ELEMENTIS

A global specialty chemicals company

Enhanced Performance Through Applied Innovation

Performance Additives and Resins for Solvent-based Systems

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Contents

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Rheological Additives

BENTONE®, BENGEL® and BENTONE SD® organoclay rheological additives are reaction products of highly purified smectite clay (bentonite or hectorite) and a quaternary ammonium salt. When properly selected and activated, they will increase low shear viscosity, reduce sagging and help reduce settling in solvent-based formulations. These 100% active rheological additives are not temperature sensitive and can be activated using polar compounds such as methanol, ethanol or propylene carbonate or chemical activators such as DAPRO® FX 2060 or DAPRO® BEZ 75.

THIXATROL® and THIXCIN® rheological additives are based on castor oil derivatives, polyamide or polyester amide chemistry. They typically must be subjected to appropriate wetting, dispersion forces and minimum temperature requirements to reach an activated structure.

THIXATROL® MAX and THIXATROL® P200X are effective in all solvents, provide excellent sag control, are seed resistant and have a broad activation temperature window.

In MS-Polymer sealants THIXATROL® MAX also provides excellent rheology at low activation temperatures.

THIXATROL® AS 8053 is a 100% active, seed resistant organic rheological additive based on diamide technology. THIXATROL® AS 8053 provides high viscosity build, imparts thixotropy and and allows application at high layer thicknesses .

The low temperature (30 - 60 °C) activation of THIXATROL® AS 8053 makes sealant and paint manufacturing less complex. This consequently often results in a significant cost benefit.

M-P-A® anti-settling agents inhibit pigments and extenders movement in the paint. In most formulations, settling problem will largely be eliminated. These products function by chain entanglement and can be used alone or in combination with a thixotropic additive for enhanced performance.

Product selection is typically dependent on the solvent and reactivity of the system to be modified.

