K-RESIN®
STYRENE-BUTADIENE COPOLYMERS
The Smart Choice™

TIB 204

Blown Film

Introduction

K-Resin® styrene-butadiene copolymers (SBC) are a family of clear resins produced by Chevron Phillips Chemical Company LP. K-Resin® SBC were commercialized in the early 1970's. Since that time, they have grown steadily in the marketplace as more and more applications have been developed utilizing these polymers' unique blend of sparkling clarity and impact strength.

Applications range across the spectra of conventional processing techniques. K-Resin® SBC, alone or in blends with crystal polystyrene, can be extruded as a film, K-Resin® SBC makes a clear, stiff, high gloss film suitable for applications such as candy twist wrap, shrink sleeves and overwrap. If extreme processing and regrinding conditions are avoided, the polymers can be reprocessed in multiple passes with minimal change in properties and processing.

A feature that makes K-Resin® SBC more economically attractive when compared to other clear plastics is its low density. K-Resin® SBC have a 20 to 30 percent yield advantage over most non-styrenic, clear resins.

All K-Resin® SBC grades as shipped by Chevron Phillips Chemical Company LP, meet the specifications of the United States FDA Food Packaging Regulation 21 CFR 177.1640 or the specifications of an effective United States FDA Food Contact Notification. By virtue of this FDA compliance, K-Resin® SBC grades may be used as a component of articles for use in contact with food. Most K-Resin® SBC grades meet the food contact requirements for EEC Directive 2002/72/EEC and all its amendments.

Most K-Resin® SBC grades have been tested and meet the requirements of a USP XXIII Class VI type polymer. Even so, Chevron Phillips Chemical Company does not recommend using any K-Resin® SBC grade in medical applications that involve permanent or temporary implantation in the human body. Detailed information on the biocompatibility and sterilization methods of K- Resin® SBC can be obtained in TSM 292 Medical Applications of K-Resin® SBC.

K-Resin SBC Grades

K-Resin® SBC grades specifically for blown film extrusion are DK11, KR53 and KR52 as a coextruded structure as well as a mono layer-film. DK11 has high stiffness, excellent clarity, and good permeability. KR53 is not as stiff, has greater elongation and improved tear resistance and KR52 was designed specifically for the shrink sleeve applications, and is a high stiffness film. All three materials DK11, KR53 and KR52 contain an anti-block, and therefore will require surface treatment (such as corona discharge) before printing. KR52 is the most printable grade and holds very high dyne levels after treating.

K-Resin® SBC films offer exceptional clarity combined with stiffness, excellent gloss and 100 percent crease retention for dead fold. K-Resin® SBC can be processed with both uniaxial and biaxial orientation which makes it an excellent candidate for shrink films, candy twist wrap, shrink sleeves and flexible medical packaging. Its low shrink force reduces the likelihood of package deformation and its orientation produces labels that shrink uniformly to finished products. K-Resin® SBC films are a preferred choice for candy twist wrap because the twist seal remains in place, keeping the package tightly sealed. K-Resin® SBC film can be easily pigmented to make tinted, high gloss transparent for decorative films, which may be used as floral wrap or gift wrapping.

K-Resin® SBC offer good oxygen, carbon dioxide, and water vapor permeability for produce packaging, which allows fresh cut fruits and vegetables to retain their freshness over longer time periods.

K-Resin® SBC may be coextruded with barrier or sealant layers for use in many food packaging applications. In addition, K-Resin® SBC may be processed on extrusion lamination and coating equipment to produce multilayered structures for the replacement of paper and foils.

Blown Film

K-Resin® SBC can be manufactured on blown film lines. This process offers unique processing merits for K-Resin® SBC film production which are worth noting. In blown film extrusion, the film is oriented in both machine and transverse directions. The blown film process is capable of producing either tubes or flat films, depending on the operation of the take off equipment. This makes blown film equipment more versatile in today's market driven economy.

