Honeywell
THE POWER OF CONNECTED

Performance Additives

Lubricant Solutions for Rigid PVC Processing

Making your processing window wider

In the PVC processing industry the use of lubricants is absolutely essential. Lubricants influence the manner in which PVC melts and flows during processing. Several parameters like energy consumption of the processing equipment, melt pressure in the machine, productivity, dispersion of fillers and pigments, gelation of the PVC, are directly affected by the right selection, the best combination and the optimum dosage of lubricants.

Honeywell has been supplying lubricants to PVC processors for over 50 years. Unique products have been developed to meet the specific needs of this industry. Application laboratories in the U.S., Germany and China provide customized service and support customers by optimization of their formulations.

Honeywell International is a diversified technology and manufacturing leader, serving customers worldwide with aerospace products and services; control technologies for buildings, homes and industry; automotive products; turbochargers; and specialty materials. Based in Morris Township, N.J., Honeywell's shares are traded on the New York, London and Chicago Stock Exchanges. For additional information, please visit http://www.honeywell.com.

Honeywell Specialty Materials, based in Morristown, N.J., is a global leader in providing customers with high-performance specialty materials, including fluorine products; specialty films and additives; advanced fibers and composites; intermediates; specialty chemicals; electronic materials and chemicals; and technologies and materials for petroleum refining.

A-C® Polyethylene Waxes

Polyethylene waxes are recognized in the PVC industry as very efficient external lubricants. Honeywell as the world's first commercial manufacturer of low molecular weight polyolefin polymers offers a wide range of high quality PE-waxes specifically designed to perfectly meet the various requirements of PVC processors. Combinations of the different A-C® Waxes enable formulators to adjust processing conditions exactly to the optimum.

Low-density homopolymers

Non-functional homopolymeric PE-waxes are relatively incompatible with PVC. Due to their amorphous structure and low meltviscosity they act as strong external lubricants. During processing, these products move to the PVC melt - metal interface where a film layer is formed resulting in reduced shear and improved surface quality (gloss).

Low-density oxidized homopolymers

Oxidized LO-Polyethylene waxes contain functional groups (acid and ester groups) causing improved compatibility with the PVC melt. In the extrusion process these waxes provide efficient external lubrication that help to maintain premium physical and aesthetic properties under high shear operating conditions.

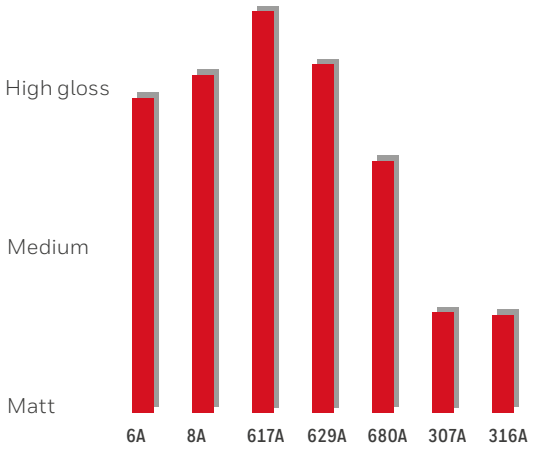
High-density Oxidized Homopolymers

Based on their high melt viscosity, crystalline structure and functional groups, oxidized HD-Polyethylene waxes act as very powerful fusion promoters. They improve metal release and distribution of other additives in rigid PVC extrusion. The increased melt homogeneity results in enhanced dimensional stability of the extruded product.

Gloss

Lubricants have a strong effect on surface quality of the extrudate. While effective external lubrication creates smooth surface and high gloss, a more internal lubricant tends to matt the surface. By selecting the right combination of lubricants you can adjust the surface quality to a level of your choice.

Gloss control with A-C® Wax

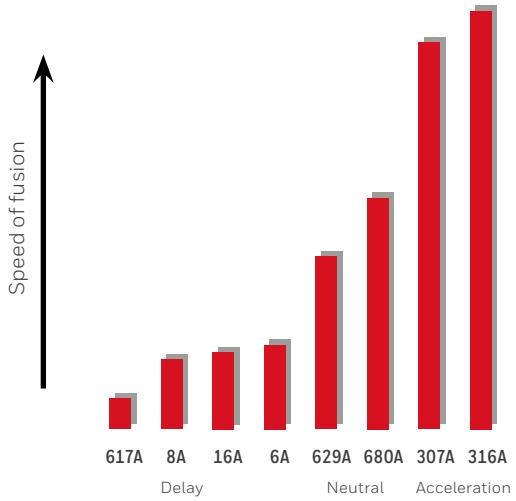


Fusion

Speed of fusion is affected directly by the character of the lubricant. Non oxidized LOPE waxes tend to delay fusion of the PVC melt: oxidized HOPE waxes act as strong fusion promoters. With a combination of the lubricants you can individually adjust the point of fusion to your compound formulation and extruder characteristics.

