BYK

OVERVIEW

# BYK ADDITIVES FOR PAPER COATINGS

A member of ALTANA

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# Introduction

Paper coatings can impart special properties to the surface of the paper to deliver a performance not exhibited by the uncoated base paper. In all cases, additives and functional materials are designed to deliver an optimized paper surface and the required performance. BYK has a wide range of products that can be incorporated into the formulation to:

- assist in the preparation of a **homogeneous** coating color
- aid in the coating process to produce a **high-quality finish** to the coating
- improve the **paper performance** when compared to uncoated base papers
- provide **specialized functional** performance

For more information on additives for paper coatings please visit us on **byk.com** or **contact your local sales representative.**

**Note**

To ensure the best appearance and full functionality, please open in Adobe Acrobat.

# Range of BYK additives for paper coatings

| | Coating color preparation | Improved coating process | Paper surface improvement | Functional paper surfaces |
|---|---|---|---|---|
| Wetting and dispersing | ● | | | |
| Defoamers and antifoams | ● | ● | | |
| Rheology control | ● | ● | | |
| Surface additives | | ● | ● | |
| Wax and polymer additives | | | ● | ● |
| Functional clay additives | | | | ● |

T. 01

# Coating color preparation

## Wetting and dispersing

One of the most important steps in the production of pigmented paper coatings is the homogeneous distribution of solid pigments within the liquid binder solution. Paper coatings contain a number of pigments which require sufficient wetting to allow the dispersion to remain stable and prevent agglomeration.

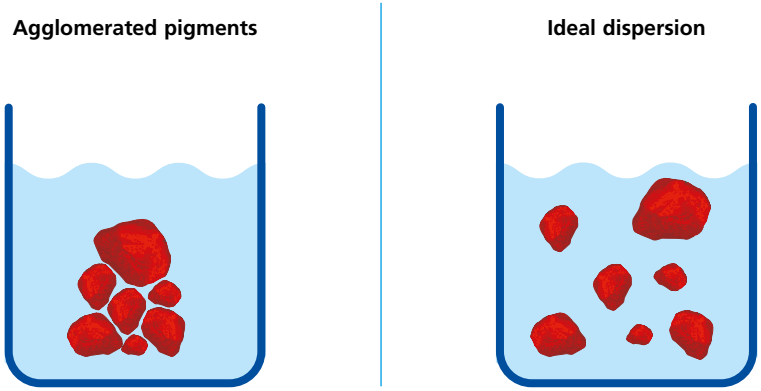
Effective dispersion of all formulation components is critical to ensure the best effects and performance is achieved on the desired coated paper surface. Incomplete dispersion leads to sub-optimal performance, coating defects, and potential damage to the coating equipment itself.

Wetting and dispersing additives can be used to assist this process and avoid lengthy, high energy dispersion processes. Their addition to a formulation at the correct stage results in a homogeneous distribution of solid particles in liquid media and ensures long-term stability.

Wetting agents are surface-active substances and improve the wetting of solids. Dispersing agents prevent particles flocculating by various mechanisms (electrostatic effects, steric effects). Wetting and dispersing additives unite both mechanisms of action in one product, i.e., they are both wetting and stabilizing.

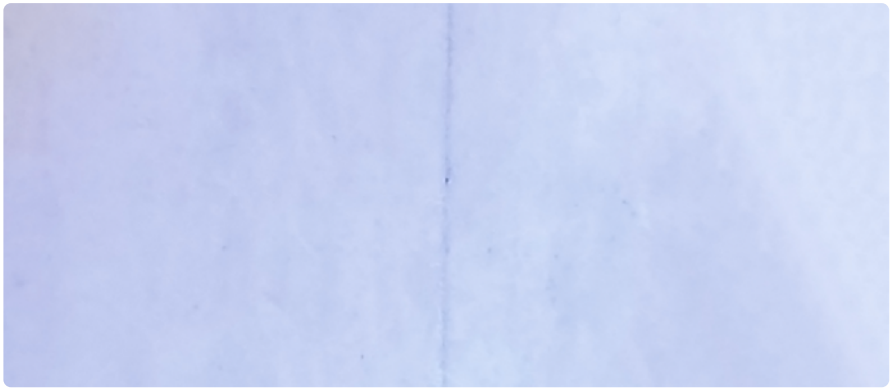
**BYK** and **DISPERBYK** products offer a range of potential additives that can be matched to the materials to be dispersed (such as anatase $TiO_2$, rutile $TiO_2$, $CaCO_3$ and kaolin).

