THE SECRET TO DRIVING EFFICIENCY AND QUALITY IN POLYOLEFIN MANUFACTURING AND PROCESSING

How to select a polymer processing aid (PPA) that can improve polyolefin processing and provide customers with clearer plastics.

EXECUTIVE SUMMARY

In the world of polyolefin processing, the smallest details can pack the biggest punch in terms of a manufacturer or processor's bottom line. In a business where competition drives the need for speed and efficiency, choosing the right polymer processing aid (PPA) can mean the difference between a productive and profitable operation and one that is plagued by regular shutdowns and sluggish throughput and production time. In an industry where customers are demanding that their plastics get thinner, lighter, tougher, and clearer—quality and performance are more essential than ever.

Manufacturers and processors are feeling the squeeze, but for an established operation, switching to a new, and potentially more efficient, high-quality PPA can feel like an unnecessary risk. This paper will help manufacturers and processors see the big picture when it comes to PPA selection and ultimately help them select a PPA that can increase efficiency and mitigate the perceived risk.

So many options... so little time

It is hard to imagine how polyolefin production could be commercially successful without PPAs. They can lower surface friction and allow for an easier flow in the extruder—bringing better process stability, higher outputs, and better film surface quality. But no two types of PPAs are alike, and many of them come with some noticeable limitations that can dramatically impact performance and total cost. As a result, choosing the right one can be tricky. Let's break down the most popular types of PPAs.

PPA TYPE	PROS	CONS
Waxes	▪ Very inexpensive	▪ Propensity to bloom and cause defects ▪ Higher cost due to higher concentration dose ▪ Organoleptic issues and deteriorates mechanical properties
Stearates	▪ Very inexpensive ▪ Slightly more effective than waxes	▪ Propensity to bloom and cause defects ▪ Higher cost due to higher concentration dose ▪ Higher concentration can lead to die buildup ▪ Organoleptic issues
Silicones	▪ Strong throughput, torque, and die pressure buildup benefits, especially in high-speed lines	▪ Limited thermal stability ▪ Higher cost due to higher concentration dose
Pure Fluoroplastics	▪ High thermal stability (up to 340 °C)	▪ Very expensive in pure form

PPA TYPE	PROS	CONS
Fluoroplastic PEG blend *(PCL blend is not available for fluoroplastics)*	▪ Lower cost due to lower concentration dose ▪ Will work at higher shear rates, especially for wire and cable applications	▪ Slightly reduced thermal stability performance compared to pure fluoroplastics (to a maximum of 230 °C) ▪ High PEG dosing can sometimes negatively impact the printability of films and lead to screw slippage
Pure Fluoroelastomers	▪ Among the most efficient processing additives ▪ High thermal stability (up to 300 °C)	▪ Very expensive in pure form
Fluoroelastomer blends *(Combines fluoroelastomers with a synergistic interfacial agent (processing agent))*	▪ Lower cost due to lower concentration dose	▪ Limited thermal stability (except in the case of fluoroelastomer PCL blends)
Fluoroelastomer PEG blends *(A fluoroelastomers blend that uses polyethylene glycol (PEG))*	▪ Lower cost due to lower concentration dose ▪ Superior performance in low-shear-rate applications	▪ Slightly reduced thermal stability performance compared to pure fluoroelastomers (to a maximum of 230 °C) ▪ High PEG dosing can sometimes negatively impact the printability of films and lead to screw slippage
Fluoroelastomer PCL blends[1] *(A fluoroelastomers blend that uses polycaprolactone (PCL))*	▪ Lower cost due to lower concentration dose ▪ High thermal stability compared to pure fluoroelastomers (up to 300 °C) ▪ Lacks printability issues or potential screw slippage of PEG blends	▪ None

[1]Exclusive to Viton™ FreeFlow™ from Chemours.

With Older, More Traditional PPAs, You Get What You Pay For

Before more advanced PPAs became widely available, manufacturers and processors turned to waxes and stearates. Both carry low price tags and provide slip benefits, but there are some significant quality and efficiency limitations that have caused them to go out of favor in the industry in recent years.

