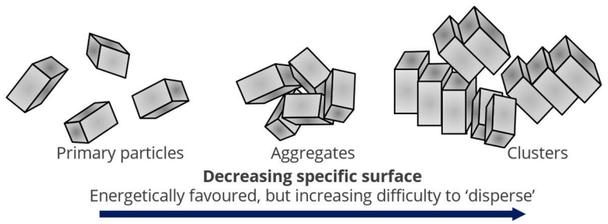
Protective and decorative properties are important performance issues of coating, ink and composite systems. Many are produced as solid colors with excellent hiding power to fulfill esthetic requirements. With increasing complexity and a large number of solid ingredients introduced in the liquid formulation, there is a corresponding increase in the problems to overcome.

The addition of dispersion control additives can provide solutions to many of these problems.

The dispersing of solid pigments and fillers into the liquid phase of binder solutions is an important step in production influencing optical properties such as gloss, color strength, and hiding power.

Dispersion control additives are used to improve and accelerate the dispersion process and to stabilize the dispersion during storage.

In the production of pigments, finely dispersed primary particles are formed. During the purification and drying process, primary particles come together and form pigment clusters or agglomerates. These clusters are in their lowest thermodynamic state, that is, the most stable physical state for the pigment.




During the grinding process, these clusters can be broken down to the level of primary particles. The grinding process in the liquid phase consists of three processes:

- Breaking up the pigment clusters (Normally accomplished by mechanical energy-**Grinding**)
- Wetting of the pigment surface (Involving the displacement of air and other adsorbents on particles in the pigment cluster-**Wetting**)
- Stabilization of the homogeneous distribution (**Dispersing**)

Once dispersed, primary particles have a tendency to re-agglomerate. This process is called 'flocculation'. The grinding process can be regarded as a de-flocculation process .

Flocculation is the association of pigment particles, which have been dispersed in a liquid medium, and is the result of forces of attraction (e.g. van der Waals) between the particles. Flocculation reduces the size of the phase boundary between pigment and dispersion medium leading to reduced color strength and brightness in the finished film.

The task for the formulator is to stabilize the de-flocculated state of the pigment in the formulation.

Two main stabilization mechanisms can be distinguished:

### Electrostatic stabilization

Electrostatic stabilization takes place when particles bear the same electrical surface charges and as a result, repulsion occurs. The charge around the particle is arranged into a double layer in which each layer possesses an equal charge.
When two particles approach one another, their charged double layers overlap and repulsion takes place.

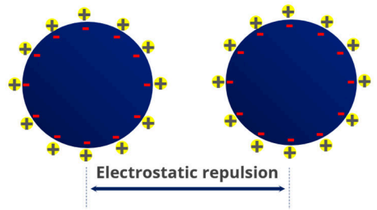
### Steric stabilization

Steric stabilization is brought about by adsorbed polymers.
Polymers must strongly adsorb on the pigment surface by appropriate functional groups (Anchoring groups) and must have sufficiently long chain segments (barrier groups) which readily dissolve in the dispersion medium (organic solvents or water), a process that leads to widening of polymer chains.

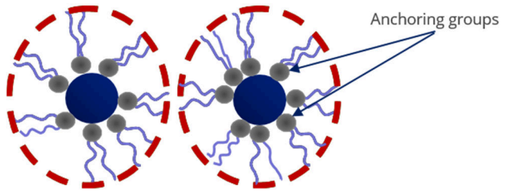
This stabilization is dependant upon the structure and dimensions of the adsorbed polymer layer.








The polymer can adsorb onto the particle through so-called 'anchoring groups', which have strong affinity toward the particle surface. The remainder of the polymer can be seen as dissolved and can extend into the resin medium. These extended parts of the stabilizing polymer are the first point of contact between two approaching particles.