## Wetting of pigments to form a stabilized dispersion




G.01

## A coating defect (blade streak) caused by poor dispersion



G.02

## Defoamers and antifoams

The presence of entrained air in the coating color can lead to a number of issues during formulation. An increase in the volume of the mix, difficulties in filling systems/ containers, interruptions to coating flow, and surface defects during coating are all unwanted side effects of foam. Not only do these cause logistical issues, but they can result in an unattractive appearance and impact the functional performance of the coating. As a result, removing or preventing foam is integral to a coating color.

Virtually all the components in the coating formulation can influence foaming behavior positively or negatively. The method of mixing, the coating substrate and application technique also have an impact on foaming behavior.

Consequently, almost all formulations require a unique solution to foaming problems rather than a generalized approach. Fortunately, the incorporation of defoamers and antifoams (or air release agents) can initially prevent air bubbles from forming or destroy foam bubbles that have been formed. To enable a bespoke solution, BYK offer a variety of chemistries targeting both microfoam (< 100 µm) and macrofoam (> 100 µm) formation to ensure that the most compatible solution can be achieved.

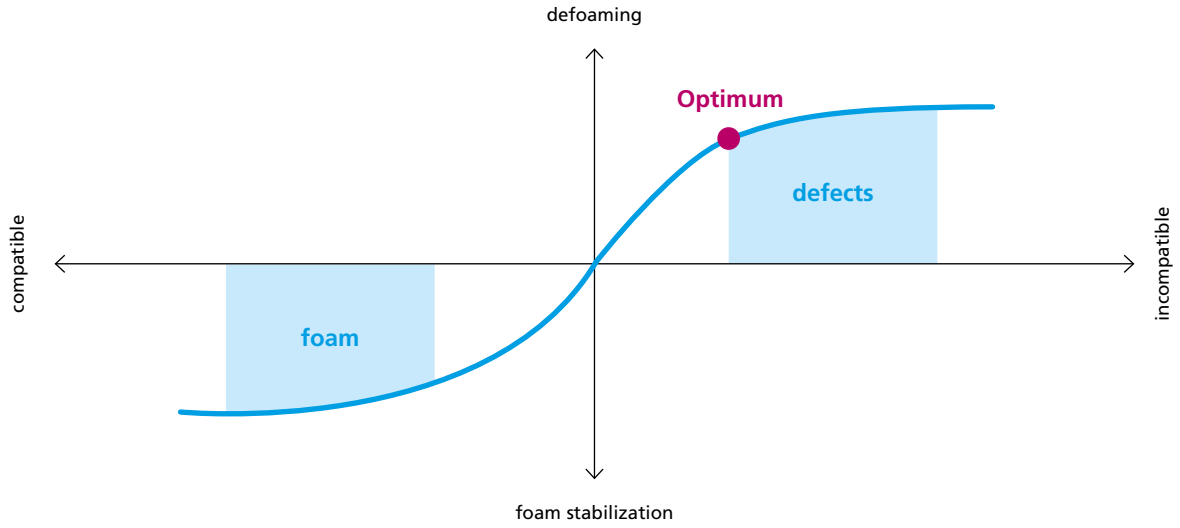
The **BYK** product range includes a number of silicone, silicone-free, mineral oil and polymer defoamers to allow maximum formulation windows.

## Rheology control

During preparation of the coating color, it is essential that it remains a homogeneous system with a low enough viscosity to easily incorporate the reagents, but with enough elasticity to prevent settling of any pigment/filler particles.

