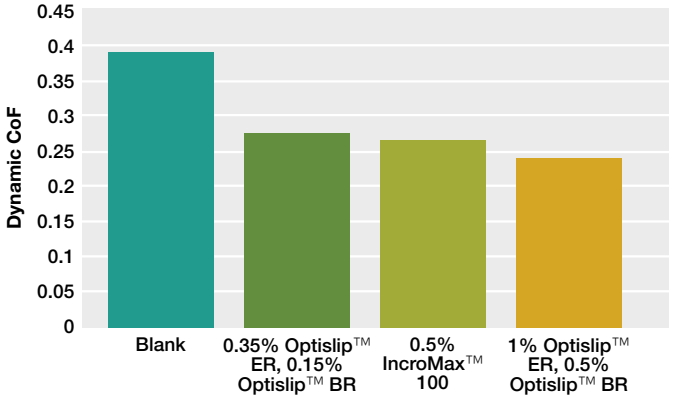




High slip & anti-blocking additives

The Optislip™ range of bio-based* slip and anti-blocking additives are also suited for use in a range of biopolymers. They act on the surface to form a lubricating layer that reduces the CoF or adhesion between contacting polymer surfaces, and the polymer and other materials. This in turn allows easier processing and handling of the film during manufacturing, and can also bring in-use benefits in the final application.

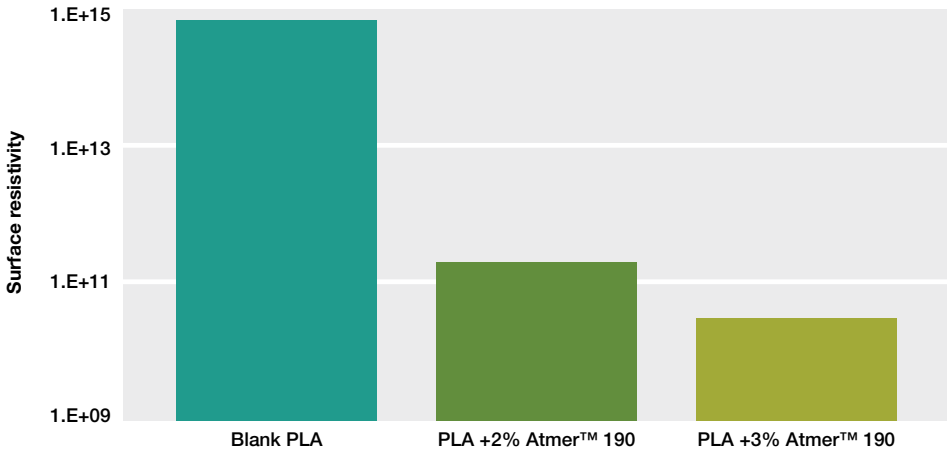
3. *Dynamic CoF of 50 µm cast extruded Polylactic Acid / Polyhydroxyalkanoate (PLA / PHA) blend films*



Migrating static control

The Atmer™ range of migrating static control additives are added into polymers as a masterbatch, during compounding or directly during extrusion to minimize the charge build up in the polymer. As shown in figure 4, Atmer™ 190 additive can be added at up to 3% in PLA to reduce the surface resistivity of the polymer, whilst maintaining optical and mechanical properties. This allows easier handling and processing of the polymer film, as well as reducing dust pickup.

4. *Surface resistivity of PLA and Atmer™ 190*



Finding the right additive for your application

With so many types and blends of biopolymers in the market, it can be difficult to understand which additive to use for the right effect and application. Here at Cargill, we pride ourselves on our technical expertise and know-how, and with 50 years of experience in the polymer additives market, we are well positioned to offer advice and guidance to help you find the right additive for your needs. Get in contact with your local sales representative for more information on how we can work together to find the right solution for you and your products.

Polymeric static control additives

Biopolymers are increasingly used in more durable goods such as electronic articles, household, and automotive applications. In these engineering applications of biopolymers, long-term static protection may be needed to protect workers and sensitive electronics from the risk of static shock, while also providing resistance to dust pickup.

