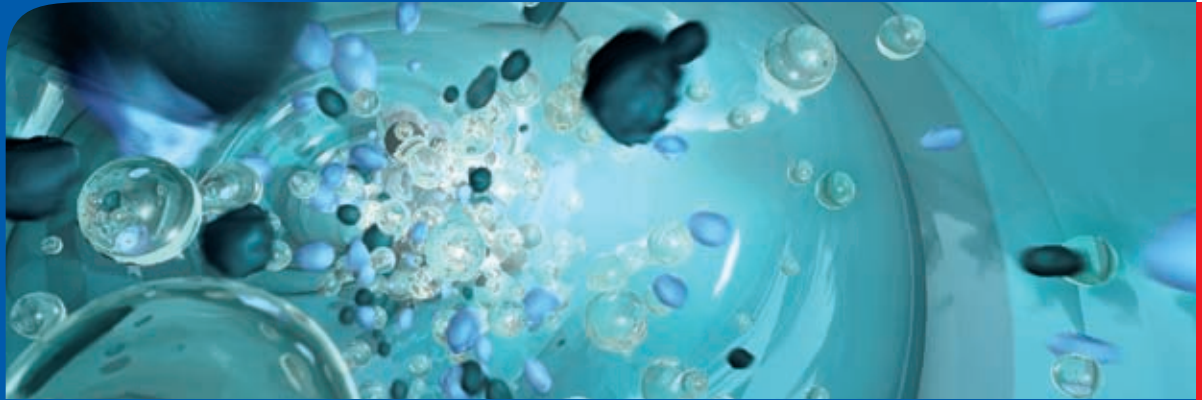
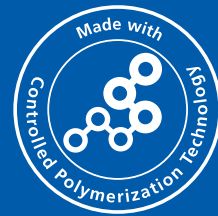


Substance for Success.



Additive News L-AN 5



Controlled Polymerization Technologies (CPT)

New Ways to Additives

Controlled Polymerization Technologies (CPT)

New Ways to Additives

Polymer Structures of Additives

Modern coating additives to a large extent are polymeric structures. They are highly specialized products and the required properties and effects can only be achieved with at least two different monomers. Wetting and dispersing additives are a good example: such additives have to adsorb as strongly and permanently as possible onto the pigment and extender particles and they also must create a thick stabilizing

layer around the solid particles (steric stabilization). For good adsorption, chemical structures are required that interact strongly with the surface of the particles and one type of monomers (A) is used for these anchoring groups (pigment affinic groups). For excellent steric stabilization, groups with high compatibility with the resin and the solvents used are needed and these are created from the second monomer type (B). To synthesize effective additives,

besides selecting the right monomers it is equally important that they be arranged in the proper manner within the copolymeric structure. As long as they are statistically distributed along the chain (random sequence) the desired additive effect will most likely not be evident. For wetting and dispersing additives, block structures are much more favorable (figure 1).

These fairly simple structures can be enhanced with more structural details (figure 2). The segments consisting of the A monomers (pigment affinic groups) do not need compatibility with the binder system because compatibility is controlled through the B segments. However, if the A segment's incompatibility is too pronounced, this may lead to handling problems and reduced pigment stabilization. Therefore it may be helpful to intersperse the A segment with some B monomers for better compatibility. The sharp transition between the A and B segment can also be toned down by creating a smoother transition, where the concentration of the A monomers is continually reduced along the copolymer chain, while the concentration of the B monomers increases (gradient copolymer).

