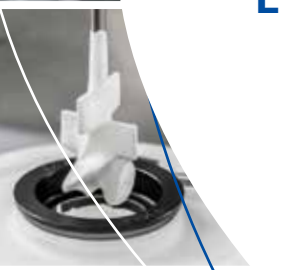
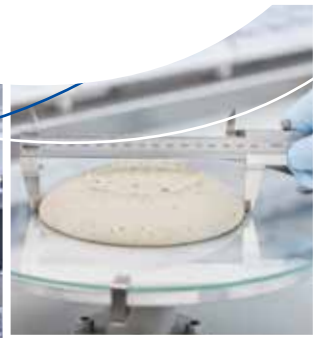
OUR LABORATORIES

EXPERTISE PLUS SERVICE. WORLDWIDE.



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Foreword

150 years of innovation

BYK is your leading global specialty chemicals manufacturer, embodying values to help advance you. For we uphold innovation, sustainability, customer proximity, and expertise – as we have done for more than 150 years.

Our entire corporate strategy is aimed at creating benefits for you, our valued customers. We provide evidence of this every day with hundreds of products, hundreds of additive samples that leave our premises daily, hundreds of researchers committed to finding solutions for you, hundreds of application engineers in your vicinity, and a service laboratory landscape such as no other supplier in the world offers.

In this brochure, we wish to present you with just a small selection of our hundreds of testing and analysis facilities. These set standards, and we place them at your disposal in our laboratories worldwide.

We combine our extensive specialist knowledge with many years of industry expertise and a broad portfolio of high-performance additives. These not only optimize the surface properties of coatings and plastics, but also make them more resistant to corrosion and scratches, for example. However, our products are also used in other fields of industrial application such as adhesives, household cleaners, electromobility, flame retardants, or in the cosmetics industry. In all of these, we meet the increasing need for environmentally friendly and sustainable products with the largest range of additives for water-based systems in the world as well as a PFAS-free product portfolio.

Thanks to a global network of highly efficient laboratories and experienced technical experts, coupled with longstanding close customer relations, we have a profound understanding of today's market requirements as well as of the challenges of tomorrow. Our range of services often saves our customers having to invest in their own laboratory capacities and ensures smooth integration of our additives into their individual applications.

A further benefit for you is the regulatory consultancy that goes along with every single one of our additives. But see for yourself the efficiency and capacity of the BYK laboratories – and how this creates added value for you.

You will find trends on **byk.com** and sustainability goals and examples on **byk.com/sustainability**, and you can follow our fascinating updates on **byk.com/socials.**

BYK wishes you an interesting and insightful read!


BYK

Our product groups

Our portfolio consists of eight different product groups. Drawing on this variety, we produce tailor-made additive packages for our customers that are precisely matched to the chemistry of their applications and the associated regulatory standards. Our commitment to innovation means that we are already working on the products of tomorrow. With these innovations, we provide solutions to the requirements that arise from new market trends, new materials, or new production processes.

Evaluation of particle size

Wetting and dispersing additives
Finely and stably distributed

Our wetting and dispersing additives serve to distribute solids finely in liquids and permanently stabilize them. With these additives, a variety of particles (such as pigments or fillers) can be incorporated in colors, paints, coatings, or plastics.

One of the many factors behind this is our know-how in the field of interface interaction. Over the years, we have refined this to the extent that a comprehensive, broad product portfolio has emerged. It offers a wide selection of products for dealing with the complexity of the many systems in the various end uses (such as coating or plastics formulations).

We use a variety of technologies, ranging from traditional fatty acid chemistry to specially designed acrylate copolymers with linear as well as highly branched structures. Complex structures such as comb polymers, core-shell polymers, or block copolymers are also included in our technology portfolio.

We are also able to develop quick, innovative, and efficient tailor-made system solutions for individual, customer-specific, and regional requirements.