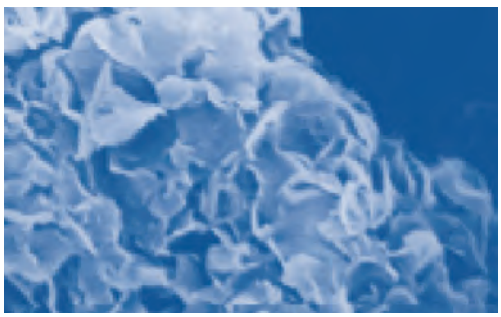
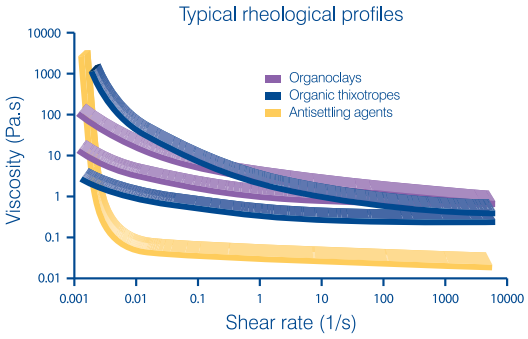
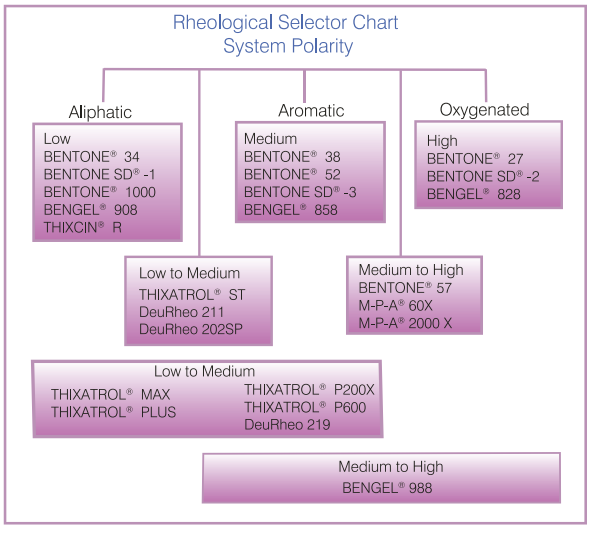
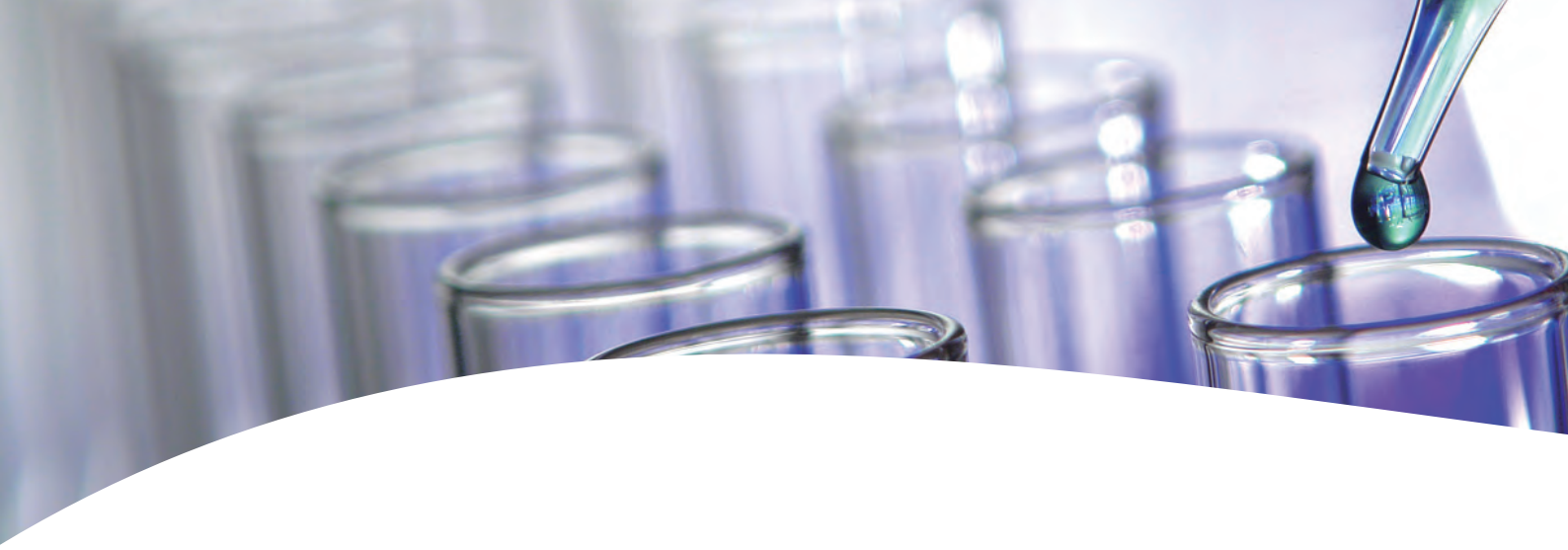


Fig.1 Enlargement of activated organoclay







Wetting and Dispersing Agents

Dispersion of pigments can be generally divided into three stages.

1. Wetting

Wetting is a process in which air and moisture on the pigment surface are replaced by wetting dispersants (as shown in fig 2).

Wetting dispersants can significantly reduce pigment surface tension, speed up pigment wetting, and lower the viscosity of pigment pastes.

Fig. 2 Wetting on pigment surface

2. Dispersion

High-speed or high shear dispersing equipment is used to disperse pigment aggregates thereby producing discrete primary particles which enable optimum flow, color, opacity and optical properties (as shown in Fig. 3).

Fig. 3 Pigment dispersion

3. Stabilization

A wetting dispersant, through its steric effect or electrostatic repulsion, keeps the dispersed and disaggregated pigment particles apart and effectively prevents their re-flocculation (as shown in Fig.4).

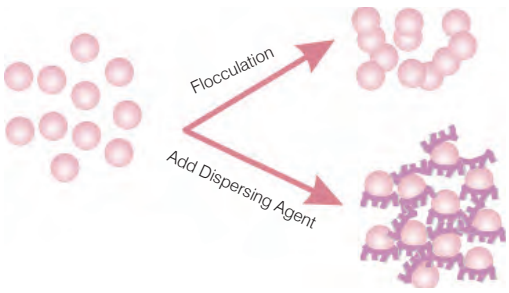


Fig. 4 Pigment stabilization

Wetting and dispersing properties of pigments are usually associated with their shape, size, surface area, oil absorption capacity, surface treatment, acidity and alkalinity, and is also closely related to the polarity, surface tension and viscosity of the paint system. The advantages of NUOSPERSE® and Disponer wetting dispersants are:

- Rapid wetting of the pigment surface to improve grinding efficiency
- Excellent viscosity reduction and dispersion performance
- Good flow of mill base at high pigment loading
- Excellent tinting strength and color development
- Improved flooding, floating and color rub up issues
- Long-term viscosity stability
- Excellent initial gloss and gloss retention
- Elimination of hard settling

NUOSPERSE® AP 657 is a versatile wetting, dispersing and stabilizing aid for non-aqueous systems. It is compatible with a broad range of air drying resin systems as well as plasticizers. It has a very low aromatic content.