Possible Structures of Copolymers

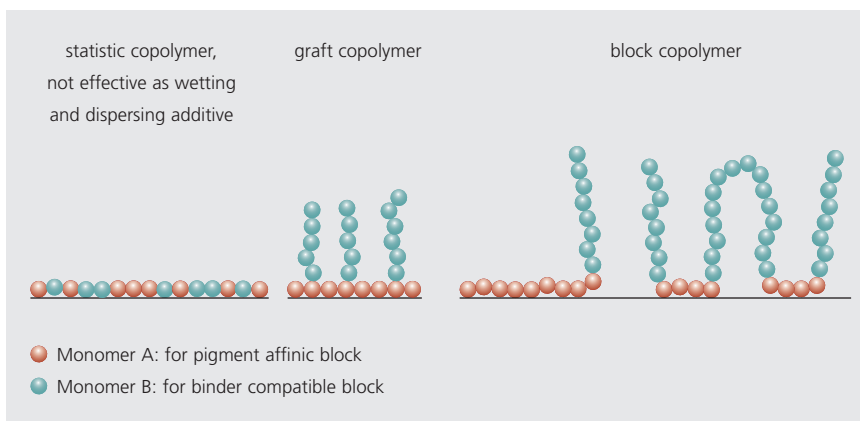


figure 1

Block Copolymers with Modified Blocks

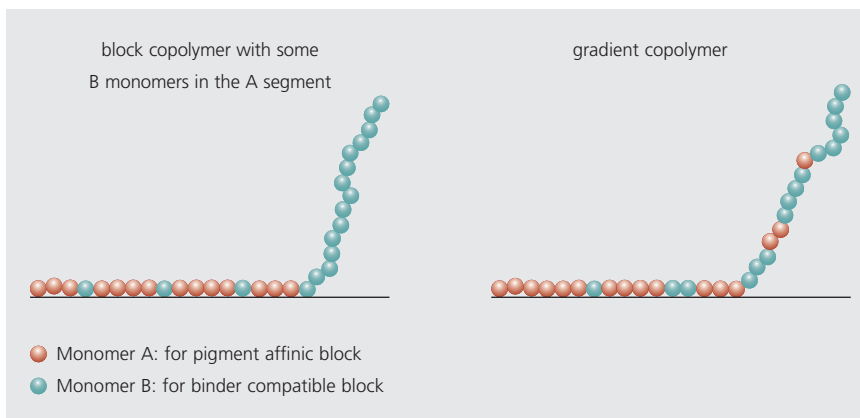


figure 2

There are also good reasons to increase the number of the different monomers used: in addition to the A and B monomers a third and even a fourth monomer type can be present. The pigment affinic segment A may not be an excellent anchor group for all pigment types and the combination with a different pigment affinic group A¹ can make the additive more useful for a wider range of pigments. Likewise, combining various monomers B, B¹,... can give better control over the compatibility of the additive.

Modern Polymerization Methods

The knowledge about the relationship between copolymer structure and effectiveness is only useful, if the fairly complex copolymer structures can be properly designed in the laboratory. In this respect we are in a much better position today than several years ago. Conventional standard polymerization methods offer only limited control over the details of copolymeric structure. However, for some years now, modern polymerization methods have been available (ATRP, NMP, C-RAFT, S-RAFT, GTP) that allow the control of copolymeric structure to a very high degree. With these methods and their specific advantages, a wide range of monomers can nowadays be polymerized under controlled conditions. For the polymer chemist, this is like a tool box from which he can select the suitable tool and method to realize a specific polymer structure. But what is possible in small batches in the laboratory also must work on a larger scale under production conditions. The above-mentioned methods are robust enough to yield the same perfect polymeric structures in production batches of several tons as well as in a one liter glass flask. And this is what makes them so interesting for commercial additive production.

The polymeric structures are very reproducible and there is one other important aspect: the molecular weight distribution is much narrower. The elimination of polymers with very high molecular weight allows formulation of additives with a higher solid content and at the same time are easier for handling and storage.

Wetting and Dispersing Additives through Controlled Polymerization.

