Honeywell
THE POWER OF CONNECTED

Performance Additives

A-C® Performance Additives for Colour Concentrates

Making your processing window wider

Honeywell...
Gives you every advantage

Honeywell's A-C Performance Additives help you streamline processes to make better, more effective and profitable colour concentrates for a wide variety of thermoplastics materials that give you a competitive edge in the marketplace. With a versatile line of nearly 100 polyethylene, copolymer, and micronized polyolefin waxes, we can offer a diverse array of compositions, properties and particle sizes that meet virtually any application requirements you have.

You Have a Wide Range of Choices

This versatile line of A-C® Performance Additives includes a variety of different chemical functionalities that can satisfy the needs of just about any type of colourant system used in plastics. Among our offerings are homopolymers as well as ethylene-acrylic acid and other copolymers. We also offer the AClyn® series of ionomers (metal salts of acid functional copolymers.)

You Can Rely on Honeywell's Expertise

Honeywell has more than 45 years of experience in the field of polymer science. We were the first to produce polyethylene waxes. Years of innovation in product design and experience in solving problems for our customers have made our line of A-C polyethylenes the world's widest, most versatile family of low molecular weight polyethylene waxes.

Today, we are still one of the world's leading manufacturers of low molecular weight polyethylene polymers and copolymers and have the know-how and expertise to consistently deliver products of the highest quality.

But products of the highest quality are only part of the Honeywell equation. You also get the advantage of our global supply and customer service capabilities, assuring you of the right product delivered when and where you need it. And you get the benefits of our vast industry applications knowledge and formulations know-how that can help you formulate your products easily and cost-effectively.

Here's how A-C® Additives help you make better colour concentrates

Because of their versatility and composition, A-C Polyethylene products give you a unique set of performance characteristics in almost all colour concentrate systems, including those used in polyethylene, polypropylene, polystyrene, polyamide, polycarbonate, ABS, PET, PBT, SAN, and several other engineering thermoplastics.

A-C Polyethylene waxes give you a high degree of flexibility in your product development.
Benefits include:

- Compatibility with numerous polymers and manufacturing processes
- Improved performance of hard to disperse organic and Inorganic colourants
- Enhanced colour strength and performance in pre-colour resins
- Higher pigment loading at improved dispersion levels
- Higher production rates and easier processing capabilities
- Lower dusting
- Cost effectiveness

Typical properties of A-C® Performance Additives for colour concentrate applications and plastics

	METTLER DROP POINT (ASTM D-3954)	HARDNESS (ASTM 0-5) (DMM)	DENSITY (ASTM D· 1505) (G/CC)	VISCOSITY BROOKFIELD @ 140°C (CPS)	ACID NUMBER (MG KOH/G) ASTM D-1386	PHYSICAL FORM
HOMOPOLYMERS						
A-C 617, A-C 617A	101°C	7.0	0.91	180	Nil	Prills, Powder
A-C 6, A-C 6A	106°C	4.0	0.92	375	Nil	Prills, Powder
A-C 8, A-C 8A	113°C	1.0	0.93	450	Nil	Prills, Powder
A-C 9, A-C 9A	115°C	0.5	0.93	450	Nil	Prills, Powder
A-C 16, A-C 16A	102°C	5.5	0.91	525	Nil	Prills, Powder
A-C 715	109°C	2.5	0.92	4000	Nil	Diced
A-C 735	110°C	2.5	0.92	6000	Nil	Diced
HOMOPOLYMERS						
A-C 629, A-C 629A	101°C	5.5	0.93	200	15	Prills, Powder
A-C 655	107°C	2.5	0.93	210	16	Prills
HIGH DENSITY OXIDIZED HOMOPOLYMERS						
A-C 316A	140°C	<0.5	0.98	8500*	16	Powder
A-C 307A	140°C	<0.5	0.98	85000*	7	Powder
A-C 392	138°C	<0.5	0.99	4500*	30	Prills
ETHYLENE-ACRYLIC ACID COPOLYMERS						
A-C 540, A-C 540A	105°C	2.0	0.93	575	40	Prills, Powder
A-C 580	95°C	4.0	0.94	650	75	Prills
ETHYLENE-VINYL ACETATE COPOLYMERS						
A-C 400, A-C 400A	92°C	9.5	0.92	595	VA 13%	Prills, Powder