NUOSPERSE® FA 196 is a 100 % active dispersing agent for a wide range of pigments and is especially recommended for carbon black. It is effective in reducing rub-up and preventing pigment flooding and floating. This solvent free dispersant is excellent for high performance, low VOC and VOC-free coating formulations.

NUOSPERSE® FA 601 improves opacity, gloss, colour strength, brightness and is very cost efficient.

NUOSPERSE® 2008 is a solvent-free, low odour, wetting and dispersing agent. The product is typically used in high solids, alkyd coatings to improve opacity, gloss and colour strength.

NUOSPERSE® FX 9086 is a 50 % active polymeric dispersing agent for a wide range of pigments. It is universal in application and can be used in formulating high performance coatings and colorants.

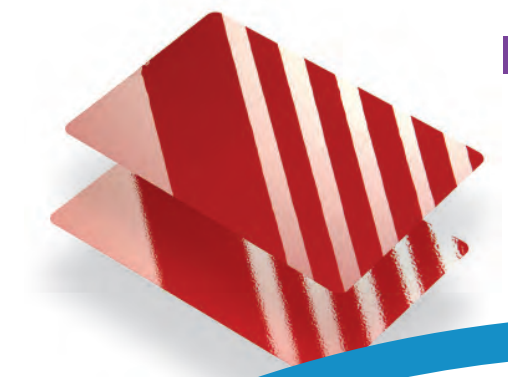
NUOSPERSE® 9100 is a 100 % active, solvent-free acrylic based pigment dispersing polymer in powder form. It can be used as the sole dispersing agent for solvent free, radiation cured and high solids coatings systems.

NUOSPERSE® 15 is a liquid version of NUOSPERSE® 9100 with 65 % active content.

NUOSPERSE® FX 9200 and NUOSPERSE® FX 9360 are newly developed hyperdispersants for use in industrial, automotive coatings and inks (including UV) applications. Based on high molecular weight polymers with multiple pigment affinic groups, they provide exceptional pigment wetting and dispersing efficiency thereby allowing high pigment loading with full color strength development in short dispersion times.

Disponer 9250 is a highly versatile dispersant for all types of TiO_2 resulting in coatings with enhanced storage stability and good color acceptance and compatibility when tinted with colorants.

Disponer 983 and Disponer 9850 are polymeric dispersing agents that are highly effective for dispersing carbon black and organic pigments. They are used in a wide range of high performance solvent-based industrial coatings.



Defoamers

DAPRO® and Defom defoamers are grouped into silicone and silicone-free categories. The broad product line offers a multitude of solutions in combating foam generated during the manufacturing and application processes of solvent-based coatings.

DAPRO® AP 1622 is a highly effective silicone defoamer used in oil and alkyd modified urethanes, nitrocellulose lacquers, chlorinated rubber and epoxies.

DAPRO® DF MOM and Defom 3500 are recommended for air-drying alkyd systems, alkyd-melamine baking enamels, acrylic isocyanate lacquers, nitrocellulose lacquers, acid-curing lacquers and epoxy primers.

Defom 5300 is a general purpose silicone defoamer that provides excellent defoaming and compatibility in industrial solvent-based coatings.

Defom 5800F is an aromatic-free, general purpose defoamer for industrial solvent-based coatings. It shows good system compatibility in various coating systems.

Defom 6800 is a 100% active, aggressive foam-release and anti-foaming agent particularly suited for epoxy floor coatings, epoxy floorings and other high-build systems.

Leveling Agents

Levaslip and Levelol leveling agents and DAPRO® interfacial tension modifiers improve surface slip, leveling and reduce film defects such as crawling, fisheyes, cratering, orange peel and Benard cells. They also promote spreading and uniform film formation on hard to wet or contaminated surfaces. These additives are also effective in overcoming color floating and flooding issues commonly found in solvent-based coatings.