You need more to do less.

While the price tag for traditional additives might be attractive, unfortunately manufacturers and processors will need much higher concentrations to deliver performance that is equal to (or less than) more advanced PPAs.

They don't pass the sniff test.

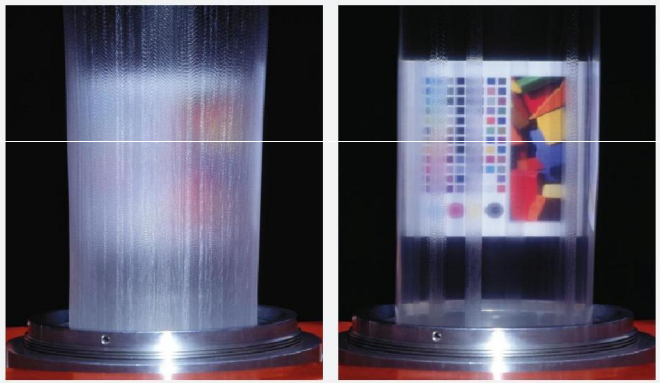
Traditional additives like metal stearates and waxes can have significant organoleptic issues, releasing a foul-smelling odor.

They can have unintended additive interactions.

The performance of more traditional PPAs can be dramatically reduced due to negative interactions with other additives, such as antiblock. This would require the manufacturer or processor to add more PPA to counteract the additive, spending more money.

They increase scrap and waste at start up.

Traditional PPAs take longer to act at start up, and a higher dosage is required to eliminate shark skin. This reduces production throughput and increases waste.



Older types of PPAs take longer to be effective and eliminate shark skin

Fluoroelastomer PPAs: Worth the Investment

Fluoroelastomers first appeared in polyolefin manufacturing and processing in the 1960's. While their purchase prices tend to be higher than more traditional options, manufacturers and processors have come to appreciate their efficiency and quality benefits, which drive down costs over the long term.

Fewer negative interactions with other additives

Many fluoroelastomer blends underperform in the presence of other additives, such as antiblock or HALS. This means manufacturers are likely to need to add more PPA to counteract the antagonistic effect of other additives, increasing the cost and potentially reducing output. Some advanced PPAs are formulated with proprietary additives to resist negative interactions and enhance performance in challenging formulations.

Less production time

Fluoroelastomer blends help manufacturers and processors make clear film faster than other PPAs. As the melt fracture in films is reduced, they can see improved production rates, simpler transitions, and reduced yield loss. By keeping the die face cleaner, the potential for product scrap or re-work caused by die lines is reduced.

Less material

With more advanced fluoroelastomer blends, a little goes a long way. Despite the higher initial price tag for fluoroelastomer blends, these advanced PPAs actually cost less in the long run. Manufacturers and processors can use significantly less PPA to achieve the same—or better—performance as other PPAs. In fact, one type of fluoroelastomer blend, Viton™ FreeFlow™ fluoroelastomers, enable processers to use 30 percent less PPA than other options.

Decreased downtime

Fluoroelastomer blends prevent the accumulation of resin particles at the die exit, eliminating the major cause of die buildup and reducing the downtime required for cleaning. This allows for smoother, more continuous production with longer intervals between downtime for maintenance.

Amplified throughput

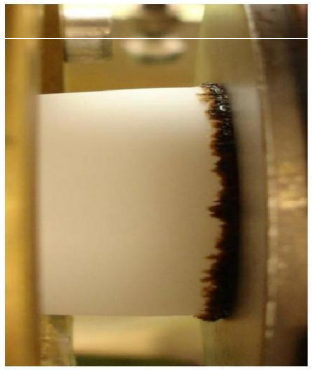
By allowing easier processing and fewer negative interactions with other additives, fluoroelastomer blend PPAs enable manufacturers and processors to push the limits of manufacturing to higher temperatures to maximize throughput. They offer more consistent performance over a broader range of processing conditions, while minimizing discoloration caused by melt fracture.

