

## Process Notes for making Mulch Film using BiologiQ's ESR Resins

BiologiQ's ESR based film resins and Masterbatches can be used to make monolayer or co-ex film on most standard blown film equipment. This Process Note highlights key procedures and information that we use to make quality film.

### ESR Masterbatch and Mixing Details

Film that is blown with BiologiQ's ESR and PBAT is typically made from an ESR Masterbatch that is further down blended during the film blowing stage. The Masterbatch typically contains:

50%	BiologiQ ESR
50%	PBAT

This Masterbatch is then further down blended during film blowing as follows to arrive at the indicated final ESR to PBAT ratios:

<u>Final Film Ratio</u>	<u>Masterbatch</u>	<u>Additional PBAT</u>
10% ESR / 90% PBAT	20% MB	80% PBAT
20% ESR / 80% PBAT	40% MB	60% PBAT
30% ESR / 70% PBAT	60% MB	40% PBAT

Notes:

- 1) If a BLACK film is required, replace 5% of the base PBAT with 5% BLACK resin (eg. 80% -> 75% PBAT + 5% Black).
- 2) If a fully diluted resin is used in lieu of a Masterbatch (ie 30% ESR / 70% BPAT), no further down blending is required during film blowing.
- 3) For concentrations of ESR greater than 40%, please contact BiologiQ directly for additional information and process suggestions.

### Machine Configuration & Setup

Most standard LDPE film blowing equipment can be used to blow film from resin containing ESR. BiologiQ has successful direct experience with monolayer equipment that have the following characteristics:

Screw Diameter	55 – 80 mm (strong mixing elements preferred but not required)
L/D Ratio	38 – 45
Die Gap	1.0 mm – 1.2 mm
Die Diameter	130/150 mm – 300 mm
Typical Blow Up Ratio	2.5 – 2.8
Screen Pack	100 mesh
Chilled Air	Highly recommended
Extruder Degassing	Not required

Notes:

- 1) Films made with ESR are slightly more sensitive to process conditions (such as die gap and blow up ratio) than are traditional films. While we find a BUR of approx. 2.5 is optimum, the best ratio for your equipment can be determined by ensuring the MD and TD strengths are essentially equivalent.
- 2) Films containing ESR respond to slip and antiblock additives similarly to other resins. However, they tend to bloom somewhat slower. We recommend measuring COF after at least 72 hours.
- 3) It is normal for our bio-based ESR resin to outgas (smoke with a slight smell) during processing. This does not affect the final film quality or performance. Note: starch based films will typically have a slight odor if starch is contained in the structure.

### Startup Procedure

- 1) Clean or replace the Screen Packs before starting. ESR based resins will act as a purge agent when introduced to the equipment, so gels and other defects might be experienced if the screen packs are not clean when ESR is introduced.
- 2) Set the Extruder Process Temperature profile as follows (all temperatures °C):

Zone	C1	C2	C3	C4	C5	AD	D1	D2	D3	D4
Set Temperature	130	140	145	150	155	160	165	165	165	165

- 3) Start with 100% PBAT and establish a stable bubble.
- 4) Introduce the required blend of Masterbatch and Base Resin to the extruder to obtain a film with the desired ESR content (eg for 30% ESR – use 60% MB + 40% additional PBAT).
- 5) After the initial introduction of the resin blend, and during the transition, adjust the extruder RPM, the Line Speed, Take up Reel Speed, Winder Speed (and any other typical parameters) to obtain the bubble stability, width and film thickness desired.
- 6) Start and maintain the film winder as normal.
- 7) On shutdown, it is recommended to purge the film extruder with either 100% LDPE or 100% PBAT. Leaving any starch based resin (like ESR) in the extruder during shutdown and startup may cause it to burn and delay normal startup on the next use.

### Resin Storage

- 1) BiologiQ resins (including Masterbatches) containing ESR should be stored in a cool dry environment until ready for use.
- 2) Maintain the inner package seal until ready for use.
- 3) After use, and if useable resin remains, remove as much air as possible and re-seal the packaging. Resin should be used within 1 year of manufacture and/or within 6 months of first opening.
- 4) If a good seal is not maintained, or the resin gathers moisture, drying may be required. Dry according to:

	<u>ESR</u>	<u>ESR Masterbatch</u>
Temperature	40°C	60°C
Time	8-12 hours	8-12 hours