**OPTIGEL** products are recommended for use in aqueous sytems if anti-settling properties are required.

## Schematic of impact of defoamer on formulation parameters




G.03

## Anti-settling of $TiO_2$ dispersion

**Without additive** **With OPTIGEL additive**

G.04

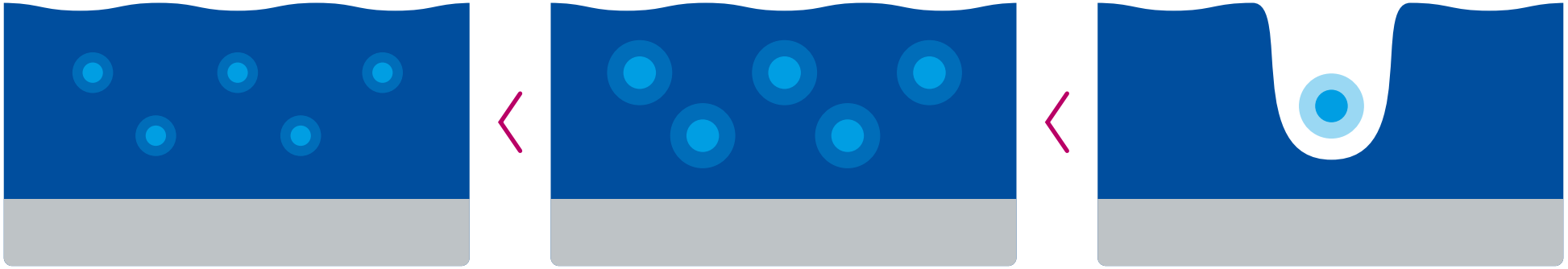
# Improved coating process

## Defoamers

Foam in the coating supply system can cause numerous defects in the final coating from fish eyes and craters to complete miscoats as well as changes in the gloss and feel of the surface. By their nature, defoamers need to be incompatible with the system to disrupt the foam. Therefore, a balance between compatibility and performance needs to be met to ensure optimal defoaming without impacting the final characteristics.

Selecting a suitable defoamer depends on the system and application. BYK therefore offers a wide range of defoamers to cover all eventualities.

## Schematic of defoamer incorporation with coating properties



**Too compatible/over emulsification**
**Weak** defoaming
Good substrate wetting/no cratering

**Optimum compatibility/good emulsification**
**Strong** defoaming
Good substrate wetting/no cratering

**Too incompatible/poor emulsification**
**Strong** defoaming
Poor substrate wetting/cratering

Defoamer Coating Substrate Shear/time

G.05

## Rheology control

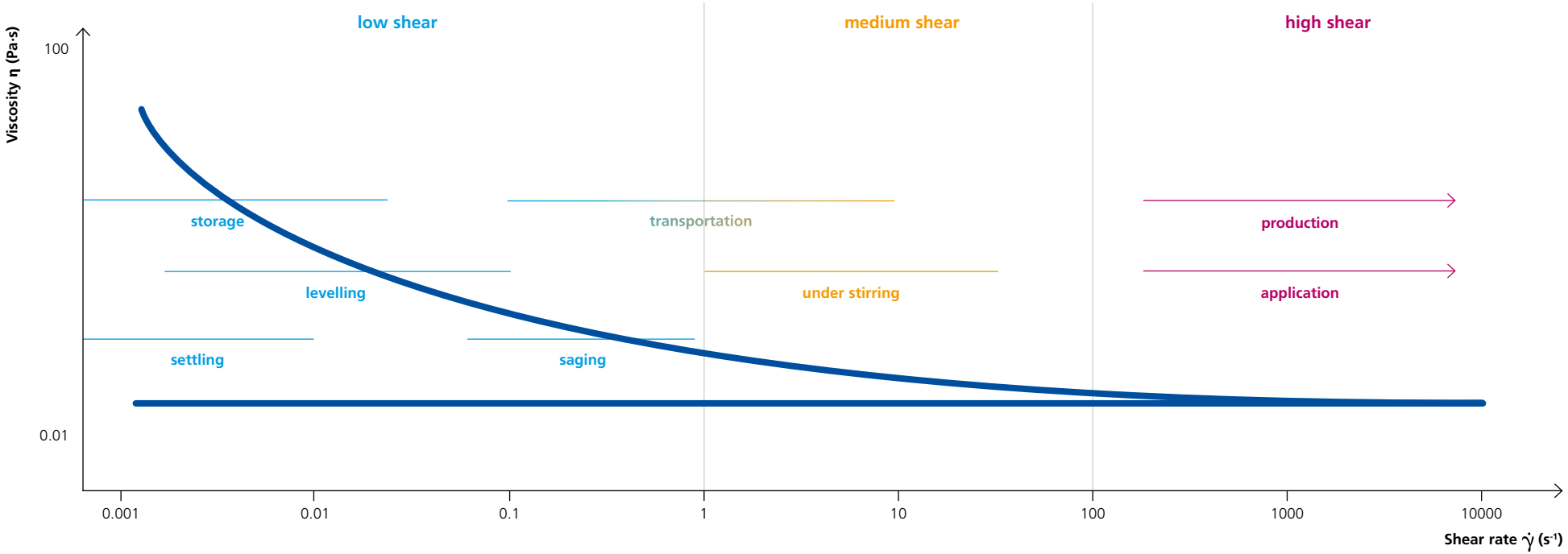
During the coating process, the coating color will be subjected to a wide range of shear conditions. Throughout these, the color must remain stable. Being able to withstand rapid changes in shear force enables a continuous flow of material to the coating head, resulting in an even coating and maximizing machine runnability.