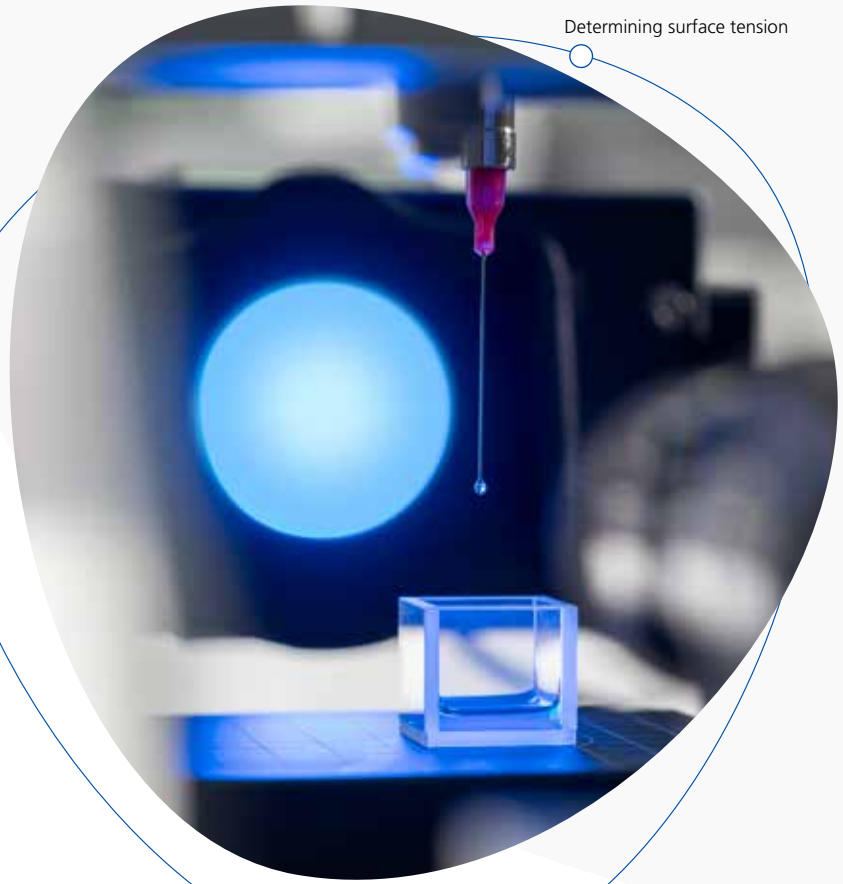
Surface additives
Regulating coating properties, preventing defects

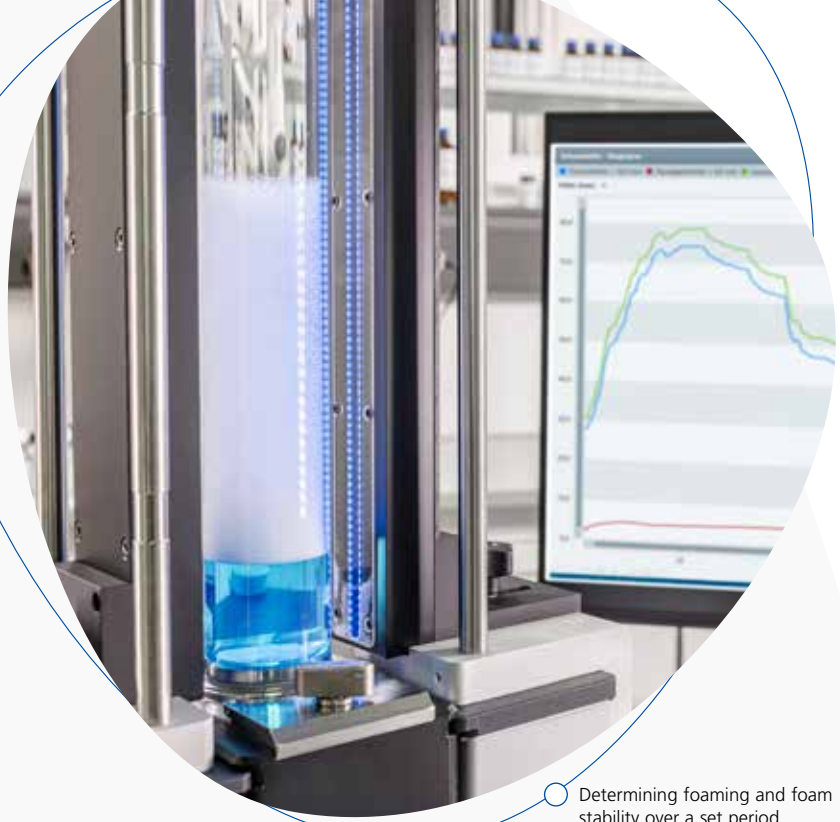
Our surface additives are also based on our expertise in interface interaction. They improve the application properties of liquids on solid substrates. While they were originally designed for coatings, today they are also used in other applications.

