

Headquartered in Morristown, New Jersey, Honeywell is a US \$24 billion diversified technology and manufacturing leader, serving customers worldwide with specialty chemicals; plastics; fibers; electronic and advanced materials; power generation systems; aerospace products and services; automotive products; and control technologies for buildings, home and industry.

The company employs approximately 120,000 people in 95 countries. Honeywell Specialty Additives is committed to delivering innovative quality products and services enabled by our technical expertise, e-business savvy and diverse talent, leveraging our global presence to support customer and shareowner growth.

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A-C® Polyethylenes in colour concentrate applications

The A-C® Polyethylene product line for the colour concentrate industry consists of polyethylene homopolymers, ethylene-vinylacetate, ethylene-acrylic acid and other copolymers, ionomers (metal salts of acid functional copolymers)...

By their versatility and their compositions, Honeywell has shown a unique performance in almost all colour concentrate systems applied in many polymers including polyethylene, polypropylene, polystyrene, polyamide, polycarbonate, ABS, PET, PBT, and SAN. For the formulator, our A-C® Polyethylenes add the following benefits:

- improvement of the dispersion properties of hard to disperse organic and inorganic colorants and pigments
- enhancement of the colour strength, resulting in significant economic benefits
- allow high pigment loading at improved dispersion level
- compatibility with polyolefins and several other engineering thermoplastics
- easy processing, higher production rates with major equipment

Although those properties generally are improved simultaneously by selecting the appropriate A-C® additive or additives combinations, some low molecular weight polyethylenes can be selected to solve a specific customer need. The choice depends on the type of pigment, the polymer type from which the concentrate and the final product are made and other constraints fixed by the customer's processing equipment.

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

Property Grade	Mettler Drop Point (ASTM D-3954) (°C)	Hardness (ASTM D-5) (dmm)	Density (ASTM D-1505) (g/cc)	Viscosity Brookfield at 140 °C (mPa.s)	Acid Number (mg KOH/g)	Physical Form
<i>Homopolymers</i>						
A-C® 617, A-C® 617A	101	7.0	0.91	180	Nil	Prills, Powder
A-C® 6, A-C® 6A	106	4.0	0.92	375	Nil	Prills, Powder
A-C® 8 A-C® 8A	113	1.0	0.93	450	Nil	Prills, Powder
A-C® 9, A-C® 9A	115	0.5	0.93	450	Nil	Prills, Powder
A-C® 16, A-C® 16A	102	5.5	0.91	525	Nil	Prills, Powder
A-C® 715	109	2.5	0.92	4000	Nil	Diced
A-C® 735	110	2.5	0.92	6000	Nil	Diced
<i>Oxidized Homopolymers</i>						
A-C® 629, A-C® 629A	101	5.5	0.93	200	15	Prills, Powder
A-C® 655	107	2.5	0.93	210	16	Prills
<i>High Density Oxidized Homopolymers</i>						
A-C® 316A	140	<0.5	0.98	8500*	16	Powder
A-C® 307A	140	<0.5	0.98	85000*	7	Powder
A-C® 392	138	<0.5	0.99	4500*	30	Prills
<i>Ethylene-Acrylic Acid Copolymers</i>						
A-C® 540, A-C® 540A	105	2.0	0.93	575	40	Prills, Powder
A-C® 580	95	4.0	0.94	650	75	Prills
<i>Ethylene-Vinylacetate Copolymers</i>						
A-C® 400, A-C® 400A	92	9.5	0.92	595	13% Vinylacetate	Prills, Powder
Property Grade	Mettler Drop Point (ASTM D-3954) (°C)	Hardness (ASTM D-5) (dmm)	Density (ASTM D-1505) (g/cc)	Viscosity Brookfield at 140 °C (mPa.s)	Saponification Number (mg KOH/g)	Physical Form
<i>Maleic Anhydride Grafted Copolymer</i>						
A-C® 573P	105	4.0	0.92	500	3-6	Pastilles
Property Grade	Melting Point (DSC) (°C)	Hardness (ASTM D-5) (dmm)	Density (ASTM D-1505) (g/cc)	Viscosity Brookfield at 190 °C (mPa.s)	Saponification Number (mg KOH/g)	Physical Form
<i>Low Molecular Weight Ionomers</i>						
Aclyn® 295A	99	1.0	0.93	4500	Nil	Powder
Aclyn® 289A	100	0.5	0.93	50000	Nil	Powder

* Measured at 150°C

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 your specific requirements.

