

# TROUBLESHOOTING GUIDE FOR TUBULAR FILM EXTRUSION



## 1 PEBD, PELBD Films or PEBD-PELBD Mixtures

### 1.1 Extrusion

#### High pressure extrusion:

- Use a filter with a wider opening (1)
- Increase the temperature of the head and nozzle (1).
- Lower the extrusion speed.
- Clean the head and nozzle (1).
- Mix the resin with 10 or 20% of another higher flow grade (PEBD or PELBD).
- Incorporate processing assistant.

#### High temperature extrusion:

- Use a filter with a wider opening (1)
- Replace the filter packages.
- Increase the water temperature of the screw feeding area (1).
- Lower the extrusion speed.
- Mix the resin with 10 or 20% of another higher flow grade (PEBD or PELBD).
- Incorporate processing assistant.

#### High variation of flow or extrusion in waves:

- Use an inverse profile, with high temperature in the feeding area and lower temperatures in the transition and pumping areas (4).
- Make sure that the granulometry of the resin and the recovery is as homogeneous as possible; especially ensure that it is free of long grains, (fine) dust particles and flakes (4).
- Verify that the sliding additive is suitable (4).
- Make sure that the extrusion motor and the transmission belts work properly (4).
- Verify with the equipment manufacturer that the screw design is suitable for the processing of the resin, especially in the case of pure linear or rich mixtures of these (4).

#### High power consumption in the extruder:

- Increase the extrusion temperature (5).
- Use a nozzle with a greater diameter and opening (5).
- Reduce the extrusion speed (5).
- Incorporate 10 to 25% of PEBD in the PELBD or the PELBD in the PEAD.
- Replace the set of the gear box in order to achieve greater power at a lower rotation speed (5).

- Use a higher flow resin.
- Verify with the equipment manufacturer that the extrusion screw set is suitable for the type of resin.

#### Wrinkles in the extrusion direction:

- Increase the collapse height (1).
- Increase the frame width or the collapse set. Open the side guides of the bubble.
- Increase the extrusion speed (1).

#### Wrinkles in the transversal direction:

- Decrease the collapse height (1).
- Decrease the frame width or the collapse basket. Open the side guides of the bubble.
- Decrease the extrusion speed (1).

#### Wrinkles in the film edges:

- Adjust the frame width or the collapse set. Open the side guides of the bubble.
- Decrease the cooling air flow (Increase the ring opening or reduce the flow supplied by the blower).
- Reduce the extrusion temperature (1).
- Decrease the extrusion speed (1).
- Increase the blow ratio (1).

#### Low extrusion flow:

- Verify with the equipment manufacturer that the screw design is suitable for the resin processing, especially in the case of pure linear or mixtures with a high content of these (4).
- Incorporate between 10 to 25% of PELBD to the PEAD or PEBD to the PELBD.
- Increase the extrusion temperature.
- Use a mesh package with a wider opening.

#### Dirt deposits on the nozzle tip:

- Reduce the extrusion, head or nozzle temperature (1).
- Incorporate processing assistant.
- Chrome the nozzle surface.

#### Cast fracture or rugged surface:

- Increase the temperature of the head and nozzle (1).
- Increase the extrusion temperature (1).
- Use a nozzle tip with a smaller opening or lower calibrated longitude (Die land).
- Clean the nozzle tip (1).

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- Calibrate the nozzle centering.
- Mix the resin with 10 or 20% of another grade of greater flow (PEBD or PELBD).
- Incorporate processing assistant.

## **Gels, warts or non-cast material:**

- Verify the absence of contaminants in the resins (1).
- Replace dirty, contaminated or broken filter or an excessively large mesh filter.
- Clean nozzle or head, paying special attention to the spiral flow distributor and the coupling ducts to the extruder (1).
- Reduce extrusion temperature (1).
- Use a descendant extrusion profile (with lower temperature in the last areas than the feeding area) or a "V" shaped profile (with lower temperature in the last areas than the feeding area and ascendant in the head and nozzle).
- Verify the absence of cold spots in the head, adaptor and coupling ducts to the extruder.

## **Presence of black spots on the extruder:**

- Replace the mesh package (4).
- Clean the extruder screw, the coupling ducts, the head and nozzle (4).
- Verify the absence of contaminants on the extruder hopper and the resin feeding ducts (4).
- Assess the quality of the resin and the additive concentrates by using another available batch in your stock (4).