Leveling agents and slip additives quickly migrate to the coating surface to reduce the surface tension of the drying film. They help to level and eliminate the development of Benard cells by providing a uniform surface. In addition, the structure of the modified polysiloxane provides a low coefficient of friction on the coating surface after drying and enhances the surface smoothness, slip and anti-scratch properties.

Levaslip Polysiloxane leveling agents are derived from a polydimethylsiloxane (Fig. 5). Modification of polydimethylsiloxane with polyether is done on pendant methyl groups to improve its compatibility and vary its surface tension. The polyether typically contains ethylene oxide (EO) and/or propylene oxide (PO) chains (Fig. 6).

By adjusting the ratio of hydrophilic (EO) and lipophilic (PO) groups, polarity of the additives can be controlled to provide good compatibility in high/low polarity coating systems. This in turn influences the leveling and foaming behaviors of the additives. Modified polysiloxanes are particularly effective in minimizing orange peel caused by short wave.

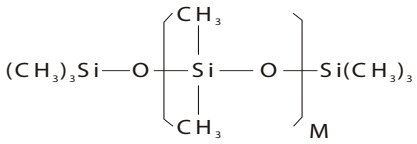
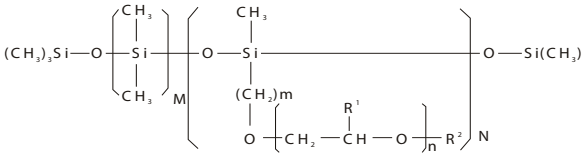


Fig. 5 Polydimethylsiloxane



EO Modification: R^1 =H PO Modification: R^1 = CH_3

Fig. 6 Polyether modified polydimethylsiloxane

Silicone-based leveling agents can migrate to the coating surface and negatively affect recoatability of dried film. Where the use of polysiloxane leveling agents is not recommended, Levelol polyacrylate leveling agents are the best alternative for systems requiring recoatability such as primers. They not only enhance film smoothness, but also promote leveling speed and substrate wetting. For enhanced performance, fluorocarbon-modified products such as Levelol 837 and Levelol 839 are recommended.

DAPRO® Interfacial Tension Modifiers

These products are designed to eliminate or reduce coating defects, such as orange peel, fish eyes and cratering. They also improve leveling of paint films. DAPRO® interfacial tension modifiers have excellent recoatability.

DAPRO® S-65 is generally effective in high solids and conventional polyesters and acrylics.

whereas DAPRO® U-99 is generally more effective in two-component epoxies and alkyds.The latter can also be used in water based systems.

Organoclays

Product	Composition	Form	Active %	Chemical Activator
BENATHIX®	Organically modified smectite clay	Powder	100	Not required
BENGEL® 434	Organic derivative of a bentonite clay	Powder	100	Recommended
BENGEL® 658	Organic derivative of a bentonite clay	Powder	100	Not required
BENGEL® 818	Organic derivative of a bentonite clay	Powder	100	Not required
BENGEL® 828	Organic derivative of a bentonite clay	Powder	100	Not required
BENGEL® 858	Organic derivative of a bentonite clay	Powder	100	Recommended
BENGEL® 908	Organic derivative of a bentonite clay	Powder	100	Recommended
BENGEL® 938	organic derivative of a bentonite clay	Powder	100	Recommended
BENGEL® 958	Organic derivative of a bentonite clay	Powder	100	Not required
BENGEL® 988	Organic derivative of a bentonite clay	Powder	100	Not required
BENTONE® 27	Organic derivative of a hectorite clay	Powder	100	Recommended
BENTONE® 34	Organic derivative of a bentonite clay	Powder	100	Recommended
BENTONE® 38	Organic derivative of a hectorite clay	Powder	100	Recommended
BENTONE® 52	Organic derivative of a bentonite clay	Powder	100	Recommended
BENTONE® 54	Organic derivative of a bentonite clay	Powder	100	Recommended
BENTONE® 1000	Organic derivative of a bentonite clay	Powder	100	Beneficial
BENTONE SD® -1	Organic derivative of a bentonite clay	Powder	100	Not required
BENTONE SD® -2	Organic derivative of a bentonite clay	Powder	100	Not required
BENTONE SD® -3	Organic derivative of a smectite clay	Powder	100	Not required