	METTLER DROP POINT (ASTM D-3954)	HARDNESS (ASTM D-5) (DMM)	DENSITY (ASTM D-1505) (G/CC)	VISCOSITY BROOKFIELD @ 140°C (CPS)	SAPONIFICATION NUMBER MG KOH/G	PHYSICAL FORM
MALEIC ANHYDRIDE GRAFTED COPOLYMER						
A-C 573P, A-C 573A	105°C	4.0	0.92	500	3-6	Pastilles, Powder

	MELTING POINT (DSC)	HARDNESS (ASTM D-5) (DMM)	DENSITY (ASTM D-1505) (G/CC)	VISCOSITY BROOKFIELD @ 190°C (CPS)	SAPONIFICATION NUMBER MG KOH/G	PHYSICAL FORM
LOW MOLECULAR WEIGHT IONOMERS						
AClyn® 295A**	99°C	1.0	0.93	4500	Nil	Powder
AClyn 289A**	100°C	0.5	0.93	50000	Nil	Powder

* Measured at 150°C
**Make to Order Product
Note: The typical property data are average production values and cannot be considered as specifications. Product specifications are available on request.
Modification of properties to meet your individual needs is possible.
Please contact us with you specific requirements.

A-C® Waxes and AClyn® ionomers as Dispersants

The molecular weights of A-C waxes range from 2000 to 8000. When combined with AClyn ionomers, they provide optimal dispersing behaviour and colour strength. Their low to medium melt viscosity, coupled with their high thermal stability, lets you reduce pigment degradation during processing.

AClyn ionomers, which are made by the reaction of ethylene acrylic acid copolymers with a strong base, such as ZnO, have a much higher viscosity and are harder than unmodified waxes. The ionomers provide better performance over all three steps of the dispersion mechanism, including mixing. The other A-C waxes are particularly important during the wetting and distribution steps of the mechanism.

You can attain the excellent dispersion and other performance characteristics by using the appropriate A-C additive or combination of additives for your formulation. The choice of which product to use depends on the type of pigment, the polymer type from which the final product is made, and on constraints fixed by the processing equipment. However, no matter what your specific need, there is an A-C wax that meets it.

For example, if you're formulating for polyolefin based concentrates, you might use a blend of A-C 9A and A-C 629A. This combination is more effective in dispersing organic pigments than either stearates or A-C 6A with stearates. By adding polarity to the wax system, you get greater affinity to the pigment surface. This gives you better dispersion and wetting.

Similarly, you might consider using A-C 573A (Ethylene Maleic Anhydride) in a polyolefin matrix because it has an excellent affinity for rutile grade titanium dioxide (TiO2). This product gives you far more effective dispersion than either homopolymer or oxidized homopolymer products.

Moreover, when working with polar pigments, you might choose a polar wax like an oxidized polyethylene. If over-lubrication becomes a problem during processing, or if the wax doesn't help disperse the pigment, especially difficult pigments such as phthalocyanine and quinacridone, you might add an ionomer to your dispersant mix.

A-C Polyethylenes & Copolymers Product range for MB's (Masterbatches)

GRADE	USE
PE HOMOPOLYMERS	
A-C 617A	Polyolefins (Styrenics, PVC)
A-C 6A	
A-C 8A	
A-C 16A	
A-C 9A/F	
ETHYLENE VINYL-ACETATE COPOLYMERS	
A-C 400A	Styrenics, PVC
MALEIC ANHYDRIDE GRAFTED COPOLYMERS	
A-C 573A	Polyolefins, Compatibilization, Fluorescent MB
IONOMERS	
AClyn 295A/289A*	Colour Enhancer, Compatibilization, Universal MB, Engineering Plastics