## **1.2 Formation of the bubble:**

### **Deformed (Asymmetrical) Bubble:**

- Verify the correct centering of the nozzle and head (4).
- Verify that the polymer temperature is homogeneous along the entire nozzle (4).
- Verify the absence of obstructions in the cooling ring, the air distributor and the feeding air ducts to the ring (4).
- Verify that the cooling ring is correctly centered and leveled.
- Make sure that the opening of the iris in the "vacuum box" of the head is centered with respect to the extrusion nozzle.
- Protect the film from hot or cold air currents that circulate around the work area.

- Make sure that the nozzle, or the core of the head have not become oval-shaped.

### **Vertical instability of the bubble:**

- Decrease the cooling air speed (Increase the ring opening or reduce the flow supplied by the blower).
- Reduce the extrusion temperature (1).
- Lower the extrusion speed (1).
- Increase the blow ratio (1).
- Use a ring with a double air release valve or install a head with an inner bubble cooling system (IBC).

### **Horizontal instability of the bubble:**

- Decrease the cooling air speed (Increase the ring opening or reduce the flow supplied by the blower).
- Reduce the extrusion temperature (1).
- Lower the neck height or cooling line (1).
- Lower the extrusion speed (1).
- Increase the blow ratio (1).

## **1.3 Finished Product:**

### **High Thickness Variation:**

- Reduce the extrusion temperature (1).
- Increase the temperature of the head (1).
- Clean the head and nozzle (1).
- Clean the cooling ring and the air distributor (1).
- Check the centering of the nozzle and alignment of the head (1).
- Assess the uniformity in the extruder flow, by: varying the pressure, turning speed of the screw and power consumption (It may arise in situations in which a high-speed line is operating at a very low speed).
- Check resin, pigment and recovered feed granulometry.

### **Low impact resistance:**

- Raise the neck height or cooling line (1).
- Reduce the extrusion temperature (1).
- Increase the blow ratio (1).
- Increase the extrusion speed (1).
- Clean the head and nozzle (1).
- Low tear resistance in the extrusion direction (MD):
  - Raise the neck height or cooling line (1).
  - Reduce the extrusion temperature (1).

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- Increase the blow ratio (1).
- Use a nozzle tip with a bigger opening (1).

## **Low tear resistance in the transversal direction (TD):**

- Lower the neck height or cooling line (1).
- Decrease the cooling air flow speed (Increase the ring opening or reduce the flow supplied by the blower).
- Reduce the blow ratio (1).
- Increase the extrusion temperature (1).
- Use a nozzle tip with a bigger opening (1).

## **Low brightness and transparency level:**

- Increase 10 to 20°C the nozzle, head or extrusion profile temperature in the described effective order (4).
- Raise the air flow or reduce the cooling air temperature (4).
- Incorporate between 10 and 25% of PEBD if the film is PELBD, without exceeding the total PEBD mixture content of 35%.

## **Yellowish colored film:**

- Reduce the extrusion, head and nozzle temperature (4).
- Reduce the extrusion speed (4).
- Verify the correct operation of the temperature controllers.
- Check the volatile and antioxidant additive content of the resin.

## **Blocked film:**

- Reduce the roll tension (1).
- Raise the cooling air flow or reduce the cooling air temperature (1).
- Increase the height of collapse set.
- Reduce the extrusion, head and nozzle temperature (5).
- Reduce the extrusion speed (1).
- Increase the anti-blocking additives dose.
- Verify that the treatment intensity is suitable (If possible, reduce the intensity) (6).
- Refrigerate the collapse rollers.
- Use a higher density resin (5).

## **Film with printing defects:**

- Increase the treatment intensity (1).
- Eliminate Wrinkles in film (1).
- Verify the sliding additives dose (1).

- Verify the absence of contaminating fats or lubricants on the film surface (4).
- Install the treatment equipment as close to the bubble collapse rollers as possible (4).
- Verify that the treatment operates properly.
- Verify the quality of the inks using another available lot from your stock.

## **Presence of scratches in the film:**

- Clean the head or nozzle (4).
- Verify that the nozzle surface is damage free (marks, bumps, etc.) (4).
- Use products with process assistant or increase the dose of same (4).
- Increase 10 to 20°C the nozzle temperature.
- Verify that the rollers in the pull and collapse system are clean and are spinning without problems (lubricate its bearings).
- Use low friction collapse sets (mobile rollers, plush or air-cushioned rollers).

