



**Tech Bulletin**  
Cast Film & Extrusion Coating

## Die Lip Buildup: Causes and Remedies

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### What is Die Lip Buildup?

Die lip buildup (DLBU) or die drool is the gradual accumulation of material on the die lips or at the exit of extrusion dies. DLBU can be a chronic problem in high-output cast film or extrusion coating operations and is generally more likely to occur when extruding polymer blends that are highly filled or pigmented.

As the buildup accumulates, it degrades and may eventually create visible defects or gauge variations in the film. These deposits must be physically scraped or removed from the die causing lost production time, film waste, and increased operating expenses.

NOVA Chemicals has studied DLBU extensively and developed this memo as a general guide to help troubleshoot and reduce or eliminate DLBU problems.

### Causes of Die Lip Buildup

There are many causes of DLBU and no single or universal solution has been identified that will eliminate DLBU in all systems. However, recent studies at NOVA Chemicals and published literature suggest that addressing the following factors can reduce chronic DLBU:

#### Die Exit Geometry

DLBU is more common in die exits that form 90° angles or have converging geometry. Several studies have shown that die exits with flared or diverging angles accommodate die swell at the exit and are less prone to buildup.

#### Component Separation and/or Entrapped Moisture

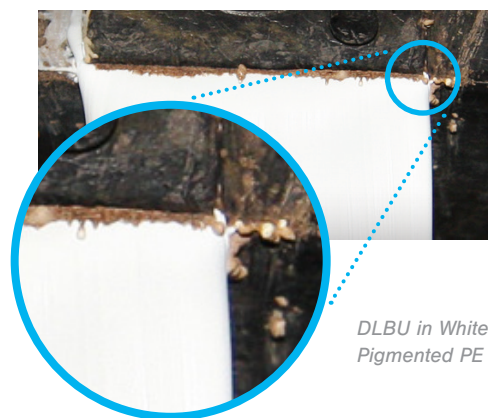
Blends of polymers with additives or inorganic materials are frequently prone to separate in high-shear, high-temperature extrusion processes. The separation of lighter components often leads to die deposits. Moisture entrapped in the polymer or blend components can accelerate separation and buildup.

#### Melt Pressure and Die Exit Velocity

Elevated pressures and exit velocities can create a vacuum or vortex at the die exit. This vacuum can pull lighter components onto the die lips. Reducing melt pressures and exit velocities can reduce the vacuum and DLBU.

#### Polymer Architecture

Polymers exhibiting die swell and polymers with broader molecular weight distributions are often prone to generate DLBU. However, the lower molecular weight fractions of some broad molecular weight distribution (MWD) polymers may act as lubricants that reduce shear induced separation and thus reduce DLBU. Therefore, the best polymer architecture will depend on the specific blend and processing conditions.



*DLBU in White Pigmented PE*

Polymers exhibiting die swell and polymers with broad molecular weight distributions are typically more prone to generate Die Lip Buildup.

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## Troubleshooting Die Lip Buildup Problems

NOVA Chemicals recommends the steps listed here to troubleshoot DLBU problems. Since these recommendations will result in lost production time, consider running simulations on a smaller scale extruder with the same materials and similar processing conditions if possible.

1

Systematically remove blend components to isolate the source. If any components such as color concentrates are hygroscopic, test the material after complete drying to less than 0.05 weight % moisture.

2

Substitute the primary polymer with an alternate. Determine the effects of properties such as molecular weight distribution, viscosity, and additive types and levels.

3

Inspect the die exit for wear and surface irregularities. Notches or nicks at the die exit can create different flow patterns leading to polymer adhesion and buildup.

4

Evaluate a wider die exit if possible by mechanically opening the gap.

5

Analyze the actual buildup for compositional analysis. Information related to the molecular weight and chemical composition can help identify to root cause.

## Potential Remedies to Die Lip Buildup Problems

Many chronic DLBU problems do not have a single solution and may require multiple remedies. Consider the following recommendations:

### Change the Die Exit Geometry

Using a diverging die exit can reduce the polymer melt pressure and velocity at the exit. NOVA Chemicals recommends evaluating alternate exit geometries on smaller equipment first and consulting your machinery manufacturer before making any permanent changes.

### Evaluate a Process Aid to Specifically Address DLBU

While most process aids are designed to eliminate melt fracture, certain process aids are very effective at reducing or eliminating DLBU.

### Plate or Coat the Die Interior

Uniform metallic coatings that resist abrasion and oxidation can reduce DLBU by reducing shear and polymer adhesion at the die walls. Finally, consider changing base materials, blend components, additives, and/or processing conditions. In general, blend components with similar rheological profiles are preferred. Drying or replacing hygroscopic components of blends can also reduce DLBU and improve film quality.



DLBU in Strand  
Die Control Sample



Control Sample with  
Specific Process Aid

### Publications and References

Chai, Choon K.; Adams, Gordon; Frame, Jason "Polyethylene Die Deposit - Measurement, Formation Mechanism, and Routes to Reductions" Annual Technical Conference - Society of Plastics Engineers (2001), 59th (Vol. 1), 401-406

Chaloupkova, K.; Zatloukal, M. "Theoretical and Experimental Analysis of Die Drool Phenomena for Metallocene LLDPE" Polymer Processing and Science - 2007. 871 - 881.