**Steric stabilization**

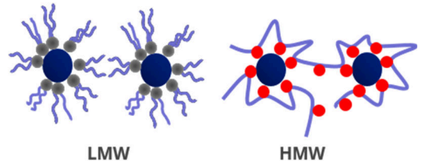
We offer two types of dispersion control additives:

**Low molecular weight** (LMW)

- 800 g/mol < Molecular weight < 2,000 g/mol
- Categorized according to their chemical structure and the nature of their hydrophilic groups (amphoteric, cationic, etc.)
- The interaction of their polar groups with the pigment surface and the behavior of the non-polar chains in the medium determine their effectiveness
- Only used for stabilizing inorganic pigments and extenders
- They reduce liquid surface tension & interfacial tension solid/liquid
- Good for wetting and reduction of dispersing time
- They have generally good compatibility to all kinds of resin systems
- They reduce flooding and floating tendencies and exhibit anti-settling properties

**Hight molecular weight** (HMW)

- 5,000 g/mol < Molecular weight < 35,000 g/mol
- They are built of branched or long linear molecules, which in general have a PU, polyacrylate, polyester or block copolymer structure
- Designed to adsorb via special groups with high affinity towards specific sites on the pigment surface. These are called anchoring groups, and are built in at strategic points on the polymer backbone
- Suited for inorganic and organic pigments, in addition to carbon black pigments
- Anchoring groups enable strong interaction between the dispersion control additive and the pigment surface
- This interaction is much stronger than in the case of the low molecular weight types as the dispersion control additive is bound to numerous sites (Multi-adsorption) on the surface via the anchoring groups assuring an efficient steric hindrance between the solid particles by keeping them apart.




To achieve the best de-flocculation/stability effect of pigment dispersions, one must consider the compatibility of the dispersion control additive with the vehicle, quantity of the dispersion control additive in relation to pigment and proper application procedure.

A quick preliminary test can be carried out to ensure that no major errors are made in the initial choice of the dispersion control additive. The test is done by mixing the dispersant with the main let-down vehicle in the ratio 90:10. This test, however, is not indicative of the effectiveness of the dispersion control additive. It can only predict possible deficiencies in de-flocculation performances (loss of gloss) and, in the case of mixed pigments, the risk for floatation.