## **Presence of cloudy or dull longitudinal bands:**

- Adjust the air flow and the air cooling temperature in the bubble (4).
- Verify the absence of obstructions in the cooling ring and the feeding air ducts to the ring (4).
- Use materials with process assistant or increase the dose of same.
- Check with the equipment manufacturer the cooling ring design and the flow distributor of the head so that they are suitable for the processed material.
- a.4) Rolling:
- Collapse of the roll cores:
- Reduce the rolling tension (4).
- Increase the cooling air flow, reduce the cooling air temperature or decrease the extrusion temperature (4).

## **Excessive variation in the film width:**

- Control the bubble stability (See horizontal instability of the bubble).
- Verify that the pulling speed in the equipment remains constant.
- Make sure that the tension control devices allow maintaining a constant pulling tension.
- Make sure that the extrusion flow pumped by the extruder remains constant.

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## **Lack of tension in the central area of film (Baggy):**

- Adjust the film thickness all throughout same (6).
- Verify that the temperature along the entire nozzle perimeter is constant (6).
- Protect the bubble from hot or cold air currents that circulate around the work area (6).
- Replace or rectify the rollers which have concave defects (6).

## **Telescoping of the roll:**

- Increase the rolling tension (4).
- Make sure that the sliding level of the resin is suitable (4).
- Verify the correct alignment of the rolling unit with the cooling tower and the extrusion head (4).

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## 2 PEAD films with high molecular weight:

### 2.1 Extrusion:

#### Low extrusion flow:

- Verify the water flow cooling the cylinder feeding area (3 to 5 gal/min) (2).
- Reduce the water temperature cooling the cylinder feeding area (2).
- Verify the absence of obstructions in the extrusion screw feed, especially the forming of bridges in the hopper discharge.
- Reduce the temperature in the screw feeding area.
- Verify the absence of damages on the screw surface of the feeding area, especially during the first 2 or 3 spins of the helix.
- Make sure that the wear level of the screw (expressed by the tolerance between the screw and the cylinder) is not excessive.

#### Dirt deposits on the nozzle tip:

- Reduce the extrusion, head or nozzle temperature (1).
- Incorporate processing assistants.
- Chrome the nozzle surface.

#### Presence of flow lines of the head:

- Raise the head temperature in 5°C until the lines disappear (2).
- Verify the correct operation of the heating bands and of the temperature controller (2).

#### Frequent rupture of the bubble:

- Use a descendant extrusion temperature profile in order to increase the cutting effect produced by the screw (2).
- Clean the nozzle and the head.
- Replace the mesh package of the extruder.
- Do not leave the extruder on for long periods of time if the screw is not operating.
- Verify the correct operation of the temperature controllers.
- Incorporate 10 to 20% of PELBD of fractioned MFI.

#### Overheating of the heat areas of the screw:

- Increase the temperature of the overheated area (2).

- Check the operation of the temperature controller (2).
- Verify the correct installation of the Termopar.
- Verify the correct operation of the blower refrigerating the area.
- Reduce the extrusion speed.

#### Irregular tension or pulses in the extrusion direction (Longitudinal surging):

- Verify that the pulling tension is constant (2).
- Adjust the tension of the pulling rollers (2).
- Verify that the pulling and retracting system rollers spin freely. Lubricate the bearings (2).
- Assess the uniformity in the extruder flow, by: varying the pressure, turning speed of the screw and power consumption (It may arise in situations in which a high-speed line is operating at a very low speed).
- Check resin, pigment and recovered feed granulometry.

#### Irregular tension or pulses in the transversal direction (Transverse surging):

- Verify that the nozzle is correctly centered (2).
- Make sure that the cooling ring is correctly centered and leveled (2).
- Clean the cooling ring and its air distributor (2).
- Make sure that the longitude and diameter of the cooling ring air feeding ducts are the same in all of them (2).
- Verify the absence of air leaks in the cooling ring air feeding ducts (2).
- Protect the bubble from the effects of hot or cold air currents (2).

### 2.2 Formation of the bubble:

#### Deformed (Asymmetrical) Bubble:

- Verify the correct centering of the nozzle and head (4).
- Verify that the polymer temperature is homogeneous along the entire nozzle (4).
- Verify the absence of obstructions in the cooling ring, the air distributor and the feeding air ducts to the ring (4).
- Verify that the cooling ring is correctly centered and leveled.
- Make sure that the opening of the iris in the "vacuum box" of the head is centered with respect to the extrusion nozzle.