Shear Energy	Principal Use	Use Level %	Product
Medium	Suitable for medium-to-high polarity solvent-based coatings, inks and unsaturated polyester gel coats	0.5 - 1.0	BENATHIX®
High	Low polarity aliphatic and aromatic systems	0.3 - 1.2	BENGEL® 434
High	Low polarity aliphatic and aromatic systems	0.2 - 1.5	BENGEL® 658
High	Low polarity aliphatic and aromatic systems	0.2 - 2.0	BENGEL® 818
High	High polarity aromatic and oxygenated systems	0.2 - 2.0	BENGEL® 828
High	Medium polarity aliphatic and aromatic systems	0.2 - 2.0	BENGEL® 858
High	Low polarity aliphatic and aromatic systems	0.2 - 2.0	BENGEL® 908
High	medium polarity aliphatic and aromatic systems	0.2 - 2.0	BENGEL® 938
High	Low polarity aliphatic and aromatic systems	0.2 - 1.5	BENGEL® 958
Medium	Suitable for medium-to-high polarity solvent-based coatings & inks	0.2 - 2.0	BENGEL® 988
High	High polarity aromatic and oxygenated systems	0.2 - 1.0	BENTONE® 27
High	Low polarity aliphatic and aromatic systems	0.2 - 1.0	BENTONE® 34
High	Medium polarity aliphatic and aromatic systems	0.2 - 1.0	BENTONE® 38
High	Low-medium polarity aliphatic and aromatic systems	0.2 - 1.0	BENTONE® 52
High	Low-medium polarity aliphatic and aromatic system	0.2 - 1.0	BENTONE® 54
High	Low polarity aliphatic and aromatic systems	0.2 - 1.0	BENTONE® 1000
Medium	Low polarity aliphatic and aromatic systems	0.2 - 2.0	BENTONE SD®-1
Medium	High polarity aromatic and oxygenated systems	0.2 - 1.0	BENTONE SD®-2
Medium	Medium polarity aliphatic and aromatic systems	0.2 - 1.0	BENTONE SD®-3

Organic Rheological Additives

Product	Composition	Solvent	Form	Active %
THIXATROL® AS 8053	Proprietary organic	None	Powder	100
THIXATROL® MAX	Proprietary organic	None	Powder	100
THIXATROL® PLUS	Proprietary organic	None	Powder	100
THIXATROL® P600	Polyamide wax	None	Powder	100
THIXATROL® P200N	Special polyamide wax	Ethanol, etc.	Paste	19 - 21
THIXATROL® P220X	Special polyamide wax	Xylene/alcohols	Paste	19 - 21
THIXATROL® P220XF	Special polyamide wax	BTX-free solvent	Paste	19 - 21
THIXATROL® P240X	Special polyamide wax	Xylene/alcohols	Paste	19 - 21
THIXATROL® P260X	Special polyamide wax	Xylene/alcohols	Paste	19 - 21
THIXATROL® PM 8056	Proprietary organic	None	Powder	100
THIXATROL® ST	Organically modified castor oil derivative	None	Powder	100
THIXATROL® UV 1104	Polyester	None	Liquid	100
THIXCIN® R	Organic derivative of castor oil	None	Powder	100
M-P-A® 10X	Complex polyolefin compound	Xylene	Liquid	9 - 11
M-P-A® 1078-X	Organic compound	Xylene	Paste	40
M-P-A® 20X	Complex polyolefin compound	Xylene	Liquid	19 - 21
M-P-A® 2000-X	Organic compound	Xylene	Liquid	20
M-P-A® 4020BA	Proprietary organic	N-butyl acetate/ mixed esters	Liquid	20
M-P-A® 4020 X	Proprietary organic	Xylene	Liquid	20
M-P-A® 60-X	Organic compound	Xylene	Paste	24
M-P-A® E106A	Synthetic wax	Xylene, butyl acetate and alcohol	Liquid	5 - 7
M-P-A® H105	Complex polyolefin	Xylene	Paste	4 - 6

