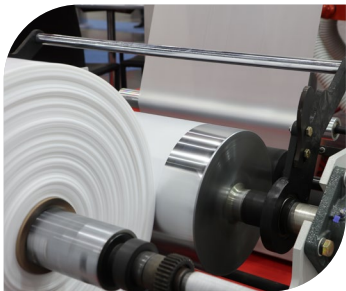


Incroslip™



The Ultimate in
High Stability
and Performance



Incroslip™

Incroslip™ is a market leading range of innovative, high stability solutions delivering slip, torque release, mold release and anti-scratch benefits to polyolefins even in the most challenging applications.

Manufactured using proprietary processes to ensure the highest level of stability, the Incroslip range can be used in many applications where high stability, long-term performance and excellent customer experience is desired. This allows you to choose the best solution for your particular performance requirements.

The Incroslip range has been optimized to provide different combinations of slip and oxidative stability to suit different polyolefin application requirements. Products in this range can be added via masterbatch, during compounding or extrusion at levels between 0.1 and 1% depending on the application.

Why are High Stability Additives Needed?

Standard slip additives, such as erucamide, oleamide and behenamide are commonly used in many plastics applications, including packaging, automotive and high value plastics. These additives bring many benefits in processing and end-use, including high, fast or controlled slip, and anti-block.

However, some of these standard additives contain double bonds which cause the additive to be prone to oxidative breakdown, resulting in poor stability. Poor oxidative stability can lead to issues in the final part over time or when subjected to stressed conditions such as high temperature or prolonged exposure to UV light.

How can High Stability Slip Additives Add Value?

The Incroslip range of high stability slip additives are manufactured using proprietary processes to ensure the highest level of stability.

Incroslip products can be used in many applications where high stability, long-term performance and excellent customer experience is desired.

Our range of high stability additives allows you to choose the best solution for your particular performance requirements.



Product Information

PRODUCT	PHYSICAL FORM AT 25°C	PRIMARY EFFECT	APPLICATION	COMMENTS	RENEWABLE CARBON
Incroslip™ SL	Bead	Slip, anti-scratch, torque release	Film, caps, packaging and automotive	For use when the ultimate in high slip and stability is required	100%
Incroslip™ C	Powder/ Bead	Torque release	Caps & closures	For use when high slip is required with good organoleptic properties	100%
Incroslip™ Q	Bead	Torque release	Caps & closures	For use when both slip and stability are required	100%
Incroslip™ B	Bead	Torque release	Caps & closures	For use when high stability is required	100%
Incroslip™ G	Bead	Mold release anti-scratch	Automotive	For use when high stability is required	100%

Spotlight on Incroslip SL

Incroslip SL was developed by our R&D team to deliver the ultimate in high stability while also delivering optimized slip performance even in the most challenging applications.

The unique structure of this fully saturated product was scientifically designed to resist oxidative breakdown while also reducing the coefficient of friction (CoF) in a range of polyolefins.

Key Performance Benefits:

- High and long lasting slip similar to erucamide
- Low application and release torque
- Scratch and scuff protection
- Enhanced mold release properties

Key Stability Benefits:

- High oxidative stability
- Excellent organoleptic properties
- Low visible bloom
- Reduced tackiness

The Incroslip range has been optimized to provide different combinations of slip and oxidative stability to suit different polyolefin application requirements. Products in this range can be added via masterbatch, during compounding or extrusion at levels between 0.1 and 1% depending on the application.

Masterbatch and Compound



Slip, torque release, mold release and anti-scratch additives are often added into polymers via a masterbatch or compound. It is recommended that our Incroslip™ products are added this way to ensure optimized dispersion and accurate dosing. The Incroslip range offers many stability benefits over standard grade additives, including long-term performance, excellent color stability and shelf-life extension.

Added Benefits in Polyolefin Masterbatch

Incroslip products offer improved stability in polyolefin masterbatch by resisting oxidative breakdown. This can result in the following benefits:

Extended Shelf Life of the Product

Superior stability can result in a product that degrades more slowly, potentially increasing the shelf life of the resin, resulting in cost saving and less waste.

Save Costs by Using Less Additive

Lowers the requirement to over-dose the slip additive to ensure performance is achieved over time. Therefore, there is potential to reduce the total amount of slip additive used resulting in a cost saving.

Incroslip SL shows improved stability over standard erucamide in unstabilized (anti-oxidant free) LDPE masterbatch. As shown in figure 1, after 28 days in accelerated aging conditions, Incroslip SL is still present at 92% of its original level, whereas standard erucamide has broken down resulting in only 29% of the product remaining. Similar results are observed in LLDPE masterbatch.