General Extrusion Equipment

With a few considerations, K-Resin® SBC films can be processed on many types of conventional extrusion equipment. Extruders may be either air or water cooled, provided they are capable of controlling all barrel zones within 5°F (3°C) of target. Screw cooling is typically not required and in some cases may be detrimental. Extruder feed sections should be equipped with adequate water cooling to prevent polymer bridging at the feed throat. Temperature controllers should indicate set-point and actual temperatures, as well as percentage of heating/cooling. Extruders should be between 20:1 and 24:1 L/D ratios in length. To minimize the residence time of

K-Resin® SBC in the extruder, extruders having L/D ratios higher than 30:1 should be avoided for blown film extrusion.

Screw Design

The design or selection of the extrusion screw is a major consideration in balancing output rate with melt quality. K-Resin® SBC are shear sensitive and may be degraded by high shear screws. A compression ratio of 3.25:1 is recommended for both barrier and single stage screw designs. High shear mixing sections and mixing pins should be avoided for all screw designs.

Screw designs which have high compression ratios (below 3.5:1 is preferred) or special mixing sections should be avoided where possible, but may be used at lower output rates. Gel counts are generally higher when high compression screw designs or special mixing sections are used.

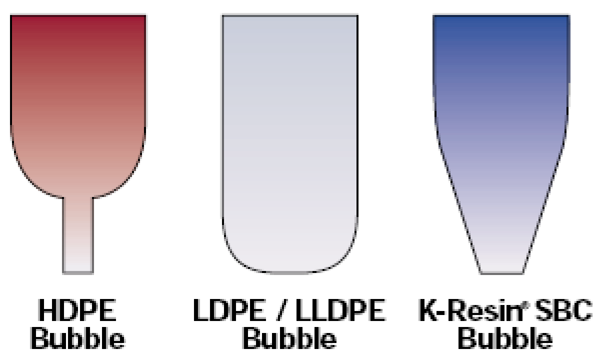
Blown Film Equipment

Film Die

Some conventional bottom fed HDPE or LDPE spiral dies may be used to produce K-Resin® SBC blown film with optimum clarity and toughness. Oscillating or stationary dies may be used. In each case, the die should have no stagnant flow areas. Material residence time within the die should be minimized when processing K-Resin® SBC. A die opening of 35 – 40 mils (0.9 - 1.0mm) will yield a good balance between drawdown ratio and properties for monolayer K-Resin® SBC film. An opening of 40 – 60 mils (1.0 - 1.5 mm) is recommended for coextrusion of K-Resin® SBC with polyolefins. Depending on the die design, larger die openings may result in port lines in the finished film, limit drawdown capability or increase machine direction shrink.

Air Ring

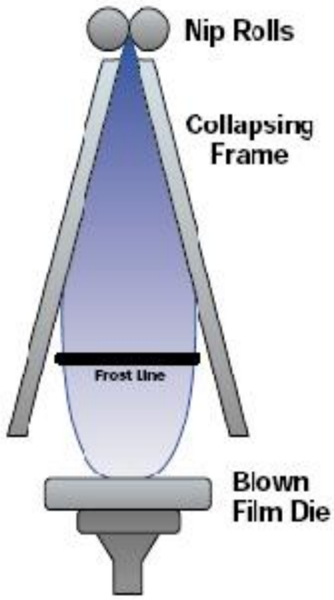
K-Resin® SBC are amorphous materials, therefore they do not undergo a crystalline freezing transition. K-Resin® SBC have relatively high densities, compared to polyolefins, which translate into very efficient heat transfer rates for finished films. These two properties are the reason K-Resin® SBC films production require no special cooling techniques such as internal bubble cooling (IBC) or chilled air at normal processing speeds. The air ring may be a single lip or dual lip design, with certain considerations. Single lip air rings should have short and upright cones and be equipped with a blower capable of controlling the air velocity at very low rates. Air velocity control is critical, and consistency of the air temperature and flow rate around the circumference of the air ring is necessary for maintaining a stable K-Resin® SBC films bubble.



Dual lip air rings should have upright cones and be designed such that low air velocity produces a sufficient venturi effect to lock the bubble in the pocket. If the lower air velocity required for K-Resin® SBC films processing does not produce a sufficient pressure differential in the air ring, the bubble will not remain stable in the pocket. Dual lip air rings with shallow and open cones are not recommended for K-Resin® SBC blown film production due to the shape of the K-Resin® SBC film bubble. However, when coextruding K-Resin® SBC with other polymers, bubble shapes will tend to exhibit the processing characteristics of the other polymer.