Activator	Principal Use	Use Level %	Product
Temperature control and dwell time requirements	Hybrid sealants, industrial coatings, epoxy primers and polyurethane top coat systems	0.5 - 3.5	THIXATROL® AS 8053
Temperature control and high shear forces	Low-high polarity systems	0.2 - 2.0	THIXATROL® MAX
Temperature control and high shear forces	Conventional and high build industrial coatings	0.2 - 2.0	THIXATROL® PLUS
Temperature control and high shear forces	Heavy duty coatings, epoxy paint, chlorinated rubber, alkyd paint	1.0 - 3.0	THIXATROL® P600
Suitable for post-add	Solvent-based coatings, ink systems, sealants	1.0 - 5.0	THIXATROL® P200N
Suitable for post-add	Solvent-based coatings, ink systems, sealants	1.0 - 5.0	THIXATROL® P220X
Suitable for post-add	Solvent-based coatings, ink systems, sealants	1.0 - 5.0	THIXATROL® P220XF
Suitable for post-add	Solvent-based coatings, ink systems, sealants	1.0 - 5.0	THIXATROL® P240X
Suitable for post-add	Solvent-based coatings, ink systems, sealants	1.0 - 5.0	THIXATROL® P260X
Temperature control and dwell time requirements	Industrial coatings, 2C epoxy primers, two component polyurethane top coat systems and solvent-free epoxy systems	0.5 - 2.0	THIXATROL® PM 8056
Temperature control and high shear forces	Low polarity aliphatic and aromatic systems	0.2 - 0.8	THIXATROL® ST
Temperature and shear forces	High solids or 100 % NV pigmented UV systems	0.2 - 0.6	THIXATROL® UV 1104
Temperature control and high shear forces	Low polarity aliphatic systems	0.2 - 0.8	THIXCIN® R
Temperature control and high shear forces	Prevent pigment settling, especially for metallic paint	2.0 - 5.0	M-P-A® 10X
Temperature and high shear forces	Industrial coatings, traffic paint, marine coatings	0.5 - 1.0	M-P-A® 1078-X
Temperature control and high shear forces	Anti-settling for pigment, metallic and pearlescent paint in solvent-based coatings	0.5 - 2.0	M-P-A® 20X
Temperature and high shear forces	Medium-high polarity aromatic and oxygenated systems	0.5 - 2.0	M-P-A® 2000-X
Temperature and high hear forces	Medium-high polarity aromatic and oxygenated HAPS free systems	2.0 based on industrial coating	M-P-A® 4020BA
Temperature and high shear forces	Medium-high polarity aromatic and oxygenated systems	1.0 - 2.0	M-P-A® 4020 X
Temperature and high shear forces	Medium-high polarity aromatic and oxygenated systems	0.5 - 1.0	M-P-A® 60-X
High shear forces	Car refinish, slip agent for can and coil coatings, aluminium orientation	80 - 150 based on aluminium paste	M-P-A® E106A
High shear forces	Metallic paint and pearlescent coatings	3.0 - 10.0	M-P-A® H105

Wetting and Dispersing Agents

Product	Composition	Solvent	FP* °C	Form	SG*
NUOSPERSE® 15	Modified thermo-plastic acrylic polymer	PMA	42	Liquid	1.04
NUOSPERSE® 2006	Multi functional anionic & non-ionic surfactant	Water	>100	Liquid	1.09
NUOSPERSE® 2008	Multi functional surfactant	None	>100	Liquid	1.04
NUOSPERSE® AP 657	High molecular weight polyester	Naphtha (petroleum), hydrotreated heavy	57	Liquid	0.95
NUOSPERSE® FA 196	Surface active compound	None	>100	Liquid	1.04
NUOSPERSE® FA 601	Combination of surface active agents in solution	Solvent mixture	40 - 42	Liquid	1.01
NUOSPERSE® FX 9086	Polymeric surfactant dissolved in methoxy propyl acetate	PMA	42	Liquid	1.02
NUOSPERSE® FX 9200	Highly branched copolymer containing multiple anchoring groups	None	>100	Powder	1.13
NUOSPERSE® FX 9360	Highly branched copolymer containing multiple anchoring groups	N-Butyl acetate	31	Liquid	0.98
Disponer 903	Modified polysiloxane	Xylene/i-butyl alcohol	24	Liquid	ca. 0.85
Disponer 904	High molecular weight carboxylic acid	Xylene/diisobutyl ketone	33	Liquid	ca. 0.94
Disponer 904S	Solution of polycarboxylic acid polymer with modified polysiloxane	Xylene/diisobutyl ketone	33	Liquid	0.92 - 0.95
Disponer 912A	Solution of a salt of polyamide and polyester, electroneutral	Xylene/Isobutyl alcohol	28	Liquid	ca. 0.91
Disponer 923	Electroneutral amine salt of polycarboxylic acid	Aromatic hydrocarbon solvent	49	Liquid	ca. 0.89
Disponer 923S	Electro-neutral amine salt of polycarboxylic acid with modified polysiloxane	Aromatic hydrocarbon solvent	49	Liquid	ca. 0.89