Color Stability

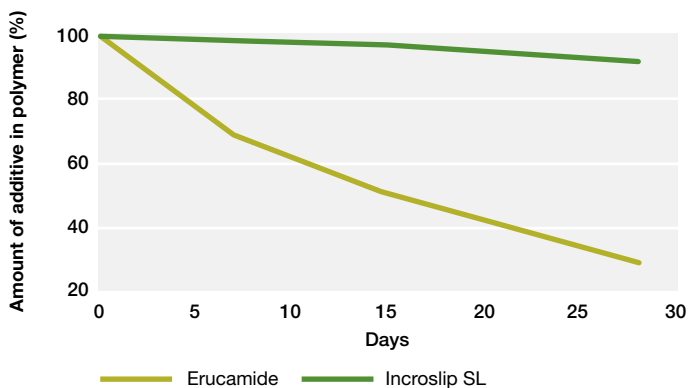
The improved stability of Incroslip products can result in improved color stability of masterbatch and compound over time.

Incroslip SL and Incroslip B show improved color stability compared to standard grade erucamide over 168 hours at 120°C, as shown in figure 2.

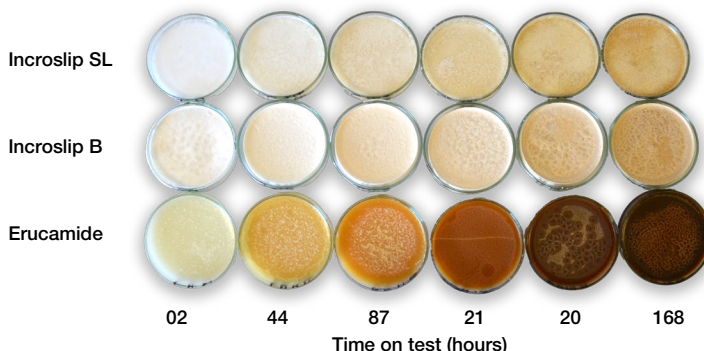
What does this change in color mean?

- Less yellowing indicates less oxidation
- Lower color of finished product
- Fewer oxidative by-products
- Less demand on anti-oxidants

1. The amount of slip additive present in unstabilised LDPE after accelerated aging at 50°C in air



2. Oxidative stability of Incroslip SL and Incroslip B vs erucamide at 120°C



Film & Sheet



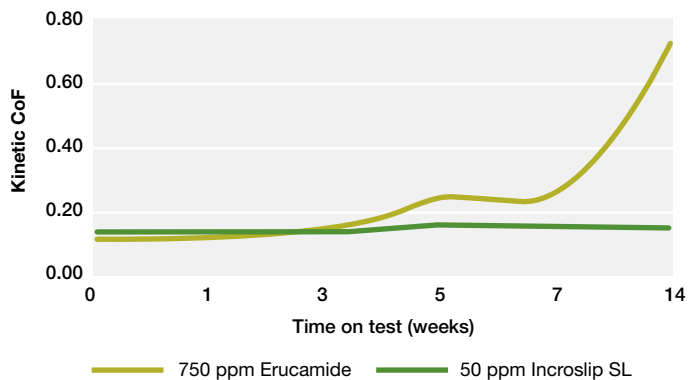
Incroslip™ products can be used in food packaging and non-food grade films to reduced friction during processing, to improve ease of converting and aid in end-use. This is done by improved slip and anti-block performance.

Incroslip products can provide improved stability over standard slip and anti-block additives, to ensure performance is maintained over time.

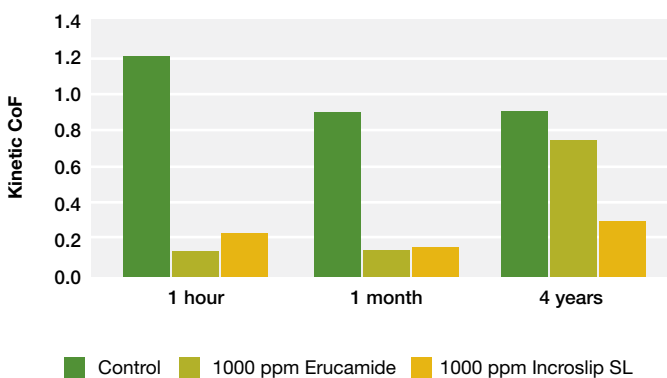
Incroslip SL demonstrates equivalent slip performance to standard grade erucamide in the week following extrusion. After exposure to heat and natural light over 14 weeks, the slip performance of erucamide falls drastically, whereas Incroslip SL retains constant performance. Incroslip SL has even been shown to retain slip performance for up to four years, as shown in figure 3.