Special cooling techniques such as IBC or chilled air are recommended for coextrusion or very high production rates. Auxiliary bubble stabilization techniques such as bubble baskets or an iris can enhance bubble stability for both monolayer and coextruded film production.

Tower and Collapsing Frame



The tower includes the nip rolls, collapsing frame and any connected bubble stabilizers. Its purpose is to collapse the tubular film bubble into a flattened tube which is free of wrinkles and has the same dimensions as the original bubble. Having the die, air ring, collapsing frame and nip rolls perfectly aligned is critical for producing wrinkle free K-Resin® SBC films. The collapsing frame should be designed to contact the bubble a few inches above the frost line. Having the collapsing frame in this position will help keep the bubble stable, which will minimize film wrinkles. The tower should be relatively short, or adjustable, to bring the nip rolls fairly close to the die, 12 – 15 feet (3.6 – 4.6 m). Taller towers maybe used, provided that all equipment is well aligned. In this case, a bubble cage is recommended to insure good stability. Film temperature should be maintained as warm as possible to minimize wrinkles, preferably 110 – 130°F (43 – 54°C). K-Resin® SBC are fairly stiff materials with excellent crease retention, thus if wrinkles are allowed to form, they will be permanently set into the finished film.

The collapsing frame controls the bubble between the top of the die and the nip rolls by using wooden slats, aluminum rollers, or an air frame. Hardwood slats are preferred for monolayer

K-Resin® SBC films because they impart enough drag to maintain bubble stability, but do not scratch the surface of the film if properly maintained. Aluminum rollers are inexpensive and may be used with many types of materials which offer the processors more flexibility. Air frames improve film cooling and in some cases film surface finish due to the absence of film contact with the collapsing frame. However, for this reason, air frames may cool monolayer K-Resin® SBC films too quickly, resulting in wrinkles. EVA or LLDPE polymer may stick to wooden slats unless high levels of slip additives are used. In some cases, employing chilled air will reduce drag on the collapsing frame, but may also cool the bubble too quickly, sacrificing bubble stability control or producing wrinkles. Working with a reputable equipment manufacturer to address the specific requirements for the collapsing frame is strongly recommended.

Nip Rolls

Perfect symmetry of the nip rolls with the die, collapsing frame and winder is necessary for wrinkle free K-Resin® SBC films production. Nip rolls typically consist of one chrome plated and one rubber roll. Oscillating or stationary nip rolls may be used. Temperature control of the rolls is optional. However, heated rolls may significantly reduce line out time and wrinkles when extruding K-Resin® SBC film, while chilled rolls provide improved cooling for polyolefin or coextruded films, which results in increased output rates. The nip rolls must be free of imperfections, including dirt, when processing K-Resin® SBC films, as K-Resin® SBC will reproduce any scratches, rough patches, or dents in the roll surfaces.

General Post Extrusion Equipment

Corona Treater

Conventional treating equipment may be used to increase the surface tension of K-Resin® SBC films. Corona treatment should produce a minimum of 44 – 48 dynes per centimeter surface energy. For best results, treat and print or laminate the film in line. If it is not possible to convert the film in line, the film should be processed as soon as possible (within 48 hours) after treating.

K-Resin® SBC films, like most films, will lose their surface tension over time. The dissipation rate of the surface tension is dependent on initial treatment levels and storage conditions. If the surface tension of K-Resin® SBC films are lower than the level required for printing, the film may be retreated. However, power requirements are generally higher during a second treatment. Therefore, for the same power level of treatment, the surface tension will not be returned to the original level. High storage temperatures will accelerate the loss of surface tension.

Slitter

Standard razor blade knives may be used to slit K-Resin® SBC films to a desired width. Knives should be kept sharp, and slitting should occur as close to the secondary nip rolls and winder as possible. Care should be taken to protect operators from injuries caused by improper slitter design or operation.

Winder

With good tension control, K-Resin® SBC films can be wound successfully on either center or surface winders. Center winders consistently produce higher quality rolls. Regardless of the winder used, it is critical that the winder be properly aligned with the upstream equipment and the film dimensions be maintained without added stress from the primary nip to the slitter. Baggy film or stretched film will hinder wrinkle free roll production.