A-C® Polyethylenes & Copolymers Product Range for MB's

Grade	Use
<i>PE Homopolymers</i>	
A-C® 617A A-C® 6A A-C® 8A A-C® 16A A-C® 9A/F	Polyolefins (styrenics, PVC)
<i>Ethylene Vinyl-Acetate Copolymers</i>	
A-C® 400A	Styrenics, PVC
<i>Maleic Anhydride Grafted Copolymers</i>	
A-C® 573A A-C® 597A	Polyolefins, Compatibilization, Fluorescent MB
<i>Ionomers</i>	
Aclyn® 295A/289A	Colour Enhancer, Compatibilization, Universal MB, Engineering Plastics

Waxes and ionomers as dispersants

A-C® waxes with their molecular weight from 2000 to 8000 and ionomers are selected because they combine:

- optimum dispersing behaviour & colour strength
- low to medium melt viscosity
- high thermal stability
- compatibility with numerous polymers
- higher pigment loading (SPD)
- broader compatibility
- reduction of pigment degradation

Ionomers that are made by reaction of Ethylene Acrylic acid copolymers with a strong base (such as ZnO), have a much higher viscosity and are harder than unmodified waxes. Due to their physical properties, the ionomers provide benefits during the three steps of the dispersion mechanism, including mixing, while the other waxes are particularly important during the wetting and the distribution steps.

Homopolymers PE waxes are recommended for dispersing pigments in polyolefins. Polar waxes like oxidized PE & ionomers are preferred for polar pigments. Ionomers are to be used when over-lubrication takes place during processing or if waxes on their own are not efficient enough to help dispersing the pigments, and particularly the most difficult ones such as phthalocyanine, quinacridone ...

Experiments

1. Phthalocyanineblue - LDPE masterbatch dispersed on a Brabender kneader

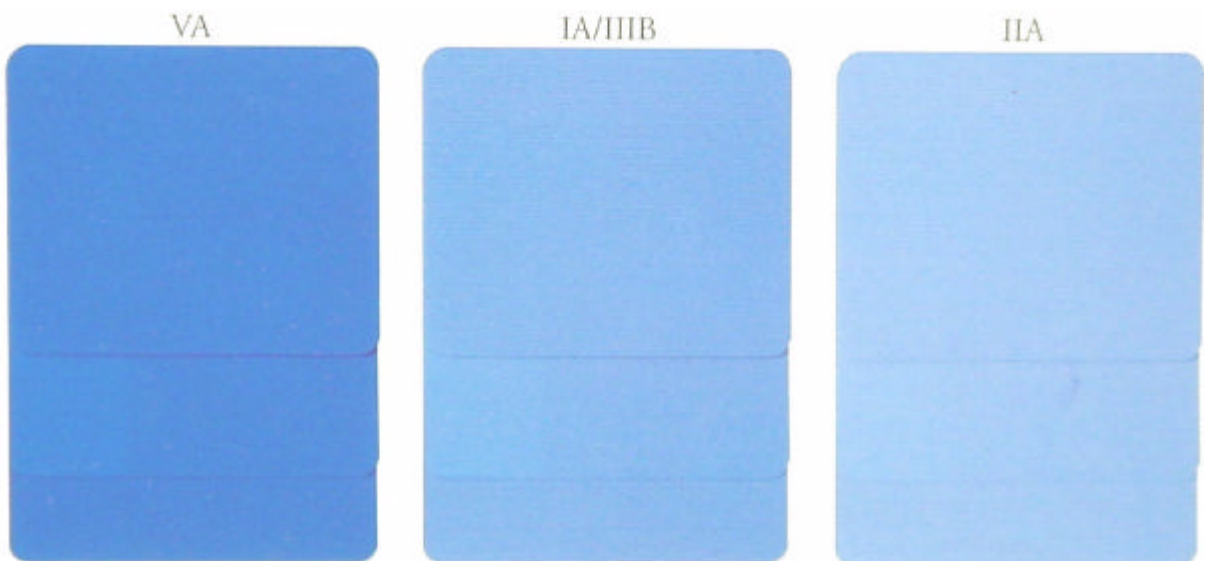
The efficiency of Honeywell's additives to improve dispersion of pigments was evaluated by preparing masterbatches on a Brabender Kneader and measuring the colour strength.