In polypropylene films, Incroslip SL outperforms standard grade erucamide when subjected to strong UV light over 7 days. Erucamide quickly breaks down and loses slip performance, whereas Incroslip SL maintains high slip until the point that the film itself starts to degrade. We recommend that Incroslip SL is used in combination with an anti-blocking additive, such as silica or talc, to ensure optimum performance in film applications.

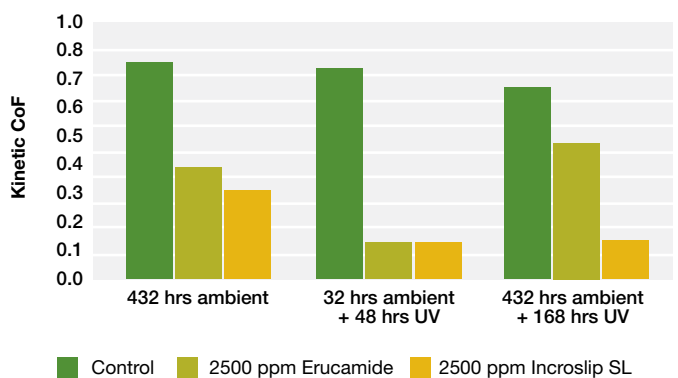
3. Comparison of kinetic CoF of Incroslip SL and erucamide in 35 µm LDPE blown film after exposure to natural UV light



4. Kinetic CoF of Incroslip SL and erucamide in LDPE blown films after exposure to natural light over 4 years



5. Kinetic CoF of Incroslip SL and erucamide in hPP cast film after exposure to accelerated aging in a UV cabinet at 50°C



Caps & Closures



Incroslip™ products are designed to deliver exceptional stability in cap and closure applications, by using proprietary production processes and unique chemistries. This results in improved organoleptic properties in the final product such as taste and odor.

Application and Release Torque

The Incroslip range of high stability additives demonstrates improved application and release torque in both PP and HDPE caps and closures, as shown in figures 6 & 7.

Optimized Torque and Ultimate Stability

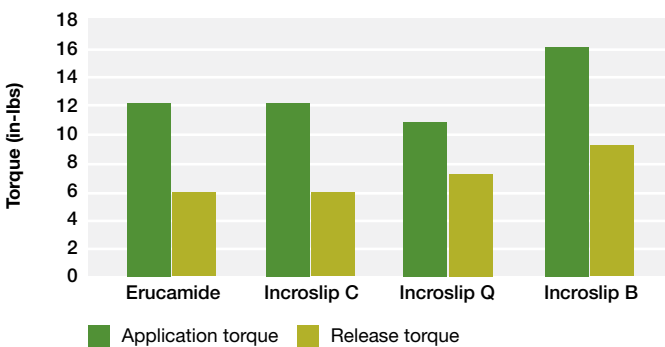
For ultimate stability in cap and closure applications, we recommend Incroslip SL. The performance of Incroslip SL can be optimized to achieve the desired combination of torque and stability, as shown in figure 8.

Unlike some traditional torque release additives, the torque performance of Incroslip SL is affected by the density of the polymer. The performance of Incroslip SL can be optimized by changing the density. This can be done by dosing Incroslip SL into HDPE caps via an LDPE masterbatch.

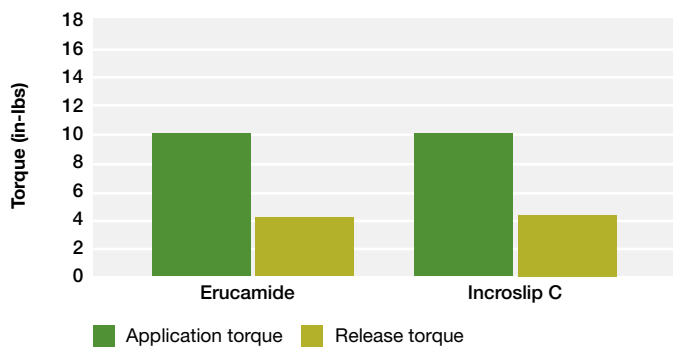
Organoleptics Properties

Standard torque release additives can suffer from taint, taste and odor issues, which can impact sensitive applications like bottled water. Extensive odor testing of the Incroslip range has shown significantly reduced odor when compared with standard torque release additives. In a panel study of volunteers, Incroslip SL was rated as the lowest odor when compared against standard grade erucamide, behenamide and blank HDPE.