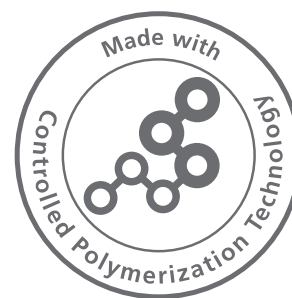
DISPERBYK-2000 and DISPERBYK-2001 are the first wetting and dispersing additives produced by controlled polymerization and they were introduced into the market in 1999. These products were developed for high-end systems such as CAB containing metallic base-coats and deep black topcoats for cars. The method that yielded the best defined polymers with the highest degree of uniformity was selected for such systems from the CPT toolbox.

More recent additives such as DISPERBYK-2010 (for aqueous systems), DISPERBYK-2020 and DISPERBYK-2025 (for solvent-borne systems), as well as DISPERBYK-2009 (for solvent-free systems) make full use of modern CPT.

What can be expected in practice from this technology? CPT will not create additives with absolutely new properties but the additives can be adapted to changing market needs easier and faster, and as tailor-made products, they can

do their job better and more efficiently. Due to more stringent legislation (like REACH) it will be nearly impossible in the future to introduce new monomers for the production of commercial additives. But with CPT, it is possible to use well-known established monomers and synthesize copolymers with improved properties by fine-tuning their polymeric structures.

For the time being, the focus is on wetting and dispersing additives, but clearly, controlled polymerization can be used for other additives as well. Rheology modifiers or additives for surface control will also benefit from this technology in the future.



Best Pigment Stabilization with DISPERBYK-2020 in a Critical Formulation



figure 3

Products and Applications

BYK Additives

Additives are used during the production of coatings, printing inks and plastics to optimize the production process and to improve the quality of the final product.

Product Range Additives

- Additives to improve surface slip, leveling and substrate wetting
- Adhesion promoters
- Defoamers and air release agents
- Foam stabilizers
- Processing additives
- Rheological additives
- UV-absorbers
- Viscosity depressants
- Waxes
- Wetting and dispersing additives for pigments and extenders

Application Areas

- Ambient curing resins (FRP)
- Architectural coatings
- Automotive OEM
- Automotive refinishes
- Can coatings
- Coil coatings
- Color masterbatches
- Industrial coatings
- Leather coatings
- Marine paints
- Molding compounds
- Paper coatings
- Pigment concentrates
- Polyurethane foams
- Powder coatings
- Printing inks
- Protective coatings
- PVC plastisols
- Thermoplastics
- Wood and furniture coatings

BYK-Chemie GmbH

P.O. Box 10 02 45
46462 Wesel
Germany
Tel +49 281 670-0
Fax +49 281 65735

info@byk.com
www.byk.com/additives

BYK Instruments

BYK offers a complete line of testing instruments to meet your needs in many application areas:

- Gloss/Appearance
- Color

Portable or stationary laboratory equipment – including easy to use quality control software.

BYK instruments – the complete solution for the coatings and plastics industry.

BYK-Gardner GmbH

P.O. Box 970
82534 Geretsried
Lausitzer Strasse 8
82538 Geretsried
Germany
Tel +49 8171 3493-0
+49 800 427-3637
Fax +49 8171 3493-140

info.byk.gardner@altana.com
www.byk.com/instruments

ANTI-TERRA®, BYK®, BYK®-DYNWET®, BYK®-SILCLEAN®, BYKANOL®, BYKETOL®, BYKOPLAST®, BYKUMEN®, DISPERBYK®, DISPERPLAST®, LACTIMON®, NANOBYK®, SILBYK®, and VISCOBYK® are registered trademarks of BYK-Chemie. AQUACER®, AQUAFLOUR®, AQUAMAT®, CERACOL®, CERAFAK®, CERAFLOUR®, CERAMAT®, CERATIX®, and MINERPOL® are registered trademarks of BYK-Cera.

This information is given to the best of our knowledge. Because of the multitude of formulations, production, and application conditions, all the above-mentioned statements have to be adjusted to the circumstances of the processor. No liabilities, including those for patent rights, can be derived from this fact for individual cases.

This brochure replaces all previous issues – printed in Germany.