

Dispersion

The incorporation from the pigments and fillers is one of the important steps at the paint production, because they should be available in primary particles in the paint. But normally they are agglomerated in delivery form, so that they must disaggregate at this production step. This process is one from the time-, energy- and cost-consuming step at the paint production. However, the quality of the pigment dispersion is strongly influencing essential coating properties. The optimum of color strength, hiding power and gloss is only achievable, if the pigments fine size particles. Also the mechanical properties could be change through insufficient dispersion.

Dispersing additives accelerate the splitting from the pigments and fillers, prevent the settling, prevent flooding and floating, improve the hiding power and increase the gloss properties. Nowadays the ideal dispersion from the pigments and fillers is essential with increasing requirements at the ready paint. 1957 Bernd Schwegmann GmbH & Co. KG developed with ANTIGEL the first solution for the optimal dispersion and stabilization from pigments in the paint industry. Since that time they expand his product range to find solutions for the different pigments, formulations and requirements from the market.

Dispersion process

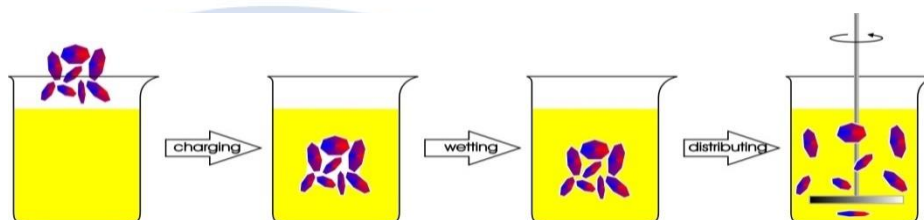
As visible in picture 1, there are three steps in this process. First step is to wet the surface of the pigments with the resin / additives mixture. Next is to split the agglomerates in primary particles and at last the dispersion result must be stabilized. This steps runs at once at the whole process.

step 1: pigment wetting

Delivery form of the pigments and fillers are normally in agglomerates (balling at the edge) and/or aggregates (balling at the plane). Goal of the dispersion is to split this agglomerates in primary particles. (It is not possible to split aggregates) First step of this process is to wet the pigment surface with the additive / resin / solvent – mixture, to get a fine distribution of the pigments in this mixture. The surface tension from the liquid mixture must be lower than the surface tension from the surface of the pigment. Also the mixture must replace the air in the capillary tubes and should also wet the pigment surfaces there. One of the functions from dispersing additives is to reduce the surface tension from the liquid phase to improve the wetting step.

step 2: grinding of the agglomerates

This will achieve with adding energy in the system by using mechanical dispersing units as dissolver, pear mill etc. Wetting agents improve the splitting from the agglomerates by reduction of the interaction between the pigments and fillers. It is less of energy necessary, the splitting process is faster and the grinding process need not so much time.



picture 1

Incorporation of the pigments and fillers, wetting step, splitting and homogenization of the pigments

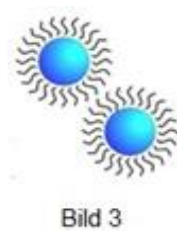
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step 3: stabilization of the dispersion

After the grinding process the pigments try to agglomerate again. Reason is to get this lower energy level. Function of the dispersing additives is to prevent this agglomeration and to stabilize the dispersion.

Stabilization effect by dispersing- and wetting agents

There are two different kind of stabilization mechanism in the theory, the electrostatic and steric stabilization of the pigments and fillers. The wetting and dispersing additives which are tight adsorbed on the surface at the pigments act as so called "distance holder".



picture 2 – electrostatic stabilization; Picture 3 – steric stabilization, Picture 4 – low molecular additives with one pigment affine group; Picture 5 – high molecular additives (polymer) with divers pigment affine groups

The electrostatic stabilization (picture 2) is in water-based paints typical and will describe with the DLVO – theory. (named by Derjagin, Landau, Verwey und Overbeek). The dissociation of the adsorbed wetting agents molecules in an anion, fixed at the pigment surface, and a free mobile cation, generate a mobile double layer around the pigment. Agglomeration is not possible, because the pigments have the same electrostatic charge and are not able to stick together. .