General Processing

Extruder Startup and Purging

It is very important to start the extrusion of K-Resin® SBC with clean equipment. This can be accomplished by using low melt flow high impact polystyrene (HIPS) of less than or equal to 3 melt flow or commercial purging compounds to purge the system after a fractional melt index polyethylene before changing over to K-Resin® SBC. Introducing K-Resin® SBC to the system at operational rates is recommended, provided the K-Resin® SBC will follow a polymer with at least a 1.0 melt index or higher flow rate, and the operating temperature is 350°F – 400°F (177°C – 204°C). If a higher viscosity material is present in the system or operational temperatures are above 400°F (204°C), the material should be purged from the system prior to introducing K-Resin® SBC. An operating temperature of 350°F (177°C) will minimize K-Resin® SBC degradation when it is introduced into the system after purging. Elimination of all contamination using the purge material can take several hours. When using commercial purging compounds, the manufacturer's recommended processing conditions should be used. The perceived waste of valuable machine time and material during this step is often a motivation for processors to ignore it. More often than not, more material is wasted running scrap film than would have been produced during purging.

Once the system has been purged, temperatures should be set to 350°F (177°C) prior to extrusion of K-Resin® SBC. Residence time of K-Resin® SBC at temperatures above 350°F (177°C) should be minimized at all times, particularly during startup and shutdown. Gels can be readily formed in K-Resin® SBC if the material is idle in the extruder, adaptors or die for extended periods of time. Chevron Phillips Chemical Company LP produces a concentrate SKR19 containing a thermal stabilizer which, when added at 5 percent, will help prevent gel formation and thermal degradation. Caution should be exercised during startup, as cold spots in the system can produce severe equipment damage if not detected. Always allow the system to soak for at least 30 minutes once the temperature set points are reached. It is not recommended to shutdown the system with K-Resin® SBC in the die or extruder.

After the K-Resin® SBC film has been produced and polyethylene film is to be produced a fractional melt index polyethylene will purge the K-Resin® SBC out of the extruders.

Drying

K-Resin® SBC is non-hygroscopic and requires no drying under normal storage and processing conditions. However, should K-Resin® SBC require drying due to surface moisture caused by high humidity, the material should be dried for one hour at 140 °F (60°C) or 110°F (43°C) for no more than 4 hours. Excessive drying at temperatures above 140°F (60°C) may cause pellet blocking or degradation of K-Resin® SBC.

Anti-block & Slip

An anti-block must be used with K-Resin® SBC film to prevent film blocking. A less than 1 micron rubber particle high impact polystyrene to minimize haze can be used as an anti-block (added at ~2 – 3%). Lower levels may not prevent blocking and higher levels will increase the haze level of the finished film. Anti-block is needed when two K-Resin® SBC film layers come into contact during film production, either on a finished roll, or on the inside of the bubble. If K-Resin® SBC are blended with more than 20% GPPS, no anti-block is typically required. Chevron Phillips Chemical Company LP makes a slip/anti-block concentrate, SKR17, which can be added at 1-3 percent. This is specially formulated for K-Resin® SBC and maintains excellent clarity.

Extruder Shut Down

To prevent resin degradation, K-Resin® SBC should not be allowed to heat soak at even moderate temperatures for extended periods of time. Purging K-Resin® SBC from the system at operational rates using a 3.0 melt flow high impact polystyrene is recommended but a fractional melt index LDPE can also be used. This procedure saves time and material, while ensuring that residence time of K-Resin® SBC is minimized. When a shutdown using K-Resin® SBC is necessary, reduce operating temperatures to approximately 330°F (166°C) and idle the extruder at a few rpm to allow some movement of material through the extruder and die. This practice will result in less degradation of the K-Resin® SBC, while minimizing material usage during the temperature change.

Regrind

When reprocessing K-Resin® SBC, use a chopper with sharp blades, narrow clearances and adequate ventilation to avoid heat buildup. Chopped K-Resin® SBC film may be blended back with virgin resin. Multiple passes of K-Resin® SBC through the extrusion process have minimal effect on the film's properties, providing the regrind is not degraded or contaminated. More detailed information is available in TSM 315 "Reprocessing of K-Resin® SB Copolymer."