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- Protect the film from hot or cold air currents that circulate around the work area.
- Make sure that the nozzle or the core of the head have not become oval-shaped.

## 2.3 Finished Product:

### High Thickness Variation:

- Reduce the extrusion temperature (1).
- Increase the temperature of the head (1).
- Clean the head and nozzle (1).
- Clean the cooling ring and the air distributor (1).
- Check the centering of the nozzle and alignment of the head (1).
- Assess the uniformity in the extruder flow, by: varying the pressure, turning speed of the screw and power consumption (It may arise in situations in which a high-speed line is operating at a very low speed).
- Check resin, pigment and recovered feed granulometry.

### Low impact resistance:

- Raise the neck height or cooling line (1).
- Incorporate 10 to 15% of PELBD (fractioned MFI).
- Reduce the extrusion temperature (1).
- Increase the blow ratio (1).
- Increase the extrusion speed (1).
- Clean the head and nozzle (1).

### Low tear resistance in the extrusion direction (MD):

- Raise the neck height or cooling line (1).
- Incorporate 10 to 15% of PELBD (fractioned MFI).
- Reduce the extrusion temperature (1).
- Increase the blow ratio (1).

### Low tear resistance in the transversal direction (TD):

- Lower the neck height or cooling line (1).
- Incorporate 10 to 15% of PELBD (fractioned MFI).
- Decrease the cooling air flow speed (Increase the ring opening or reduce the flow supplied by the blower).
- Reduce the blow ratio (1).
- Increase the extrusion temperature (1).

### Yellowish colored film:

- Reduce the extrusion, head and nozzle temperature (4).
- Reduce the extrusion speed (4).
- Verify the correct operation of the temperature controllers.
- Check the volatile and antioxidant additive content of the resin.

## 2.4 Rolling:

### Non-homogeneous roll:

- Verify that the bubble guides, the collapse set, tower and roller are perfectly aligned (2).
- Verify that the pressure exerted by the bubble guides is not excessively low or excessively high.
- Verify that the pulling and retracting system rollers spin in a homogeneous manner. Lubricate the bearings and use rollers with a low friction rate.
- Verify the air in the rollers collapse back.

### Collapse of the roll cores:

- Reduce the rolling tension (4).
- Increase the cooling air flow, reduce the cooling air temperature or decrease the extrusion temperature (4).

### Excessive variation in the film width:

- Control the bubble stability (See horizontal instability of the bubble).
- Verify that the pulling speed in the equipment remains constant.
- Make sure that the tension control devices allow maintaining a constant pulling tension.
- Make sure that the extrusion flow pumped by the extruder remains constant.

### Lack of tension in the central area of film (Baggy):

- Adjust the film thickness all throughout same (6).
- Verify that the temperature along the entire nozzle perimeter is constant (6).
- Protect the bubble from hot or cold air currents that circulate around the work area (6).
- Replace or rectify the rollers which have concave defects (6).

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## **Telescoping of the roll:**

- Increase the rolling tension (4).
- Make sure that the sliding level of the resin is suitable (4).
- Verify the correct alignment of the rolling unit with the cooling tower and the extrusion head (4).

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## 3 Co-extruded films:

### 3.1 Extrusion:

#### Presence of parabolic flow lines in the extrusion direction:

- Use materials with a greater flow in the outer layers of the structure (3).
- Increase the extrusion temperature of the materials in the outer layers of the structure (3).
- Increase the nozzle temperature (3).
- Reduce the total extrusion flow (3).
- Use a nozzle with a wider opening (3).
- Use processing assistants in the outer layers of the structure (3).
- Increase the thickness to the contribution of the outer layers of the structure (3).
- Use materials with greater resemblance in regards to viscous-elastic properties (3).

### 3.2 Formation of the bubble:

#### Deformed (Asymmetrical) Bubble:

- Verify the correct centering of the nozzle and head (4).
- Verify that the polymer temperature is homogeneous along the entire nozzle (4).
- Verify the absence of obstructions in the cooling ring, the air distributor and the feeding air ducts to the ring (4).
- Verify that the cooling ring is correctly centered and leveled.
- Make sure that the opening of the iris in the "vacuum box" of the head is centered with respect to the extrusion nozzle.
- Protect the film from hot or cold air currents that circulate around the work area.
- Make sure that the nozzle or the core of the head have not become oval-shaped.