Dispersion Control Additives KAM-DCA®

| Trade name | Description/Composition | Dosage %<br>Supplied form based upon pigment<br>Inorganics\|Organics\|Blacks\|Bentonites | Solids % | Features & benefits | Acid curable | Acrylic OH-functional | Acrylic self-crosslinking | Acrylic thermoplastic | Long-oil alkyd | Medium-oil alkyd | Short-oil alkyd | Alkyd & PE OH-functional | Alkyd & PE melamine | Chlorinated rubber | Solvent-based epoxy | Solvent-free epoxy | Nitrocellulose | Unsaturated polyester | Silicon resin | Vinyl copolymer | Acrylic emulsion | Acrylic water-reducible | Alkyd emulsion | Alkyd melamine | Alkyd water-reducible | Epoxy | Polyester melamine | Polyurethane emulsion | 2K polyurethane | UV Curable | Packaging inks (Gravure/Flexo/Screen) | Water-based inks | Ambient Curing Systems | SMC/BMC | PVC (Plastisols/Compounds) | Thermoplastics | PUR Foams | Water-based | Solvent-based | Solvent-free & Reactive |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Solvent-based Coating | | | | | | | | | | | | | | | | Water-based Coating | | | | | | | | | Ink | | | Composite | | | | | | A & S* | | |
| **KAM-DCA 44** | Unsaturated polyamide and acid ester salts | 0.5-2 \| 2-5 \| -- \| 30-50 | 52 | Solvent-based or solvent-free coating systems. Suitable for bentonite gels | | | | | ● | ● | ● | ● | ● | | ● | ● | | ● | | | | | | | | | | | | | | | | | | | | | | | |
| **KAM-DCA 54** | HMW carboxylic acid salts | 0.5-2 \| -- \| -- \| 30-50 | 52 | Non- to medium-polar coating systems. Anti-sagging properties | | | | | ● | | | | | ● | ● | ● | | | | | | | | | | | | | | | | | | | | | | | | | |
| **KAM-DCA 46** | Modified polyurethane with pigment affinic groups | 11-22 \| 33-65 \| 90-110 \| -- | 40 | General-use industrial coatings | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | | ● | | | | | | | | | | | | | | | | | | | |
| **KAM-DCA 47** | HMW block copolymer with pigment affinic groups | 5-15 \| 30-90 \| 70-130 \| -- | 30 | High-end industrial finishes including OEM and car refinish. Ideal for carbon blacks | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | | | | | | | | | | ● | | | | | | | | | | |
| **KAM-DCA 65** | Polycarboxylic acid polymer & a polysiloxane copolymer | 0.5-10 \| 10-20 \| -- \| -- | 52 | Polyurethane systems and stoving enamels. Anti-floating agent. Good for Al flake orientation | ● | ● | | | ● | | ● | ● | ● | | ● | ● | ● | | | | | | | | | | | | | | ● | | | | | | | | | | |
| **KAM-DCA 66** | Polycarboxylic acid polymer | 0.5-10 \| 10-20 \| -- \| -- | 52 | Polyurethane systems and stoving enamels. Strong anti-settling effect | ● | ● | | | ● | | ● | ● | ● | | | | ● | | | | | | | | | | | | | | | | | | | | | | | | |
| **KAM-DCA 76** | Alkylammonium salt of a HMW block copolymer | 3-10 \| 10-30 \| 15-50 \| -- | >97 | Concentrates for polyols, PVC plastisols and color masterbatches. Ideal for carbon blacks | | | | | | | | | | | ● | ● | ● | | | | | | | | | | | | | | ● | | | | ● | ● | ● | | ● | ● |