Blending of Materials

Other packaging films such as EVA and Polystyrene, may be blended with K-Resin® SBC in the film reclaim stream. The effect on film properties depends on the blend composition and levels, as well as the processing conditions of the finished film. More information is available concerning the blend capability of other polymers with K-Resin® SBC from TSM 316 "K-Resin® Styrene – Butadiene Copolymer Blends."

Blown Film Processing Conditions

Melt Temperature

The recommended melt temperature range for K-Resin® SBC blown film production is between 340 – 400°F (182 – 204°C). To maintain this temperature range, set the extruder, transition, and die temperatures at 350°F (177°C). During startup, record each extruder barrel zone's temperature and heating/cooling percentage for several hours. If any zone begins to override in temperature, or calls for 75% cooling or more continuously, then the K-Resin® SBC may be subjected to excessive shear in that zone. In some cases, this may be corrected by increasing the temperature setting of the zone. However, the K-Resin® SBC melt temperature should be maintained below 420°F (218°C), regardless of individual zone modifications.

Table 1

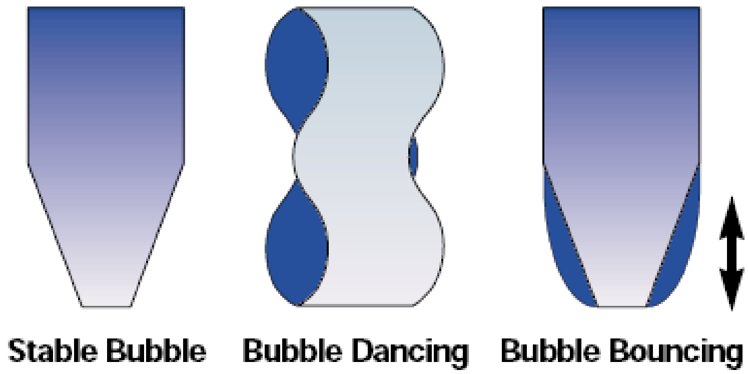
Blown Film Temperature Settings

Extruder Barrel Temperatures, °F(°C)							
Zone 1	**Zone 2**	**Zone 3**	**Zone 4**	**Zone 5**	**Adapters**	**Rotator**	**Die**
340 (171)	350 (177)	350 (177)	350 (177)	350 (177)	380 (193)	380 (193)	380 (193)

Frost Line in Coextruded Multi layer Structures

In the extrusion of K-Resin® SBC blown film, the point where the bubble reaches its final diameter marks the frost line position. This is the point where the film temperature falls below the softening temperature of K-Resin® SBC. The frost line is not typically visible when processing K-Resin® SBC film due to the exceptional clarity of K-Resin® SBC film but can be seen in coex structures. The frost line should be adjusted to stay between two and four die diameters above the die. For the best bubble stability, the collapsing frame should contact the bubble four to six inches above the frost line. If the frame is not low enough, then a bubble basket, iris, or other bubble stabilizer should be used just above the frost line.

Controlling the frost line height is critical to bubble stability and film properties. If the frost line is forced too low, bubble dancing will occur. This will cause wrinkles and gauge inconsistencies. To correct bubble dancing, less air velocity should be used in the air ring. This will reduce cooling, thus allowing the frost line height to move further from the die. Increasing extruder output or decreasing the line speed will have a similar effect. If the frost line height is too high, bubble bouncing, which is a rapid change in frost line position and bubble diameter will occur. This will cause wrinkles and inconsistencies in the film. To correct bubble bouncing, more cooling of the bubble is required. Note the bubble shape diagram, which shows the correct K-Resin® SBC film bubble configuration, along with bubble dancing and bubble bouncing.



K-Resin® Film Properties

K-Resin® SBC film is known for its excellent impact, tensile, and optical properties. Variables such as blowup ratio (BUR), additive level, and gauge can have dramatic effects on film properties such as shrinkage rate, tear properties, oxygen transmission rate, water vapor transmission rate as well as impact properties can be affected. More information is available in Technical Service Memorandum 322 "Physical Properties of K-Resin® SBC Film Structures" with respect to film structure and how they affect properties.