### 3.3 Finished Product:

#### Low impact resistance:

- Raise the neck height or cooling line (1).
- Increase to the contribution of the linear layers or increase the Octene dose in the structure.
- Reduce the extrusion temperature (1).
- Increase the blow ratio (1).
- Increase the extrusion speed (1).
- Clean the head and nozzle (1).

#### Low tear resistance in the extrusion direction (MD):

- Raise the neck height or cooling line (1).
- Increase to the contribution of the linear layers or increase the Octene dose in the structure.
- Reduce the extrusion temperature (1).
- Increase the blow ratio (1).

#### Low tear resistance in the transversal direction (TD):

- Lower the neck height or cooling line (1).
- Increase to the contribution of the linear layers or increase the Octene dose in the structure.
- Decrease the cooling air flow speed (Increase the ring opening or reduce the flow supplied by the blower).
- Reduce the blow ratio (1).
- Increase the extrusion temperature (1).
- Use a nozzle tip with a bigger opening (1).

#### Excessive cloudiness of the film:

- Use materials with a greater flow in the outer layers of the structure (3).
- Increase the extrusion temperature of the materials in the outer layers of the structure (3).
- Increase the nozzle temperature (3).
- Reduce the total extrusion flow (3).
- Use a nozzle with a wider opening (3).
- Use processing assistants in the outer layers of the structure (3).
- Increase the thickness to the contribution of the outer layers of the structure (3).
- Use materials with greater resemblance in regards to viscous-elastic properties (3).

#### Lack of uniformity in the thickness of the layers:

- Reduce the extrusion speed (3).
- Increase the extrusion temperature of the materials in the outer layers of the structure (3).
- Use a nozzle with a wider opening (3).
- Use processing assistants in the outer layers of the structure (3).
- Use materials with a greater flow in the outer layers of the structure (3).
- Increase the thickness to the contribution of the outer layers of the structure (3).

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- Use materials with greater resemblance in regards to viscous-elastic properties (3).
- Assess the flow distributor design of the head.
- Make sure to maintain a variation of temperature of each extruder no greater than 2°C (3).
- Install a static mixer in the duct that takes the polymer from the extruder to the head (3).

## **Lack of uniformity in the thickness of the layers of the extrusion direction:**

- Make sure to achieve variations in the pumping pressure in each extruder lower than 1% (3).
- Increase the counter-pressure in each extruder (Close the flow restriction screw in the coupling duct of the head or install a thinner mesh package) (3).
- Verify that the wear level of each screw is not excessive (3).
- Verify the absence of obstructions in the feeding hopper of each product (3).
- Verify the correct operation of the extruder motors and of the pulling unit (3).
- Isolate the bubble from turbulences in the atmosphere air (3).
- Adjust the inner cooling pressure control system of the bubble (3).

## **Rough interface of the layers:**

- Apply similar corrective actions as those described for solving excessive cloudiness (3).

## **Mixture of materials that comprise the different layers of the structure:**

- Apply similar corrective actions as those described for solving excessive cloudiness (3).

## **Yellowish colored film:**

- Reduce the extrusion, head and nozzle temperature (4).
- Reduce the extrusion speed (4).
- Verify the correct operation of the temperature controllers.
- Check the volatile and antioxidant additive content of the resin.

## **Surface with extruded fracture:**

- Apply similar corrective actions as those described for solving excessive cloudiness (3).

## **3.4 Rolling:**

### **Collapse of the roll cores:**

- Reduce the rolling tension (4).
- Increase the cooling air flow, reduce the cooling air temperature or decrease the extrusion temperature (4).

### **Excessive variation in the film width:**

- Control the bubble stability (See horizontal instability of the bubble).
- Verify that the pulling speed in the equipment remains constant.
- Make sure that the tension control devices allow maintaining a constant pulling tension.
- Make sure that the extrusion flow pumped by the extruder remains constant.

### **Lack of tension in the central area of film (Baggy):**

- Adjust the film thickness all throughout same (6).
- Verify that the temperature along the entire nozzle perimeter is constant (6).
- Protect the bubble from hot or cold air currents that circulate around the work area (6).
- Replace or rectify the rollers which have concave defects (6).

### **Telescoping of the roll:**

- Increase the rolling tension (4).
- Make sure that the sliding level of the resin is suitable (4).
- Verify the correct alignment of the rolling unit with the cooling tower and the extrusion head (4).

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- f) Troubleshooting Guide, SABIC.

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