*Make to Order Product

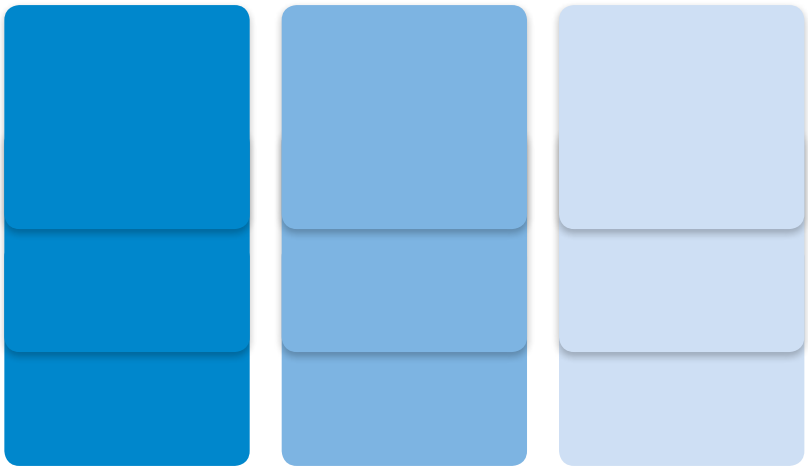
Some experimental data

Phthalocyanine Blue LDPE Masterbatch dispersed on a Brabender Kneader

The ability of Honeywell's A-C waxes and ionomers to improve dispersion was evaluated by preparing masterbatches with phthalocyanine blue on a Brabender kneader and measuring the colour strength. All ingredients in the formulations in Table 1 were pre-blended by tumble mixing, then dispersed in a Brabender kneader at a speed of 100 rpm for 15 minutes. Plaques were injection molded to provide samples for measuring colour strength.

Colour strength illustration of phthalocyanine blue formulations

VA IA/IIIB IIB



These are only indicative illustrations and do not represent exact colour strength.

Results from the experimental formulations

IA, IIA, and IIIA are resin-based colour concentrates. IB, IIB, IIC, IIIB, and IIIC are LMWPE and/or ionomer-modified colour concentrates. IVA and VA are ionomer-based colour concentrates. The initial masterbatch IA, which contains 25% pigment dispersion without wax was used as the standard. All results are expressed in percent versus standard. The phthalocyanine blue was extended to a 10:1 ratio with titanium dioxide (TiO2) in all cases. In formulations IIA and IIIA, the pigment was insufficiently wetted, resulting in re-agglomeration that reduced its effectiveness as a colourant.

Overall, however, the results showed that as the pigment concentration increased, the wax became more indispensable to the formulation, and that wax/ionomer combinations improved colour dispersion. AClyn® grades, which are even better pigment wetters than waxes, possess polar domains within the neutral wax matrix. The ionomers attract the pigment and the wax insulates it from other pigment particles. Under identical processing conditions. AClyn used as the sole carrier gave the best colour dispersion and highest pigment concentration.

PHTHALOCYANINE BLUE – EXPERIMENTAL FORMULATIONS										
FORMULATION	IA	IB	IIA	IIB	IIC	IIIA	IIIB	IIIC	IVA	VA
Pigment	25	25	30	30	30	40	40	40	45	50
Resin LDPE	75	65	70	60	60	60	50	50		
LMWPE		10		10	8		10	6		
AClyn 295A					2			4	55	50
Colour strength	100	118	72	105	120	65	100	120	140	130

The above formulations and procedures are only suggestions for customer consideration. Customers are responsible for formulating and using products in their own processes.

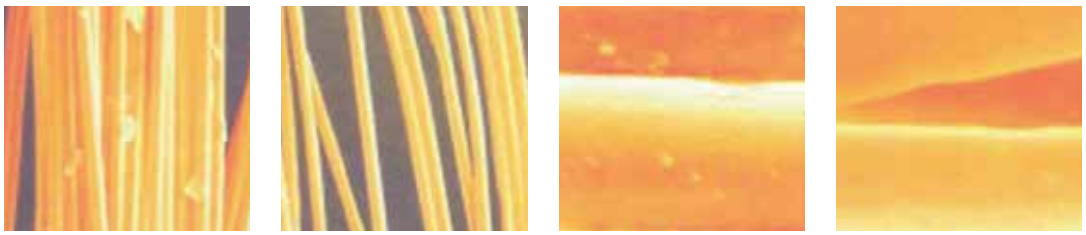
Wax/Ionomer Combination for Polypropylene Fiber Applications

Based on the wax/ionomer performance demonstrated in the typical masterbatches, a semi-technical production trial was undertaken to see how the products performed in colouring polypropylene fibers with a difficult-to-disperse red pigment. In this experiment, a wax/ionomer combination was tested against propylene wax.

The LMWPE wax/ionomer blend in the polypropylene fiber grade formulation gave a higher quality dispersion compared with the propylene wax used alone. The wax/ionomer blend improved spinnability, while providing comparable elongation to the standard fiber. As the SEM photographs taken at 200X and 2500X clearly show, there are no defects on polypropylene fibers treated with the A-C® 8A/AClyn® 295A combination. Defects are obvious on the fiber treated with polypropylene wax.