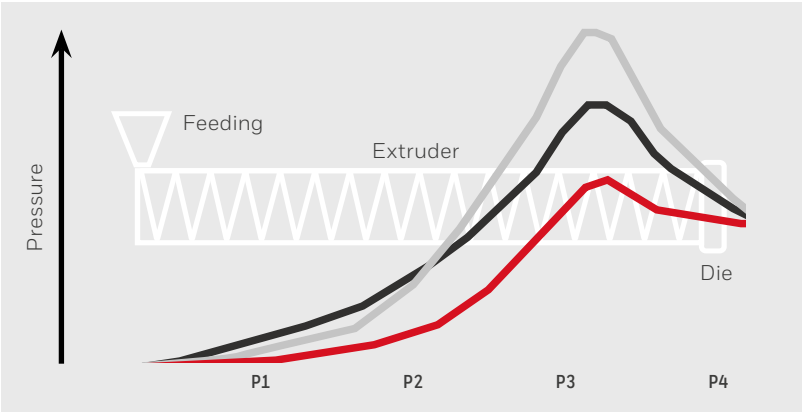
In conjunction with fusion, the pressure profile in the extruder can be adjusted. Fusion accelerating lubricants cause higher melt pressure in the last section of the extruder.

Fusion control with A-C® Wax



Extruder Pressure Profile

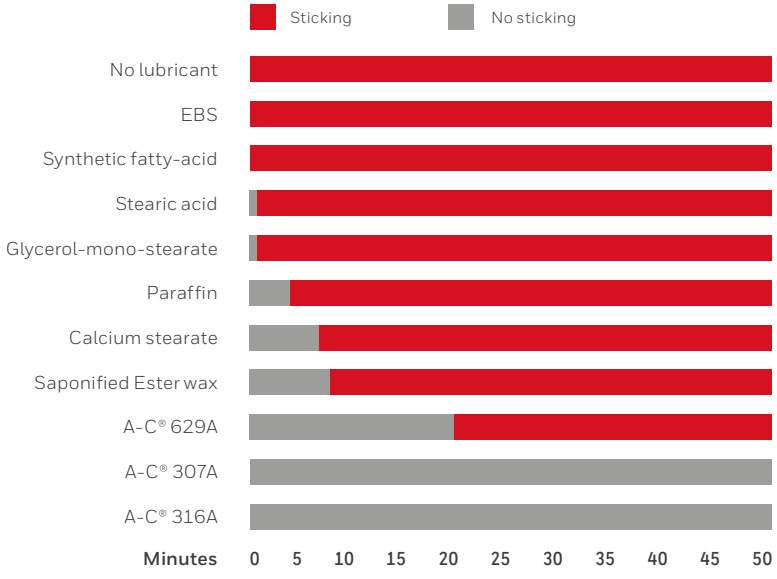
Standard A-C307A A-C316A



Sticking Behaviour

Tin formulations are known for an extraordinary demand on external lubrication to avoid sticking at the metal surface. Oxidized HOPE waxes like A-C 307A and A-C 316A are recognized as superior additives for metal release.

Sticking behaviour of various lubricants



A-C® Waxes (product list)

PRODUCT		A-C 6A	A-C 8A	A-C 617A	A-C 629A	A-C 680A	A-C 307A	A-C 316A
PE wax type		Low-density homopolymer			Oxidized low-density homopolymer		Oxidized high-density homopolymer	
Physical form		Powder	Powder	Powder	Powder	Powder	Powder	Powder
Drop point	°C °F	106 223	113 235	102 216	104 29	108 226	140 284	140 284
Viscosity 140°C (284°F)	cps	375	450	180	200	250	85000 (150°C)	8500 (150°C)
Acid number	mg KOH/g	Nil	Nil	Nil	16	16	5 to 9	16
Specific gravity	g/ccm	0.92	0.93	0.91	0.93	0.93	0.98	0.98
APPLICATIONS		USAGE LEVEL RANGE (PHR)						
Profile extrusion		0.1 -0.5	0.1-0-5	0.1 - 0.5	0.1 -0.8	0.1 -0.7	0.05-0.2	0.05-0.3
Physical form		0.1 -0.4	0.1 -0.4	0.1 -0.4	0.1-0.4	0.1-0.4	0.05-0.2	0.05-0.2
Siding extrusion		0.1 -0.5	0.1-0-5	0.1 -0.5	0.1-0.5	0.1-0.5	0.05-0.2	0.05-0.3
Injection molding		0.1 - 0.6		0.1 -0.5	0.1 -0.6	0.1 -0.6	0.05-0.2	0.05-0.2
Flexible extrusion		0.1-0.4		0.1 -0.4	0.1 -0.4	0.1-0.4		0.01-0.4

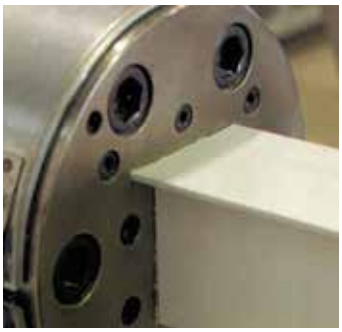
Advantages with A-C® Polyethylene Waxes

Superior gloss

Lubricants like A-C® 617A give remarkable gloss to the surface of the extrudate.