Higher quality, clear resin

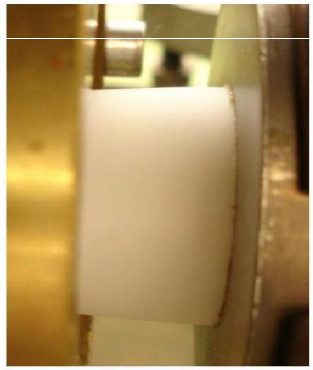
More advanced PPAs improve the clarity of the finished product. In blown film applications, many fluoroelastomer blends prevent sharkskin melt fracture, leading to smooth, clear film with high-gloss finish. For pipes and cables, they reduce die build-up, which reduces the potential for die lines and improves the surface finish.

Shark skin on blown film extrusion

Melt fracture cleared with use of Viton™ FreeFlow™ in blown film extrusion



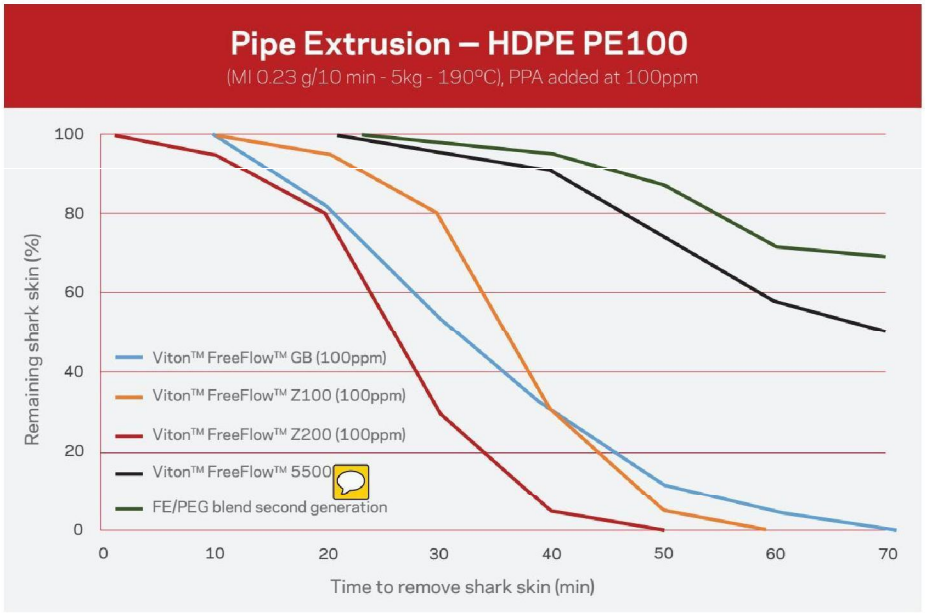
Die build-up formation after 1 hour extrusion without PPA

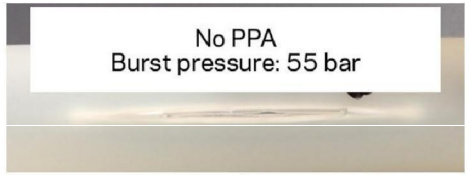


Almost non-existent die build-up using Viton™ FreeFlow™ after days of extrusion

Cost-Benefit Analysis: Pipes

- Significantly lower PPA content to eliminate surface defect up to 50% less
- Eliminate die deposit, significantly reduce downtime for cleaning
- Lower die pressure leads to higher throughput, up to 10%
- Improved surface smoothness, leading to better physical properties such as burst pressure