The **RHEOBYK** liquid rheology additives can be easily incorporated into a wide range of systems. The product range includes associative thickeners offering low shear, high shear and elongational stability.The use of rheology modifiers can significantly improve the application properties of a wide variety of paper coating systems.

## Rheology improvement for gravure coating

G.06

## Schematic of typical rheology profiles

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## Surface additives

During the application of coatings onto the paper, different surface defects can occur. A significant cause of such defects is differing surface tensions between:

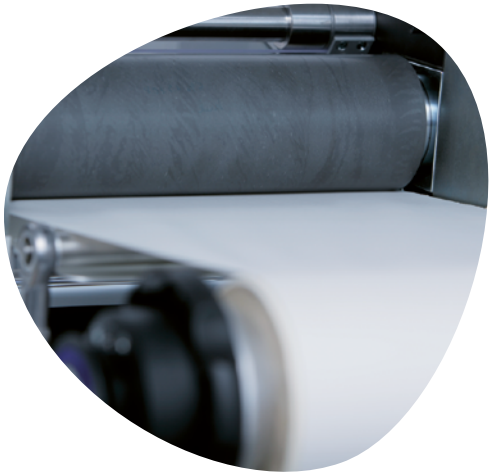
- substrate and liquid coating
- different coating layers
- areas of the coating drying at different speeds

If, for example, the surface tension of the coating is higher than that of the substrate, this manifests itself in poor wetting (high contact angle) and, with that poor adhesion and cratering.

For some application methods (such as **cast coating** and **gravure coating**), surface additives can be used to improve release from the coating rollers. This gives not only a better quality coating but can also reduce machine downtime when changing coating color due to faster roller clean downs.

Other application methods (such as **curtain coating**) require specific influence on the overall surface tension and dynamic surface tension behavior of the coating color. Control of the coating surface tension in such applications is needed to ensure new coating color surfaces are rapidly stabilized. This in turn allows for maximised operational speeds and production.

The **BYK** product range offers silicone, silicone-free, siloxane and polyacrylate surface additives to positively influence a variety of systems.



## Surface wetting

# Paper surface improvements

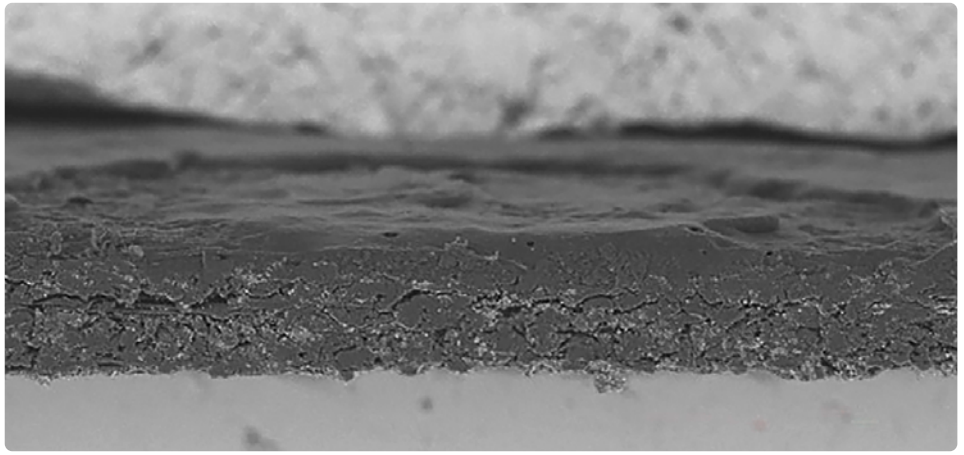
## Surface additives

After application and while the coating is drying, local surface tension differences can cause unfavorable levelling and floating of pigments. Defects such as craters, fat edges, rod lines and dewetting are unattractive but also result in less than optimum performance. Occurrence of such defects can also result in costly QC failures and manufacturing remakes. The evenness of a coating is related to the wetting of the paper surface and penetration speed into the paper web. Incorporating surface additives to reduce surface tension delivers a more uniform coating surface.