SEM photographs of PP fibers treated with a PP wax versus a LMWPE wax/ionomer combination

Photographs of pp wax and wax/ionomer combination



At 200x magnification

And again at 2500x magnification

Suggested Methods for Use of A-C Polyethylenes

Flushing (Sigma-Blade) Mixer

This production method works most easily with LMW polymer-based concentrates. Because of its low speeds. this type of mixer does not generate frictional heat. Heat the mixer with high pressure steam to temperatures of 105 to 140°C (220 to 284°F). Add low molecular weight polymer and pigment. Let the polyethylene melt. Mix to form a uniform mass. It may be necessary to change the direction of the mixing blades occasionally to prevent the formation of unmixed areas or "dead spots.'' Total cycle times will range from 20 to 30 minutes, depending on the pigment used, the size of the mixer, and the available heat. Remove the resulting concentrate from the mixer and grind with conventional granulating equipment. Blend the dispersion with HMW resin and extrude or formulate with the finished product "as is."

High Intensity Mixers

These production methods work best when used to produce LMW polymer-based concentrates. You can also use them to produce LMW polymer-modified concentrates.

Fluxing Mixer: Place all ingredients In the mixer without prior heating. Frictional heat will soften the LMW polymer and let it form small beads with the pigment. There will be a power drop when the mixture reaches a temperature of 80 to 95°C (170 to 204°F). When this occurs, transfer the material to a cooling mixer. Cool the mixture for a few minutes, then extrude or pelletize as needed.

Remember that when amperage and melt temperatures start to accelerate, cooling and discharge take place before blocking and mass melting. Also, when dry mixing or fluxing, especially when using organic pigments with a high surface area, keep the mixing time less than two minutes and the speed of the mixer below 2000 rpm to prevent re-agglomeration. Once re-agglomeration occurs, it is usually irreversible.

Banbury Mixer·: Use this kind of equipment to produce resin-based or A·C Performance Additive-based concentrates. Usually, though, it is so easy to mix concentrates made with A-C wax or wax/ionomer combinations that devices as powerful as Banbury mixers are not needed.
A-C Performance additive-based colour concentrates don't require the high temperatures used to produce HMW resin concentrates. It may even be necessary to cool the Banbury mixer to prevent excessive temperatures that wlll leave the mix too low in viscosity to provide sufficient pigment working. In some cases, after the pigment has been 'wet', it may be necessary to cool the batch to about 20°C (35°F) below the melting point of the polyethylene to ensure the necessary shear.

A-C 9A may be a more efficient process aid for compounding on a Banbury mixer. A-C 9A yields higher output rates because it provides less external lubrication (wall slippage) and better pigment dispersion because of improved shear and wax melt.

Continuous Mixer: This type of equipment is designed specifically for compounding. All operations take place in one piece of continuous equipment. The process lends itself to higher production rates. Typically, taking advantage of the higher melting point and low molecular weight of polyethylenes (LMW) maintains these high production rates.

Extruders

When compounding concentrates with an extruder, utilize a pre-mixing step to insure that the feed is uniform. You can also meter components into the feed area of the extruder. Because of the wide variety of extruder types, producing the same concentrate on two different machines involves different conditions and considerations. In general, you can mix incompatible materials more easily in twin-screw extruders than in single-screw machines.

When producing an A-C Performance Additive-modified concentrate on a single-screw extruder, let the LMW polymer coat the pigment during the pre-mix step. This assures that over-lubrication won't keep frictional heat from melting the resin pellets. This pre-wetting also provides dispersion of the pigment in the extruder.

Colour concentrates made with A-C Performance Additives require a different extruder profile than concentrates made with HMW resin systems. Since they don't have high viscosities above their melting points (unless very high loadings of organic pigments are used), concentrates made with Honeywell materials can be made at much lower temperatures.