| **KAM-DCA 100** | Unsaturated polyamide and acid ester salts | 0.2-1 \| 1-3 \| -- \| -- | >97 | Solvent-based and solvent-free industrial and architectural coatings | | | | | ● | ● | ● | ● | ● | | ● | ● | | ● | | | | | | | | | | | | | | | | ● | ● | | | | | | ● |
| **KAM-DCA 102** | Solution of nonionic surfactant | 1.0-7 \| 7-12 \| 10-15 \| -- | 65 | Solvent-based architectural and decorative paints | | | | | ● | ● | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **KAM-DCA 107** | OH-functional carboxylic acid ester | 0.9-5 \| 6-9 \| 8-11 \| -- | 90 | Solvent-based architectural and decorative paints as well as printing inks | | | | | ● | ● | ● | | | | | | ● | | | | | | | | | | | | | | | | | | | | | | | |
| **KAM-DCA 108** | OH-functional carboxylic acid ester | 0.8-5 \| 5-8 \| 8-10 \| -- | >98 | Solvent-based architectural and decorative paints as well as printing inks | | | | | ● | ● | ● | | | | | | ● | | | | | | | | | | | | | | ● | | | | ● | | | | | |
| **KAM-DCA 110** | Solution of a copolymer with acidic groups | 2-10 \| -- \| -- \| -- | 52 | Solvent-based coatings and printing inks for stabilizing titanium dioxide/inorganic pigments | ● | ● | ● | ● | | | | ● | ● | | ● | | ● | ● | | | | | | | | | | | | | | | | | | | | | ● | |
| **KAM-DCA 111** | Copolymer with acidic groups | 1-5 \| -- \| -- \| -- | 100 | Solvent-based and solvent-free coatings for stabilizing titanium dioxide/inorganic pigments | ● | ● | ● | | | | | ● | ● | | ● | ● | ● | ● | | | | | | | | | | | | | | | | | | | | | ● | ● |
| **KAM-DCA 150** | Acidic polyether | 1-3 \| -- \| -- \| -- | 100 | PVC and thermoplastics applications/Liquid and solid color masterbatches | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | ● | ● | | ● | ● |
| **KAM-DCA 161** | HMW block copolymer | 5-15 \| 30-90 \| 70-130 \| -- | 30 | High-end industrial finishes including OEM and car refinish. Ideal for carbon blacks | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | | | | | | | | | | | ● | | | | | | | | | | |
| **KAM-DCA 163** | Block copolymer | 10-20 \| 30-60 \| 80-100 \| -- | 45 | Solvent-based coatings, including automotive topcoats and high-quality industrial coatings | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | ● | | ● | | | | | | | | | | | | | | | | | ● | | | |
| **KAM-DCA 163A** | Block copolymer | 12-23 \| 33-65 \| 90-112 \| -- | 40 | Solvent-based coatings, including automotive topcoats and high-quality industrial coatings | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | ● | | | | | | | | | | | | | | | | | | | | ● | | | |
| **KAM-DCA 190** | Block copolymer | 8-35 \| 35-70 \| 40-110 \| -- | 40 | Water-based industrial coatings. Ideal for pigment concentrates | | | | | | | | | | | | | | | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | ● | | | | | | | ● | | |
| **KAM-DCA 192** | Copolymer with pigment affinic groups | 3-35 \| 15-30 \| 15-45 \| -- | >98 | Waterborne coating systems, printing inks, liquid color masterbatches and unsaturated polyester | | | | | | | | | | | | | | ● | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | ● | ● | | | ● | | ● | | |