Printability is related to printing ink acceptance and adhesion which in turn is a function of the wettability and uniformity of the paper surface. The correct balance between polar and disperse components of the surface tension is critical in delivering good printability. Failure to achieve this may lead to print mottle, missing dots and dot gain.

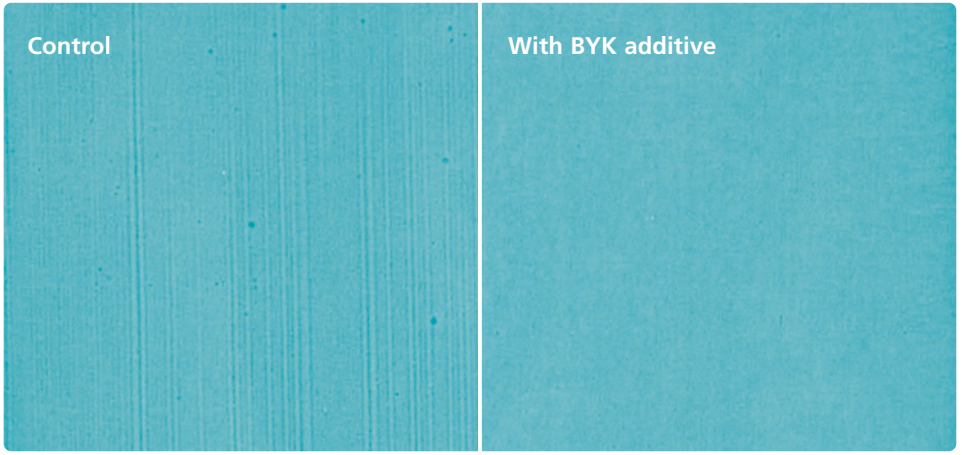
The **BYK** product range offers a variety of additives which can improve or even prevent these surface defects.

### Crater in paper coating



G. 09

### Levelling of rod lines with incorporation of a surface additive




G. 10

### Wax and polymer additives

Wax additives can be used to control the processability of products or to improve the paper surface properties. Waxes can be of a natural, semisynthetic or synthetic origin which have their own range of properties. The fundamental properties are derived from the chemical basis, the melting point and the polarity of a wax. Modifications and the subsequent manufacturing methods also influence the end properties.

Including waxes and polymers into the system can lead to:

- improved rub and scratch resistance
- reduction of penetration into the paper web improving the effectiveness of the coating
- reducing any tendency to mottling during printing by creating a more uniform surface
- adjustment in the friction between coated paper sheets to increase and reduce slip

BYK sells its wax additives in a range of water-based emulsion, dispersion and micronized solid wax preparations, as part of the **AQUACER, CERAFLOUR** and **HORDAMER** product ranges.

## Improving printability and print density

**Print without wax additive**

**With wax additive**

# Functional paper surfaces

## Wax and polymer additives

In addition to improving the properties of the coated surface, waxes and polymers can add functionality to the coating. A common use is in the **thermal transfer** of printed images from paper to other substrates. Waxes facilitate the transfer process due to their melting point, which can be matched to the required temperature for the application during formulation.

The melting point (or transition temperature) of waxes and polymers is also critical for **heat sealing**. Combinations of appropriate waxes and/or polymers will create a sufficient seal for the application allowing paper and paperboard to be used in a wide range of **packaging** from medical syringe packets to coffee cups.

In addition to their other effects, waxes and polymers form excellent barriers to certain gases and liquids. This is of particular importance in food and medical packaging applications, offering alternatives to fluorochemical, microplastic and single use plastic solutions.

The **AQUACER** and **HORDAMER** product ranges offer a range of chemistries, delivery forms and melting points providing excellent options for formulators.