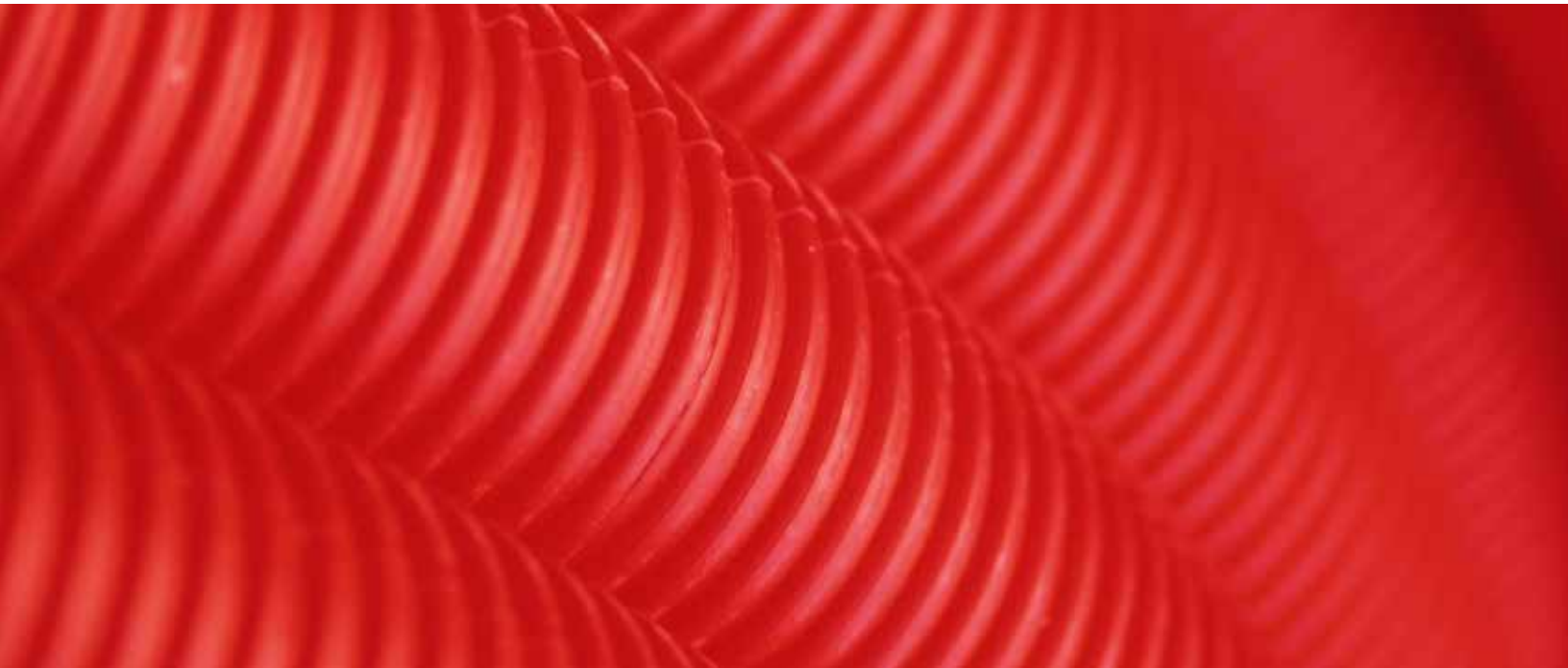
Keep the feed zone temperature between 30 and 35°C (86 to 95°F) below the softening point of the LMW polymer to allow proper feed. The vehicle melts in the next series of zones. Keep the die zone temperature 20 to 30°C (68 to 86°F) below the softening point to form the concentrate into a ·solid upon exiting from the extruder. Use a die face pelletizer to finish the product.

A-C 9A may be a more efficient process aid for compounding on an extruder. A-C 9A yields higher output rates because it provides less external lubrication (wall slippage) and better pigment dispersion because it improved shear and wax melt beyond the feed throat of the extruder.

Two-Roll Mill (Mostly PVC)

Because it is difficult to control temperatures of two roll mills, this type of equipment is best suited for the production of resin-based and LMW polymer-modified colour concentrates. You can manufacture colour concentrates based on A-C Performance Additives in two roll mills, but take care to keep the temperatures low enough, or pigment loading high enough, to ensure a workable viscosity.

The above formulations and procedures are only suggestions for customer consideration. Customers are responsible for formulating and using products in their own processes.



The Competitive Edge

A-C Performance Additives offer many important advantages and properties when used in colour concentrates for plastics. Among the improvements made possible by these versatile products are improved dispersion, enhanced pigment and filler performance, better compatibility and coupling, and improved melt flow and surface properties. And they are cost-effective.

Learn how to put the power of A-C Performance Additives to work for you. Visit our web site: **www.honeywell-additives.com** for complete technical specifications or to request a product sample. If you would like to speak to one of our dedicated account managers or customer service representatives, please contact the appropriate office in your region listed on the back cover.

For additional information or to contacts us, please visit
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