Controlled fusion

With the right combination of A-C® PE-waxes processors can adjust fusion time to their needs.



No sticking

Oxidized PE-waxes like A-C® 316A prevent the PVC melt from sticking at the metal surface.

HPL – High Performance Lubricants

Honeywell is continually developing innovative lubricant technology for rigid PVC extrusion and injection molding. A new product line of High Performance Lubricants (HPLs) has been introduced to meet the increasing challenges of the industry. HPL products are typically designed as customized formulations to meet specific cases of application.

Performance of HPL based formulations

The performance of a PVC window profile formulation prepared with Honeywell High Performance Lubricant system was evaluated against a commercially available control.

Torque Rheometry

Brabender torque rheometer studies indicate that HPL maintains lubricity comparable to commercially available dry blends while significantly reducing fusion torque. A remarkable improvement in dynamic heat stability can be observed.

Extrusion trials

The reduction in the energy required for fusion has several benefits for the extrusion process: Less energy means that the compound processes with less torque or amperage in the extruder. This finally results In lower energy consumption or higher output rate.

Improved dynamic heat stability and lower energy consumption offer a much wider processing window to the processor. This can be of high importance when working with sensitive stabilizers like Ca/Zn or Organic Based Systems.

HPL for Ca/Zn stabilized PVC profiles

The switch from lead stabilized formulations to Ca/Zn formulations is a big challenge for the PVC processing industry. The entire formulation has to be adjusted which leads to numerous factors in the processing and product performance being affected.

Honeywell's new product line of High Performance Lubricants (HPLs) helps PVC processors to manage this change while maintaining high productivity, low scrap rate and good product performance. HPLs provide much higher lubrication efficiency than conventional lubricants while significantly reducing extrusion torque.

The benefits achieved by using a Honeywell High Performance Lubricant system against a commercially available PVC window profile formulation have been proven in a series of performance evaluations.

TEST FORMULATIONS	CONVENTIONAL LUBRICANTS	HPL SYSTEM	COMMERCIAL FORMULATION
	PHR	PHR	PHR
S-PVC K 67	100.0	100.0	100.0
Processing aid	1.0	1.0	1.0
Impact modifier	6.0	6.0	6.0
$CaCO_3$ coated	10.0	10.0	10.0
TiO_2	5.0	5.0	5.0
One-pack without lubricants	2.4	2.4	
Commercial one-pack			3.4
Conventional lubricants	1.2		
HPL		0.6	

Comparison tests clearly showed reduced die pressure and extrusion torque, even at lower dosage levels of HPL. Productivity and gloss are remarkably improved. Tests were performed on a 55 mm parallel twin screw extrusion line.

Mechanical Properties

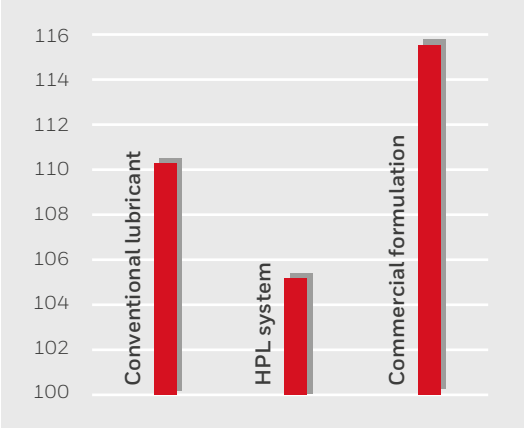
MECHANICAL PROPERTIES				
VICAT ISO 306 Method B	°C	80.4	82.4	81.5
Flexural properties NF ISO 178	MPA	2827	2828	2831
CHARPY EN ISO 179 (Single notch)	KJ/m^2	114.2	110.9	107.8
Tensile Impact strength EN ISO 8256 type 5	KJ/m^2	750	700	560
DENSITY Iso 1183	KJ/m^2	1.451	1.455	1.450

Mechanical properties of profiles produced with HPL lubricants do not vary significantly from reference formulation and meet all standards.

