PROTECT YOUR ASSETS

Troubleshooting Extrudate Issues:
Shark Skin

Practical Content Delivered by EDI® Extrusion Die Experts

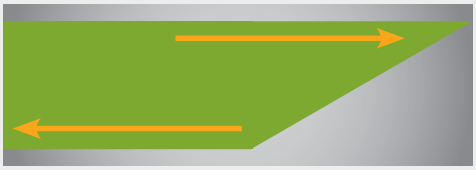
Using Rheology Data to Design & Build a Die

Rheology is the study of how a fluid-like material, like melted polymer, flows and changes.

Nordson uses rheology data to optimize our die manifolds for each customer's specific processing parameters. This means understanding how several characteristics, including viscosity and the shear rate, will impact production.

Shear Rate

The rate at which the polymer melt changes shape (deforms) during the production process due to friction caused as the melt flows through the internal die channels.



Viscosity

A measure of the resistance to flow.

A material with high viscosity will be thicker and less fluid than a material with a low viscosity measurement.

Many of the processors that we've worked with have developed and diligently adhere to a strict Preventive Maintenance (PM) schedule. This process has enabled them to reduce downtime and avoid costly repairs, especially when it comes to their extrusion die system.

But sometimes even the most organized operations can face unexpected production stoppages that require extensive troubleshooting to solve issues related to product quality. Unlike many routine maintenance practices that may only require adjusting or changing a singular component, issues with the appearance of your film or sheet could result from one or more factors that are often not related to the die.

By using a systematic approach to define the problem, sort through possible causes, and then develop a solution, future product quality issues may be minimized. Our service and technical support experiences in the field have enabled us to identify some common causes for these variances in product aesthetics, helping to fast track your troubleshooting process.

Dealing with Shark Skin (Rough Surface)

A rough surface, or shark skin, may be caused by a phenomenon known as melt fracture. Melt fracture is created when there is excessive shear stress (the result of high shear rate and/or high viscosity of the polymer melt) in the die lip land area.

Shear rates can be affected by output rates and die lip gap sizes. For example, high output rates and small lip gap sizes will result in greater shearing and deformation of the melt.

Viscosity can be affected by the melt temperature used during the production process. Lower melt temperatures increase the viscosity of the flow material, making it thicker and more difficult to move throughout the die.

When shear rates and viscosity are both increased, processors often see melt fracture as the polymer begins to stick and then release from the die's internal flow cavity. This creates a wave pattern in the film or sheet's surface and can result in small breaks (or fractures) in the appearance.

Do you need additional support? Scan our QR code with your phone for more details about the services offered by the EDI® Field Service team!

Troubleshooting Extrudate Issues *Shark Skin/Rough Surface*

Polymer Processing Aids

In some cases, a polymer processing aid (such as fluoropolymer additives) in trace amounts can help resolve a shark skin appearance. Fluoropolymers coat the die flow surfaces and can induce partial wall slip, lowering the shear rate considerably when compared to a zero slip boundary condition. The material touching the lip land has some velocity so the plastic is sheared less than a case where the material at the die wall is stationary.

Possible Causes of Shark Skin (Rough Surface)

Possible Factor	Process Adjustment Needed	Additional Notes for Your Team
Die Gap *Very Common Issue*	If the operating lip gap is too small, the polymer velocity can be very high. Increase the die gap to lower the shear stress.	Lowering shear stress also helps to improve coextrusion stability.
Output Rate	High output rates can contribute to melt fracture. Reduce the output rate to reduce both the melt velocity and the shear stress.	
Low Melt Temperature	Low melt processing temperatures will increase the viscosity of the melt. To help decrease viscosity and the shear stress, increase the melt processing temperature	
Low Die Temperature	Increase the die temperature zone setpoints.	

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