Permeability

K-Resin® SBC film has relatively low barrier properties which makes it attractive in several food packaging applications. Packaged fruits and vegetables require a balance of oxygen, carbon dioxide and water vapor to maintain the ripening process and preserve freshness.

K-Resin® SBC film permeability allows the introduction of oxygen and the release of carbon dioxide and water vapor. K-Resin® SBC film slows the ripening process, however, once the package is opened, normal ripening resumes. This characteristic significantly increases shelf life of the packaged produce. The permeability of K-Resin® SBC film may be altered by using additives such as anti block or by coextrusion of K-Resin® SBC with other types of polymers. This is very beneficial for applications which need a specific oxygen or carbon dioxide transmission rate. The addition of slip and anti-block additives can affect gas or water vapor transmission and oxygen transmission rates when used above recommended levels.

More information is available on permeability of coextruded structures with K-Resin® SBC from TSM 322 "Physical Properties of K-Resin® SBC Film Structures."

Blown Film Shrinkage

Shrinkage of K-Resin® SBC film is determined by a modified version of ASTM D2732. The percent of shrinkage in both the machine and transverse direction is directly related to the degree to which the film is oriented in processing. An increase in transverse direction shrinkage is correlated with an increased blowup ratio. An increase in machine direction shrinkage is correlated with increased drawdown ratio. Shrink film made from K-Resin® SBC is suitable for packaging goods with a variety of shapes and sizes. The low shrink force property, typical of K-Resin® SBC films, allows the film to shrink to the package without deformation of the package. For K-Resin® SBC film, the suggested tunnel temperature range is 325 – 350°F (163 – 177°C). For more information on troubleshooting problems, refer to TSM 302 "Shrink Wrapping With Film Made From K-Resin® SB Copolymers."

Decorating

Corona treatment, at a level of at least 38 – 40 dynes per centimeter, increases the surface tension of K-Resin® SBC film which helps the adhesion of most ink systems. For best results, treat and print or laminate the film in line. If it is not possible to convert the film in line, the film should be processed as soon as possible (within 48 hours) after treating. Inks with a nitro-cellulose base, as well as some water base inks, have been used successfully to print K-Resin® films. For more information, refer to TSM 305 "Decorating Methods for K-Resin® SB Copolymers."

Heat Seal Capability

To produce bags or enclose products in a package, K-Resin® SBC film may be heat sealed utilizing conventional heat sealing techniques. K-Resin® SBC film typically seals under different processing conditions than most other packaging films. Under proper conditions, heat seal strength will approach film strength. For more information, refer to TSM 320 "K-Resin® SB Copolymer Lidding Film Heat Sealing Study."

Coextruded Structures

Coextruded structures using PE, PP, PETG, and EVA can also be used to improve certain properties that may be desired, such as seal capability, chemical resistance, gloss, stiffness and economics. For more information, refer to Technical Service Memorandum 322 "Physical Properties of K-Resin® SBC Film Structures."

Introduction

Even in state of the art operations processing problems may develop. Some of the most common problems found in K-Resin® SBC blow film processing are listed here with causes and solutions.