At the steric stabilization (picture 3) the dispersing additive adsorb with the so-called pigment affine groups for example amine-groups at the surface of the pigments and the polymer segments rise in the resin / solvent mixture, so that the pigment looks like a star. Agglomeration is not possible.

In modern aqueous paint systems are additives in use with combination of electrostatic and steric stabilization.

At the market the classification from the dispersing additives in low- molecular (picture 4) and polymer types (picture 5) is also usual, especially in solvent-based systems. Normally low-molecular products are types with one pigment-affine group and polymer types with more than one and the molecular chain is longer.

Which type is meaningful to use is dependent from the kind of the pigment and / or requirements on the paint. Very often low-molecular types with acid groups as carboxyl-, phosphate-, or sulfate groups are in use with inorganic pigments in solvent-based paints. Also the anti-settling effect of the pigments is an advantage from this type.

Polymeric types are more in use to grind organic pigments, especially polyurethane types and / or polyacrylate types in solvent-based formulations. They show also advantages in paints with high gloss properties (car body paints), very good UV – stabilities and low mill-base viscosity.

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Both products provide advantages and / or disadvantages and are in use in the different paint systems. Finally the product is in use with the best price / performance ratio.

Salts of polyacrylic acid are in use in water-based systems since years. But they are not so successful in formulations with organic pigments or with high requirements on the chemical- / water-resistance. The efficiency is also in tinting pastes not good enough. Here are special polymers in use, often in combination with low-molecular types with a structure as a surfactant. Low-molecular types have also advantages regarding the compatibility in the different paint systems.

Product range by Bernd Schwegmann GmbH & Co.KG

Solvent-based systems:	SCHWEGO wett 6248, 6264, 6267, 6291, 8081, WETT AGENT, WETT AGENT 8023, ANTIGEL , ANTIGEL KF-D, ANTIGEL 6217
Solvent-free systems:	SCHWEGO® wett 6264, 6267, SCHWEGO® eco wett 6295, 8319
Water-based systems:	SCHWEGO® wett 6290, 6291, 6292, SCHWEGO® eco wett 6295, 8319
Tinting pastes:	SCHWEGO® wett 6264, 6267, 6291, 8081, 8085, SCHWEGO® eco wett 6295, 8319
UV – paints:	SCHWEGO® wett 6290, 6292
Painting inks:	SCHWEGO® wett 6264, 6267, 6290, 8083 SCHWEGO® eco wett 6295
Universell additives :	SCHWEGO® wett 6292, 6264, SCHWEGO® eco wett 8319
Bio-based paints	WETT AGENT, WETT AGENT 8023, SCHWEGO® eco wett 6295, 8319

The quality of dispersing additives can also be determined by relatively simple methods:

One method is the determination of the grinding fineness with a Hegman block, in which the fineness of the particles can be determined after a certain dispersing time. The disadvantage is that only the coarse particle sizes are recorded, but not the particle size distribution. Particle sizes lower than 5µm are difficult to differentiate.

Also opacity (hiding power), colour shade and gloss are essential characteristic properties, which are measured and evaluated by applying a defined layer thickness, for instance on an opacity card.

Another very simple and meaningful process is the so-called “rub-out-test”, which shows the floating behaviour of pigments in coating films. The rub-out test describes the colour change which will take place when rubbing at a nearly dried part of the coating in comparison to the non rubbed part. If the distribution of pigments in a coating is not homogenous, by rubbing the distribution is restored again to a homogeneous stage. By high viscosity of the varnish layer, a renewed separation until the layer will be finally dry is not possible any more. The quality of the pigment distribution and stabilisation is determined from the difference in colour tone and consequently also the effectiveness of the dispersing additive.

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