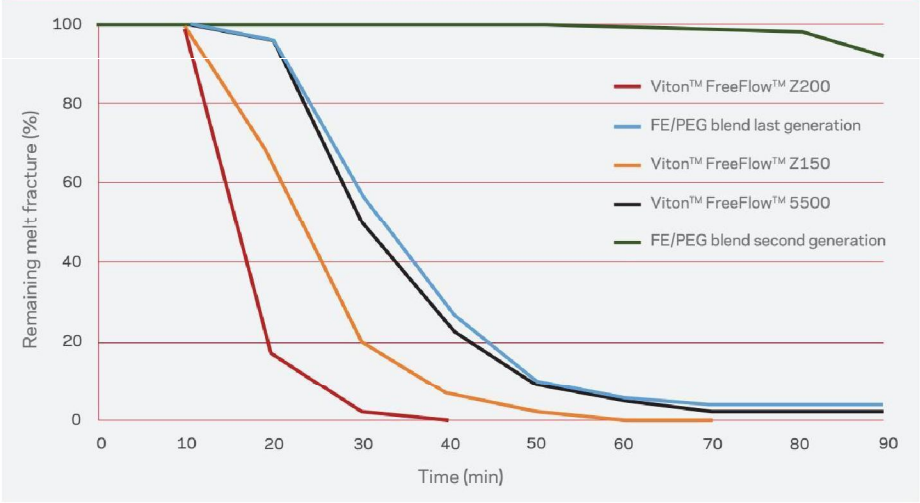
Pipe extruded without PPA. Rough surface, lower physical properties.

Pipe extruded with Viton™ FreeFlow™. Smooth inner and outer surface, improved concentricity, gauge and positive effect on material properties.

Cost-Benefit Analysis: Films

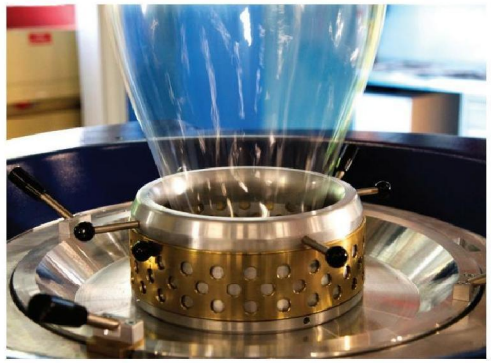
- Viton™ FreeFlow™ Z-technology outperforms other PPAs in presence of antagonists
- Low dosage required, 30 to 50% less
- Improved output in challenging formulations
- Fast die coating resulting in reduced scrap at startup

Blown Film Test – Melt Fracture Elimination



Time to eliminate melt fracture in blown film extrusion:

Shear rate: 400sec-1
Host resin: LLDPE MFR 1g/10min at 190°C, 2.16kg
Antiblock: 3000ppm of synthetic silica
PPA content: 300ppm



Smooth appearance and clear film with high gloss

About Viton™ FreeFlow™ Fluoroelastomers

With Viton™ FreeFlow™, you can do more with less.

When it comes to polyolefin manufacturing and processing, Viton™ FreeFlow™ is the additive of choice. With lower dosage requirements than competitive products by at least a factor of two to three[2], manufacturers and processors get the same throughput, with the highest product quality…all while lowering operating costs. And, because Viton™ FreeFlow™ has fewer negative reactions with other additives, customers can rely on it to deliver consistently efficient performance throughout their operations.

Why Viton™ FreeFlow™?

- **More cost-effective production with increased output and decreased waste** by eliminating melt fracture in blown films and reducing die buildup in extrusions.
- **Produces clear, high-quality films** with a consistent surface finish without impact to properties or performance.
- **Keeps customers running and prolongs equipment life** by reducing die buildup and enabling them to operate at lower pressures.
- **Delivers highest throughput** and enables customers to achieve the smoothest startup.
- **Performs extremely well in the presence of other additives**, reducing the need to increase dosage and costs.

Viton™ FreeFlow™ Z-Technology –
twice as fast with half as much[3].

The latest innovation in the Viton™ FreeFlow™ line is Viton™ FreeFlow™ Z-Technology. By allowing easier processing and fewer negative interactions with other additives, it gives customers better film faster and delivers significant improvements to their bottom lines. The U.S. patent-pending technology raises the bar for processing performance levels.

For more information, visit **Viton.com/Efficiency** or call a Viton™ FreeFlow™ technical expert: **1-[redacted]**.

Viton™ FreeFlow™
Fluoroelastomers

Chemours™

[2]"The Mounting Support for Large Particles in Fluoropolymer Process Aids," by Steven R. Oriani and William J. King; Addcon World 2005 International Conference Paper
[3]According to internal Chemours research data.