Blown Film Troubleshooting guide for Mono and coextruded Films

Problems	Possible Causes	Suggested Solutions
Wrinkles	1. Non-uniform bubble.	1. (a) Adjust die opening to obtain a symmetrical bubble. (b) Verify die temperature is consistent around die. (c) Clean air ring. (d) Adjust cooling air velocity.
	2. Collapsing frame not property adjusted or not symmetric.	2. Adjust Collapsing frame.
	3. Die not level.	3. Level Die.
	4. Nip rolls not level.	4. Level nip rolls.
	5. Bubble not stable.	5. (a) Adjust air ring to stabilize bubble. (b) Support bubble just above frost line with bubble basket, iris or similar device. (c) If possible use a coex structure within the core.
	6. Misalignment between nip rolls and die.	6. Nip rolls must be parallel with each other and in same plane. Nip rolls must be aligned over the center of the die.
	7. Improper or inconsistent wider tension.	7. Adjust winder tension.
Excessive gels or black specks in film	1. Dirty die or extruder.	1. Clean die and extruder.
	2. Broken screen pack.	2. Change screen pack.
	3. Contaminated resin feed.	3. (a) Cover feed hopper. (b) Check resin for contamination.
	4. Burned material sluffing off screw.	4. (a) Clean screw. (b) Add SKR19 to material.
	5. Overriding temperature in extruder, adapter, or die.	5. Perform maintenance on cooling system or extruder, adapter, die or replace thermocouple.
	6. Long residence time.	6. Reduce the residence time and make sure that there are no hang up areas in process.
Lines in film	1. Dirty Die.	1. (a) Pull die pin and clean. (b) Purge system. (c) Disassemble and clean die.
	2. Die face buildup.	2. Shut down and clean die face.
	3. Rough edges in collapsing frame scratching film.	3. Remove all rough edges in film path.
	4. Damaged nip roll surfaces.	4. Repair nip rolls.
Bubble instability	1. Running too slowly.	1. Increase screw rpm and nip roll speed.
	2. Room air currents.	2. Enclosure tower or close doors and other sources of drafts.
	3. Uneven air flow from air ring.	3. (a) Adjust air ring to obtain constant air velocity around ring.

Blown Film Troubleshooting guide for Mono and coextruded Films

Problems	Possible Causes	Suggested Solutions
		(b) Clean air ring.
	4. Improper location of collapsing frame.	4. Adjust collapsing frame.
	5. Extruder or tower vibration transmitted.	5. Isolate vibrations.
Bubble bouncing	1. Not enough cooling.	1. Increase air velocity to air ring or decrease air temperature.
	2. Line speed too slow.	2. Increase line speed.
Bubble dancing	1. Too much cooling.	1. Reduce air velocity or increase air temperature.
	2. Line speed to fast.	2. Decrease line speed.
Failures at fold	1. Nip roll pressure too high.	1. Decrease nip roll pressure. This pressure should be just enough to maintain bubble diameter.
Bubble blow outs	1. Gels or black specks in film.	1. See gels and black specks.
	2. Film thickness too low.	2. Increase film thickness.
Poor tear strength	1. Low blowup ratio.	1. Increase blowup ratio.
	2. Lines in film.	2. Clean die lips, extruder and tower.
Extruder surging	1. Solid concentration too high in transition zone.	1. Increase feed zone temperature.
	2. Loss of back pressure.	2. (a) Check for holes in screen pack. (b) Check into tighter screen pack.
	3. Polymer variability.	3. Examine resin for pellet size and melt index variation.
	4. Erratic feed to extruder.	4. Check for plugging in feed throat.
	5. Lack of shear.	5. Check for excessive screw and barrel wear.
	6. Inconsistent resin blend.	6. Check blend for consistency.
Extruder output loss	1. Bridging in feed throat.	1. (a) Decrease feed zone temperature. (b) Check for water circulation problem in feed zone area.
	2. Resin sticking in crew in feed zone.	2. Decrease feed zone temperature.
	3. Lack of shear.	3. Check for excessive screw and barrel wear.
	4. Inconsistent resin blend.	4. Check blend for consistency.
Gauge variation	1. Dip gap not uniform.	1. Measure gap and adjust.
	2. Non-uniform heating around die.	2. Check and replace defective heater bands and/or thermocouples.
	3. Melt temperature too low.	3. Raise die and/or extruder temperatures.
	4. Defects in flow surface.	4. Inspect and repair nicks, gouges, and other defects in flow surfaces of die.
	5. Blockage in flow channel.	5. Shim die. Break down and clean if required.
Chill roll problems ineffective cooling	1. Chill roll fouling.	1. Remove scale from inside chill roll.
	2. Cooling water flow dropping.	2. Inspect and clean all pipes leading to and from chill roll.
	3. Inlet water temperature increase.	3. Check chiller for proper operation.
	4. Additive or wax plateout on chill roll.	4. Clean chill roll surface with solvent.

K-RESIN
Styrene-Butadiene Copolymers
The Smart Choice™

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This product was manufactured in a plant whose quality management system is certified or registered as conforming to the requirements defined in the ISO 9001 Standard.

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