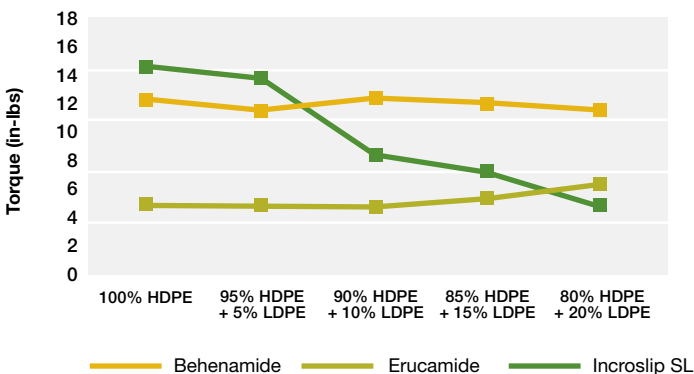
6. Torque release - Injection molded PP, one piece closure against PET neck



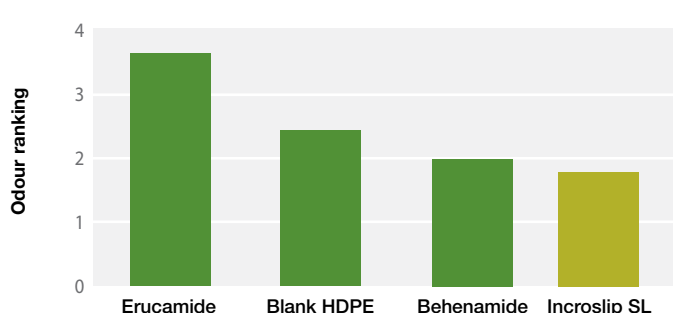
7. Torque release - Injection molded HDPE, one piece closure against PET neck



8. Release torque of HDPE caps containing Incroslip SL, behenamide and erucamide at different densities



9. Odor tests comparing Incroslip SL, behenamide and erucamide to blank HDPE



Molding



Mold Release

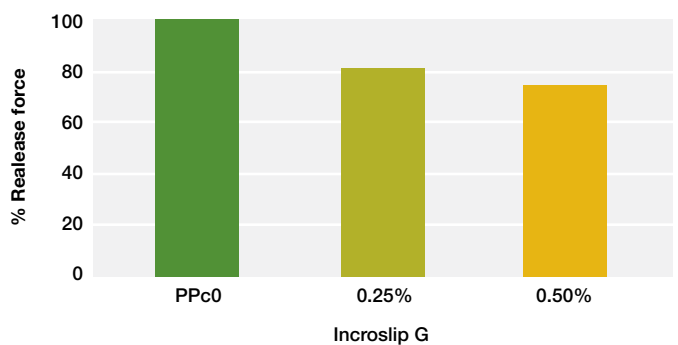
Incroslip™ products have been shown to improve the mold release properties of polyolefin molded parts. These products reduce the coefficient of friction to allow the following benefits during the molding process:

- Reduced processing temperature and pressures
- Less wear on ejection systems
- Improved surface quality
- Fewer rejects and less waste
- Better pigment dispersion
- Improved stability
- Reduced tack and odor

Film & Sheet

Plastics are prone to scratching and scuffing, which can lead to poor surface quality in parts such as automotive interiors. Incroslip additives can be used to reduce scratch width, depth and visibility on injection molded parts, while their superior stability results in reduced odour, tackiness and visible bloom when compared to standard grade additives.

10. Reduction in mold release force of Incroslip G in PP parts at various addition levels



Visible Bloom

Visible 'blooming' is caused by the migration of an additive to the surface of a polymer and crystallization of that additive at the surface. High ambient temperature and exposure to UV light can accentuate this blooming effect. Incroslip SL exhibits different crystal morphology to erucamide making it less visible at the surface and its saturated alkyl chains make it more resistant to change caused by exposure to UV light and heat. This combination of structure and stability gives Incroslip SL excellent low bloom properties.



Further Information

Cargill Bioindustrial sales and distribution are coordinated through an extensive worldwide network of technical and commercial experts. For further information or guidance please contact us:

Smartmaterials@cargill.com

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