● Suitable/Recommended

● Potentially suitable

* Adhesives and Sealants

Dispersion Control Additives KAM-DCA®

| Trade name | Description/Composition | Dosage %<br>Supplied form based upon pigment<br>Inorganics\|Organics\|Blacks\|Bentonites | Solids % | Features & benefits | Acid curable | Acrylic OH-functional | Acrylic self-crosslinking | Acrylic thermoplastic | Long-oil alkyd | Medium-oil alkyd | Short-oil alkyd | Alkyd & PE OH-functional | Alkyd & PE melamine | Chlorinated rubber | Solvent-based epoxy | Solvent-free epoxy | Nitrocellulose | Unsaturated polyester | Silicon resin | Vinyl copolymer | Acrylic emulsion | Acrylic water-reducible | Alkyd emulsion | Alkyd melamine | Alkyd water-reducible | Epoxy | Polyester melamine | Polyurethane emulsion | 2K polyurethane | UV Curable | Packaging inks (Gravure/Flexo/Screen) | Water-based inks | Ambient Curing Systems | SMC/BMC | PVC (Plastisols/Compounds) | Thermoplastics | PUR Foams | Water-based | Solvent-based | Solvent-free & Reactive |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Solvent-based Coating | | | | | | | | | | | | | | | | Water-based Coating | | | | | | | | | Ink | | Composite | | | | | | A & S* | | |
| **KAM-DCA 206** | Alkyl hydroxyl ammonium salt of uns. fatty acids | 0.5-2 \| -- \| -- \| 30-50 | 30 | Low-end water- and solvent-based paints such as primers and under-coats. Anti-settling | | | | | ● | ● | ● | ● | | ● | | | | | | | ● | ● | ● | | ● | | | | | | | | | | | | ● | | |
| **KAM-DCA 225** | Fatty-acid based polymer | 5-10 \| 10-20 \| 25-50 \| -- | 98 | Universal colorants for solvent- and water-based architectural and decorative paints | | | | ● | | | | | | | | | | | | | ● | ● | ● | | ● | ● | | | | | | | | | | | | | |
| **KAM-DCA 401** | Modified polyurethane | 2-10 \| 20-40 \| 30-60 \| -- | 50 | General-use industrial coatings. Ideal for the preparation of matting agent paste | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | | | | | | | | | | | | | | | | | | | | | | |
| **KAM-DCA 402** | Block copolymer with pigment affinic groups | -- \| 35-50 \| 35-50 \| -- | 70 | Solvent-based inks. Specially recommended for resin-free pigment concentrates | | | | | | | | | | | | | ● | | | | | | | | | | | | | | ● | | | | | | | | |
| **KAM-DCA 409** | Modified polyurethane with pigment affinic groups | 5-10 \| 30-50 \| 40-80 \| -- | 60 | Multi-purpose high molecular weight dispersion control additive for solvent-based coatings | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | | ● | | | | | | | | | | | | | | | | | | |
| **KAM-DCA 610A** | Solution of an acidic polyester polyamide | 1-10 \| -- \| -- \| -- | 50 | Solvent-based coatings and printing inks for stabilizing titanium dioxide/inorganic pigments | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | | ● | ● | | | | | | | | | | | | | | | | | | | | ● | |
| **KAM-DCA 615** | Acidic polyester polyamide | 0.5-2 \| -- \| -- \| -- | 98 | Car putties, solvent-free epoxies and PU. UPE resin systems (SMC/BMC) | | | | | | | | | | ● | ● | ● | | ● | | | ● | | ● | | ● | ● | ● | ● | | | ● | ● | ● | | | | ● | ● |
| **KAM-DCA 671** | Alkylol ammonium salt of a HMW carboxylic acid | 0.5-2 \| 2.5-5 \| -- \| -- | 52 | Water- and solvent-based systems. It prevents hard sedimentation and sagging | | ● | ● | ● | ● | ● | ● | | | | ● | ● | ● | | | | ● | ● | ● | | ● | ● | ● | ● | ● | | | ● | ● | | | | | ● | |
| **KAM-DCA 876** | Alkylammonium salt of a HMW block copolymer | 5-15 \| 15-30 \| 15-50 \| -- | >97 | Concentrates for polyols, PVC plastisols and color masterbatches. Ideal for carbon blacks | | | | | | | | | | | ● | ● | ● | | | | | | | | | | | | ● | | | ● | ● | ● | | ● | ● |
| **KAM-DCA 940** | Polycarboxylic acid polymer & a polysiloxane copolymer | 0.5-3 \| 2.5-5 \| -- \| -- | 52 | Color pastes and gel coats based on UPE resin. Anti-floating and anti-settling properties | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | ● | ● | | | | ● | |
| **KAM-DCA 980** | Unsaturated polyamide and acid ester salts | 0.1-1.5 \| -- \| -- \| -- | 80 | Car putties, adhesives and filled SMC and BMC systems based on UPE resin. | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | | ● | | | | ● | |
| **KAM-DCA 2150** | Block copolymer | 10-15 \| 30-60 \| 60-140 \| -- | 52 | Solvent-based coatings and pigment concentrates. broad compatibility. Ideal for NC and TPA | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | ● | | | | | | | | | | | | | | | | | ● | | | |
| **KAM-DCA 2163** | Block copolymer | 10-20 \| 30-60 \| 80-100 \| -- | 45 | Solvent-based coatings, including automotive topcoats and high-quality industrial coatings | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | ● | | ● | | | | | | | | | | | | | | | | | ● | | | |
| **KAM-DCA N40** | Solution of a sodium salt of an acrylic polymer | 0.5-2 \| -- \| -- \| -- | 44 | Low viscosity dispersion control additive for water-based coating systems | | | | | | | | | | | | | | | | | ● | ● | ● | | ● | ● | ● | | | | | | | | | | | ● | | |
| **KAM-DCA A40** | Solution of an ammonium salt of an acrylic polymer | 0.5-2 \| -- \| -- \| -- | 44 | Low viscosity dispersion control additive for water-based coating systems | | | | | | | | | | | | | | | | | ● | ● | ● | | ● | ● | ● | | | | | | | | | | | ● | | |
| **KAM-DCA P90** | Solution of an ammonium salt of an acrylic polymer (economical grade) | 0.5-2 \| -- \| -- \| -- | 40 | Low viscosity dispersion control additive for water-based coating systems | | | | | | | | | | | | | | | | | ● | ● | ● | | ● | ● | ● | | | | | | | | | | | ● | | |