* FP: Flash Point
* SG: Specific Gravity

Active %	Principal Use	Use Level %	Product
65	Colorants for industrial coatings	2 - 10 on total formulation-added in millbase	NUOSPERSE® 15
62 - 65	Medium duty industrial coatings systems	0.1 - 1.0 on total formulation-added in millbase	NUOSPERSE® 2006
100	Solvent-free epoxy systems, solvent-free epoxy coatings	0.1 - 0.5 on total formulation-added in millbase	NUOSPERSE® 2008
70 - 75	Industrial and alkyd based systems	0.5 - 2.5 calculated on the pigment paste	NUOSPERSE® AP 657
100	High performance coatings, especially interesting for high solids and VOC free systems	1 - 10 on total formulation-added in millbase	NUOSPERSE® FA 196
50	Architectural and industrial coatings	0.1 - 1.0 on total formulation-added in millbase	NUOSPERSE® FA 601
50	Industrial coatings	5 - 35 on the total weight of paste or tinter	NUOSPERSE® FX 9086
100	Inks	5 - 40 organic pigments and carbon black	NUOSPERSE® FX 9200
38 - 42	Colorants, automotive and plastic coatings	20 - 40 organic pigments 50 - 150 carbon black	NUOSPERSE® FX 9360
8.5 - 10.5	Solvent-based colored paint	0.1 - 1.0 based on total formulation	Disponer 903
49 - 51	Medium to high polarity solvent and solvent-free systems	0.5 - 3.0 inorganic pigments 2.0 - 5.0 organic pigments	Disponer 904
49 - 51	Medium to high polarity solvent and solvent-free systems	0.5 - 3.0 inorganic pigments 2.0 - 5.0 organic pigments	Disponer 904S
48 - 52	Solvent-based coatings, wood primer	0.2 - 5.0 based on inorganic pigment 0.2 - 0.4 based on wood primers 10 - 50 based on the organic bentonite	Disponer 912A
48 - 52	Medium to high polarity inorganic pigment systems	As dispersant: 0.5 - 2.0 based on total pigments As organoclay activator: 30 - 50 based on BENTONE®	Disponer 923
38 - 41	Medium to high polarity inorganic pigment systems	As dispersant: 0.5 - 2.0 based on total pigments As organoclay activator: 30 - 50 based on benton	Disponer 923S

Wetting and Dispersing Agents

Product	Composition	Solvent	FP* °C	Form	SG*
Disponer 9250	Solution of a copolymer with acidic groups	Solvent naphtha/ propylene glycol methyl ether acetate	45	Liquid	1.01 - 1.05
Disponer 926	Anionic surfactant	None	370	Liquid	ca. 1.04
Disponer 929	Anionic surfactant	Xylene/aromatic hydrocarbon solvent/ n-butyl acetate	36	Liquid	ca. 0.93
Disponer 983	High molecular weight polymer	Xylene/butyl acetate	34	Liquid	0.95 - 0.99
Disponer 9850	Modified polyurethane	Xylene/propylene glycol monomethyl ether acetate/n-butyl acetate	30	Liquid	0.97 - 1.01

* FP: Flash Point
* SG: Specific Gravity

Active %	Principal Use	Use Level %	Product
48.5 - 51.5	Acrylic/melamine, acrylic polyurethane	2 - 5 based on pigment	Disponer 9250
82 - 88	Medium to high polarity organic pigment systems	Organic pigment: 1.0 - 3.0 based on pigment Inorganic pigment: 0.5 - 1.5 based on pigment	Disponer 926
48 - 51	Organic pigment systems	As a sole grinding vehicle: 20 - 50 based on total formulation As a wetting and dispersing agent: 20 - 80 based on carbon black	Disponer 929
52.5 - 54.5	Solvent-based coatings	Carbon black: 20 - 80 based on pigment	Disponer 983
44 - 47	Acrylic/melamine, alkyd/melamine, acrylic polyurethane	40 - 120 based on pigment	Disponer 9850

Enhanced Performance Through Applied Innovation

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