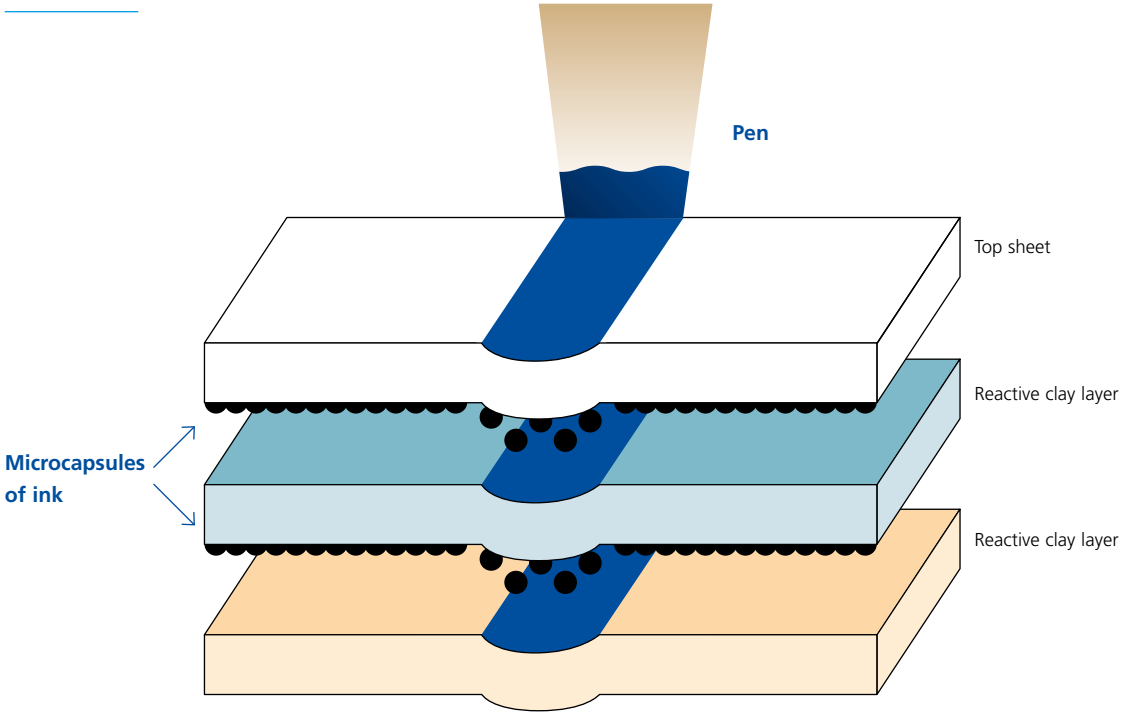
## Functional clay additives

Modified clays can be used to deliver specialized functional surfaces for printing applications. Acid activation develops a surface that has both excellent absorption properties and reactive sites to deliver an immediate, sharp and permanent image. This has particular benefits in carbonless copy paper enhanced by the consistent performance of the clay in all color former systems and microcapsule types.

The excellent absorption properties of activated clays can be employed to deliver a bright, clear and sharp image in inkjet printing. Controlled particle size distribution allows rapid removal of the ink carrier to deliver fast drying, which is of critical importance in high-speed printing applications.

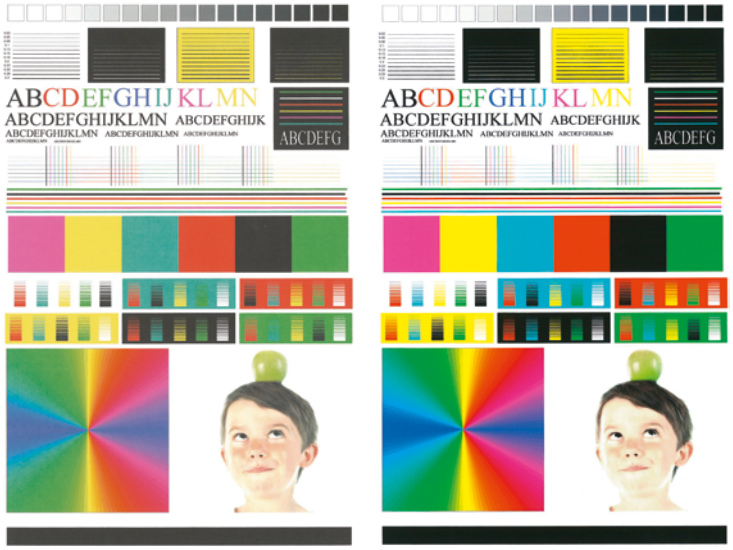
The acid activated clays in the **FULACOLOR** range combine controlled porosity with reactive surfaces to create products suitable for various printing techniques.