The pigment used in the masterbatch formulation was phthalocyanineblue.

All ingredients in the formulations of table 1 were pre-blended via tumble mixing and then dispersed in a Brabender Kneader at a speed of 100 Rpm for 15 minutes.

Chips were injection moulded to measure colour strength.

Colour strength illustration of phthalocyanineblue formulations



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

Phthalocyanineblue - Experimental formulations

<i>Formulation</i>	IA	IB	IIA	IIB	IIC	IIIA	IIIB	IIIC	IVA	VA
<i>Pigment</i>	25	25	30	30	30	40	40	40	45	50
<i>Resin LDPE</i>	75	65	70	60	60	60	50	50		
<i>LMWPE</i>		10		10	8		10	6		
<i>Aclyn® 295A</i>					2			4	55	50
<i>Colour strength</i>	100	118	72	105	120	65	100	120	140	130

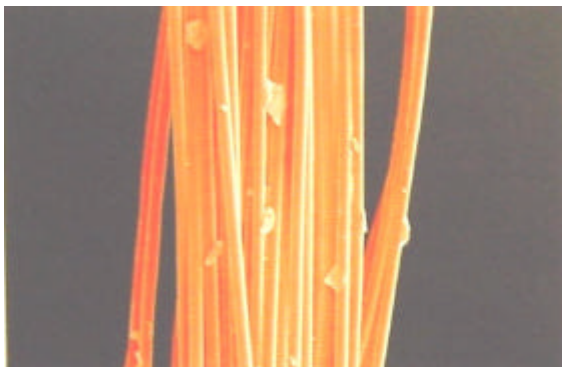
- IA, IIA and IIIA are resin based colour concentrates.
- IB, IIB, IIC, IIIB and IIIC are LMWPE and/or ionomer modified colour concentrates.
- IVA and VA are ionomer based colour concentrates.
- The initial masterbatch IA containing 25 % pigment dispersion without wax is used as the standard and all subsequent results are expressed in percent versus the standard. The phthalocyanineblue is extended 10:1 with titanium dioxide in all cases.
- The higher the pigment concentration, the more indispensable the wax becomes. In formulation IIA and IIIA the pigment is not sufficiently wetted, and will reaggregate, reducing its effectiveness as colorant; this means reduced colour strength.
- The presence of wax/ionomer combinations gives improved colour dispersion. Aclyn® grades are even better pigment wetters than waxes. They possess polar domains within the neutral wax matrix. The ionomers attract the pigment and the wax insulates it from other pigment particles.
- Aclyn® as sole carrier provides the best colour dispersion and allows reaching a higher pigment concentration at the same processing conditions.