Artificial weathering

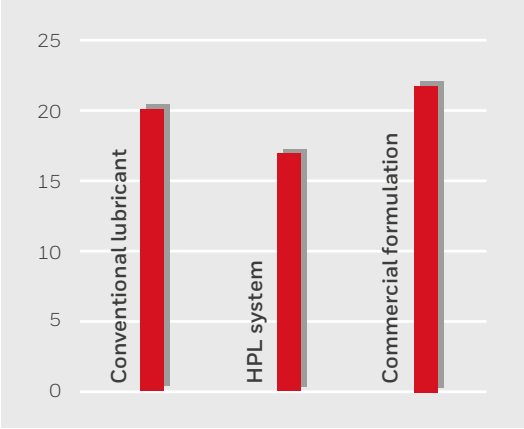
Profiles produced with HPL have been tested in a ISO 4892 weathering test. The profiles meet the recommended standards:

ARTIFICIAL WEATHERING											
TIME (H)	L*	△L*	A*	△A*	B*	△B*	C*	△C*	H	△H	△E
0	95.61		-0.48		3.62		3.65		97.5		
1000	96.04	0.43	-0.08	0.4	1.47	-2.15	1.47	-2.18	93.0	-4.5	2.23
2000	96.27	0.66	-0.06	0.42	1.44	-2.18	1.44	-2.21	92.3	-5.2	2.32
5000	95.90	0.29	-0.05	0.43	1.37	-2.25	1.37	-2.28	92.0	-5.5	2.31



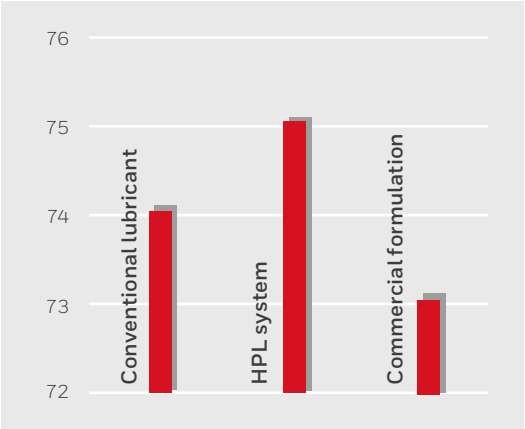
Die pressure (bar)

Applied at same dosage level HPL formulations show a remarkably lower melt pressure



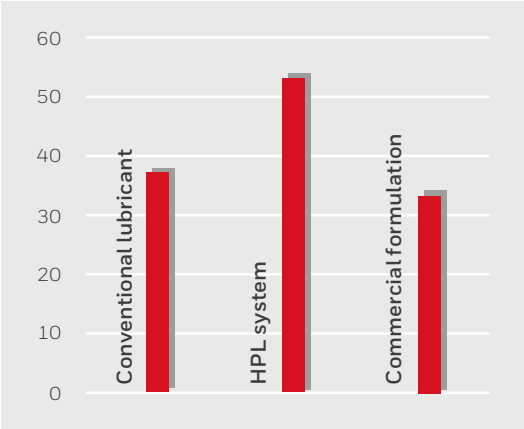
Extrusion torque (%)

Excellent lubrication characteristics of HPL lead to low torque resulting in lower energy consumption



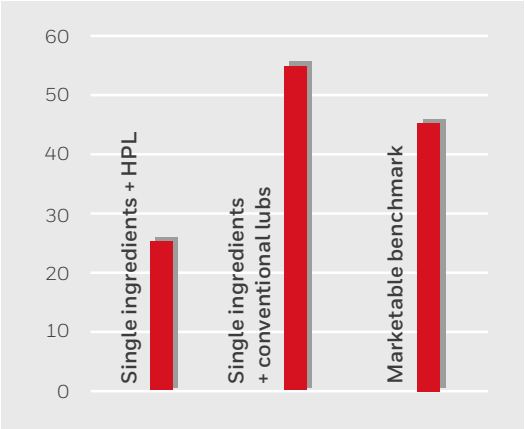
Throughput (kg/h)

Lubrication with HPL systems enable processors to run at higher throughput rate without danger of shear stress problems.



Gloss (60°)

Even low dosages of HPL can create perfect gloss on the PVC surface



Calibration plate-out (total) Amount of plate-out (mg)

Calibration plate-out is a very critical point in rigid PVC extrusion. Shorter cleaning cycles and high scrap rates can lead to a noticeable reduction of productivity. In a comparison, trial, compounds with HPL clearly outperformed a similar formulation with conventional lubricants and a commercial standard product.

Optimized PVC processing with HPL

- Increased output rates
- Lower melt temperature
- Reduced plate-out and scrap rates
- Improved colour hold {less discolouration)
- Wider processing window (optimized processing conditions)

Profile extrusion

- Superior gloss and surface quality
- Reduced calibration plate-out
- Higher productivity and less scrap

Injection molding

- Reduced melt viscosity and better melt flow
- Improved colour stability
- Superior gloss and surface aspect

Pipe extrusion

- Increased output rates
- Reduced calibration plate-out
- Increased filler level maintaining physical properties

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