## Carbonless copy paper






## Inkjet printing on uncoated paper (left) and FULACOLOR coated paper (right)

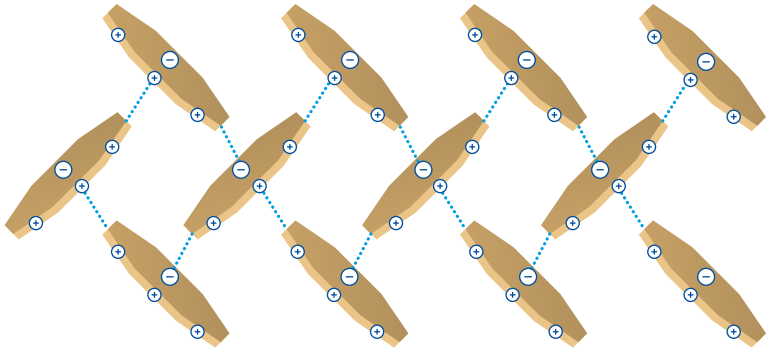


**LAPONITE** is a synthetic high purity mineral which disperses completely in water under moderate shear to individual platelets to provide a clear dispersion. When the shear is removed, the platelets quickly reassemble to form a "house of cards" structure which can stabilize dispersions and prevent sedimentation. When the shear is reapplied, the structure collapses providing a suitable liquid for coating. Once coated onto paper, the **LAPONITE** platelets align to form a transparent film.

The high aspect ratio of the dispersed mineral and the charge distribution of each platelet combine to produce a conductive layer that can dissipate and prevent static charge build up. This is particularly important in applications where static can cause damage to components or increase wear, such as in POS thermal printing, labels, thermal transfer ribbons, and abrasive base papers for sanding belts.

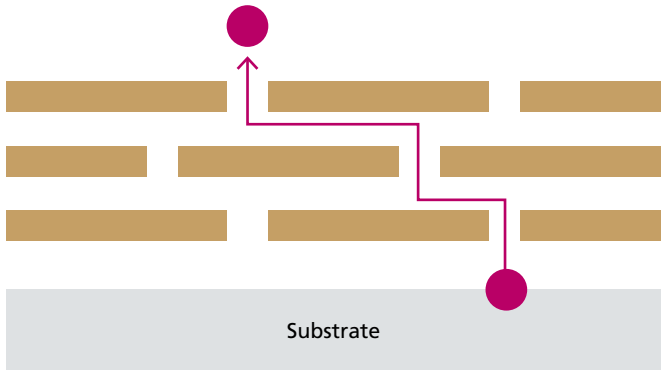
The alignment of high aspect ratio platelets is also ideal for creating a barrier to molecules by creating a "tortuous path". This can aid in providing a physical barrier coating to decrease permeation of gases and liquids.

## Single LAPONITE platelet and the house of cards structure that it forms



G. 14

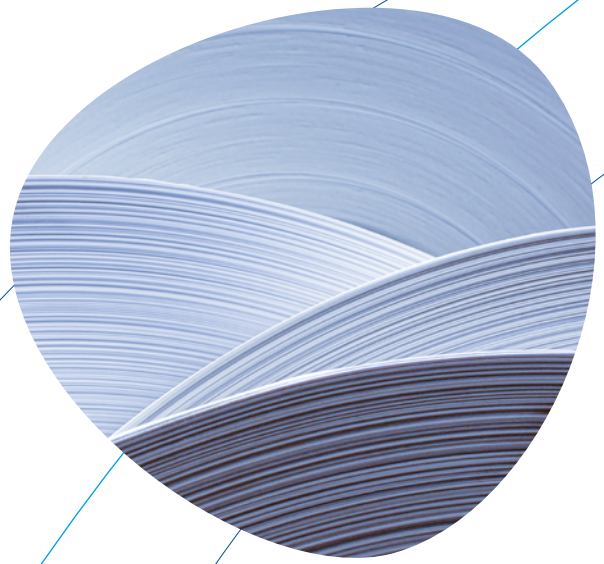
## Tortuous path through high aspect ratio clay platelets aligned in a film




G. 15

# Optimized solutions by BYK additives

The variety of technologies available facilitate the development of optimized solutions for specialized paper applications. This is supported by state-of-the-art analytical capability which allows characterization of the paper surface. This understanding of the surface combined with an extensive knowledge of the requirements for application means that BYK additives can be easily selected to suit the needs of each customer.



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