2. Wax/ionomer combination for PP fibre applications

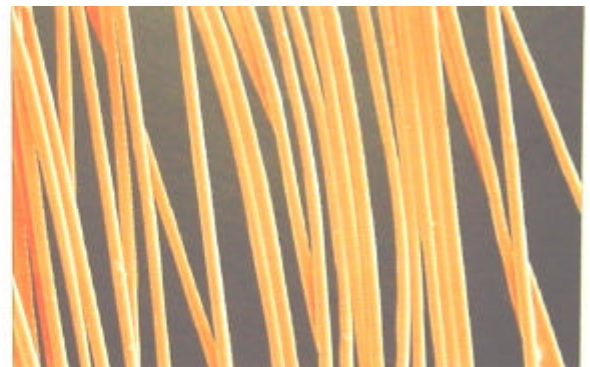
Based on the ionomer/wax performance demonstrated in typical masterbatches, a semi-technical production trial was done on the colouring of PP fibres with a red pigment extremely difficult to disperse. A wax/ionomer combination is tested against a polypropylene wax.

The LMWPE wax/ionomer blend in a PP fibre grade formulation results in a higher quality dispersion versus the tested PP wax. Using the wax/ionomer blends, the spinnability is improved while the elongation is comparable to the standard PP fibre. SEM photographs taken at 200X and 2500X magnification clearly show the absence of micro-defects on the PP fibres treated with the A-C® 8A/Aclyn® 295A combination, while they clearly appear on the fibre with the PP wax.

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

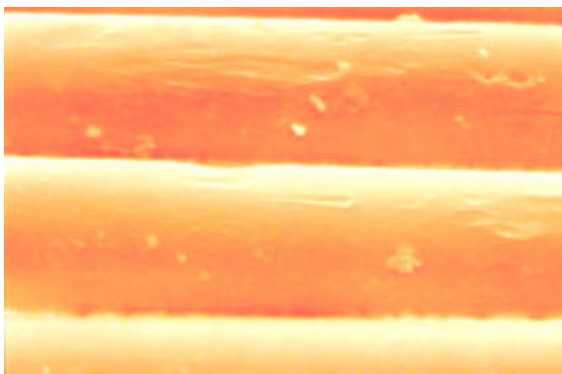


PP WAX

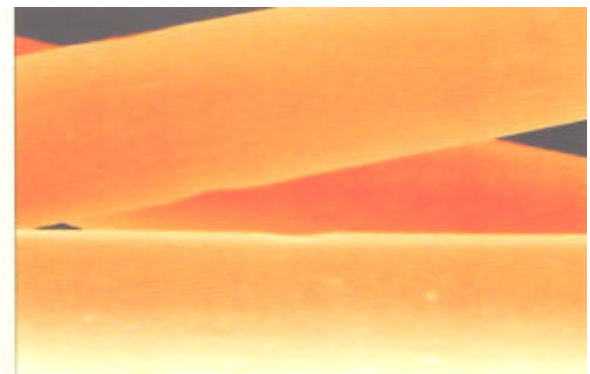


MAGNIFICATION 200 X

WAX / IONOMER



PP WAX



MAGNIFICATION 2500 X

WAX / IONOMER

ISO 9002 CERTIFICATION

Honeywell's production plant in Orange, Texas obtained the ISO 9002 certification by Underwriters Laboratories which registers companies for ISO 9000 in the US. This certification covers all of our commercial product grades.

FOOD CONTACT STATUS OF A-C® WAXES

The United States Food and Drug Administration Regulation for A-C® waxes and copolymers, Acumist® Micronised Polyolefins are covered in brochure GEN-002. Blanket approval is not implied and the user should refer to the specific regulations for details. Further information on European food contact approval is available upon request at Honeywell.

ENVIRONMENTAL CONSIDERATIONS

Users of A-C® polyethylenes should review their operations in terms of applicable governmental laws and regulations and are advised to consult with appropriate regulatory agencies before discharge, treatment or disposal of waste.

SAFETY PRECAUTIONS

Material Safety Data Sheets and safe handling Information are available on request.

PACKAGING/SHIPPING DATA

A-C® polyethylenes are supplied in 25 kg three-ply Kraft bags except for a few products which are supplied in 20 kg LDPE bags to a pallet, net weight 1000 kgs, and stretch-wrapped.

In addition, big bags in double woven coated polypropylene with a net weight from 350 kg to 1000 kg are available.

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