Ionphase™ inherently dissipative polymers (IDP), commonly known as permanent anti-statics, are incorporated into the polymer to provide a co-continuous ion network that lowers the resistivity of the polymer. They provide an immediate effect during the lifetime of the polymer and addition levels can be optimized to allow the right static control for specific applications and even allow compliance with key industry standards for electrostatic protected areas (EPA and EX).

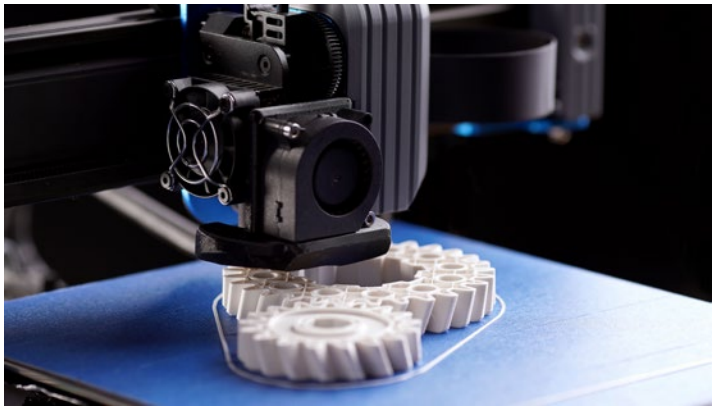
Externally coated static control and anti-fogging additives

With certain types and blends of bio-polymers, for example bio-polyethylene terephthalate (bio-PET), internally migrating additives can negatively affect the clarity or performance of the polymer and can therefore not be used. In these polymers, an externally coated additive can be used.

Product Guide for Biopolymers

PRODUCT NAME	PHYSICAL FORM AT 25°C	BIO-BASED CARBON CONTENT	COMMENTS	RECOMMENDED POLYMERS
Slip and anti-block				
Optislip™ ER	Powder / microbead / bead / pastille	100 %*	Erucamide additive that is effective as a slip agent in a range of biopolymers.	PLA & PLA blends
Optislip™ BR	Bead	100 %*	Behenamide additive that is effective as an anti-blocking agent in biopolymers.	PLA & PLA blends
Optislip™ SRV	Bead	100 %*	Stearamide additive that offers a quick acting anti-block effect in biopolymers.	PLA & PLA blends PHA, PBAT, PBS, TPS
Friction reduction and scratch resistance				
IncroMax™ 100	Pastille	100 %*	A proprietary blend of esters providing friction control in biopolymers, particularly suited for injection molding of bio-PET.	PLA & PLA blends bio-PET
Processing aid				
Atmer™ 103	Powder	100 % †	A sorbitan ester based additive that offers better processability during injection molding and extrusion.	PLA & PLA blends
Migrating / external static control and anti-fog				
Atmer™ 190	Pastille	0 %	A migrating static control additive for PLA and PLA blends. Effective for up to 12 months.	PLA & PLA blends
Atmer™ 110	Liquid	Approx. 28 % †	An externally applied static control additive, that is applied by spray or dip coating.	All polymers
Atmer™ 116	Liquid	Approx. 32 % †	An externally applied anti-fogging additive, that is applied by spray or dip coating.	All polymers
Polymeric static control				
Ionphase™ trSTAT	Pellet	33 - 37 % †	A polymeric static control agent, commonly known as a permanent anti-static, designed for use in PLA extrusion applications.	PLA
Ionphase™ U5	Pellet	28 - 32 % †	An externally applied static control additive, that is applied by spray or dip coating.	All polymers

* Tested according to ASTM D6866
† Determined based on the calculated bio-based content values for the raw materials as per ASTM D6866.
When used at <1% addition level, these additives are not expected to have a material impact on the rate of degradation of the polymer.



Further Information

Cargill Bioindustrial sales and distribution are coordinated through an extensive worldwide network of technical and commercial experts. For further information or guidance please contact us:

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