These additives regulate the surface tension of liquids and minimize differences in the surface tension of the substrate and the coating, thereby improving wetting. They also play a role in preventing leveling problems, floating, cratering, and other defects such as scarring that can occur during application or when drying. Overall, our surface additives optimize the protective function of coatings as well as their visual impression. They can also have a positive effect on the smoothness and polarity of the surfaces, as well as making them easy to clean.

Our diverse surface metrology and analytics complement our portfolio, which consists of modified polysiloxanes and polyacrylates. In conjunction with versatile application technology, we can prepare additive formulations that are perfectly suited to our customers' materials.

Determining surface tension





Determining foaming and foam stability over a set period

Defoamers and air release additives
Foam-free from their production to the dry film

Foam is more than an undesirable side effect when processing liquids. It jeopardizes the function of colors, paints, and other coatings. If small bubbles form during processing, these can cause tiny craters which will lead to defects and ultimately impair the protective function of the coating. Our defoamers and air release agents prevent this process by destroying the foam lamellae. They thus ensure flawless surfaces. Foam is also a problem in the manufacturing of coatings and paints, and in this area too, our products ensure smooth, hitch-free processes.

Originally developed for colors and coatings, these additives now also optimize the properties of numerous other products. These applications include, for example, inks for inkjet printing, lubricating greases, and cleaning agents.

Depending on the application, our defoamers are based on silicones, polymers, or mineral oil. They are suitable for solvent-borne, water-based, and solventfree systems. When selecting the respective suitable additive, the chemical composition of the formulation and the application technique (paintbrush, roller, etc.) also play key roles.

Viscosity reducers
Optimized flow behavior

Viscosity reducers improve the flow behavior of PVC plastisols across the entire processing range. For example, they prevent drop formation and ensure better substrate wetting, thereby facilitating the processing of the material, and optimizing the properties and costs of the end products.

VISCOBYK is the main BYK brand of viscosity modifiers for PVC plastisols. The VISCOBYK-5000 series consists, in part, of bio-based raw materials and is low in emissions. Some additives from other product families (for example BYK-1165 and BYK-P 9915) are also suitable for use as viscosity reducers.

The respective products are designed for different shear rates and they are effective in filled and unfilled systems.

We create individual additive packages for our customers, enabling them to control individual or multiple phases of the plastisol manufacturing. These include mixing, pumping, processing, and storing.

Viscosity measurement with a cylinder system

Measuring the topography of a coating

Wax additives
Tailor-made gloss, topography, and mechanical strength

Wax additives change the properties of surfaces. As needed, they can influence gloss or matting, or, for example, adjust the slip or slip resistance. Apart from that, they can create structured surfaces or improve the mechanical strength of a coating. Our portfolio is suitable for aqueous, solvent-borne, and solventfree systems.

Alongside natural waxes, we also use predominantly semi-synthetic or synthetic waxes. The choice of raw material depends significantly on the respective property profile of the substances. In this way, we tailor our additive formulations precisely to the systems of our customers. In doing so, regulatory requirements relating to food contact or environmental protection (e.g. EU Ecolabel) play an increasingly important role.

Adhesion promoters and coupling agents
Strong bond, high stability

Adhesion promoters and coupling agents create stable connections between interfaces. They can optimize both coatings and plastics, but are also used, for example, in adhesives and printing inks. The same additive can often be used in both applications – with differing results.

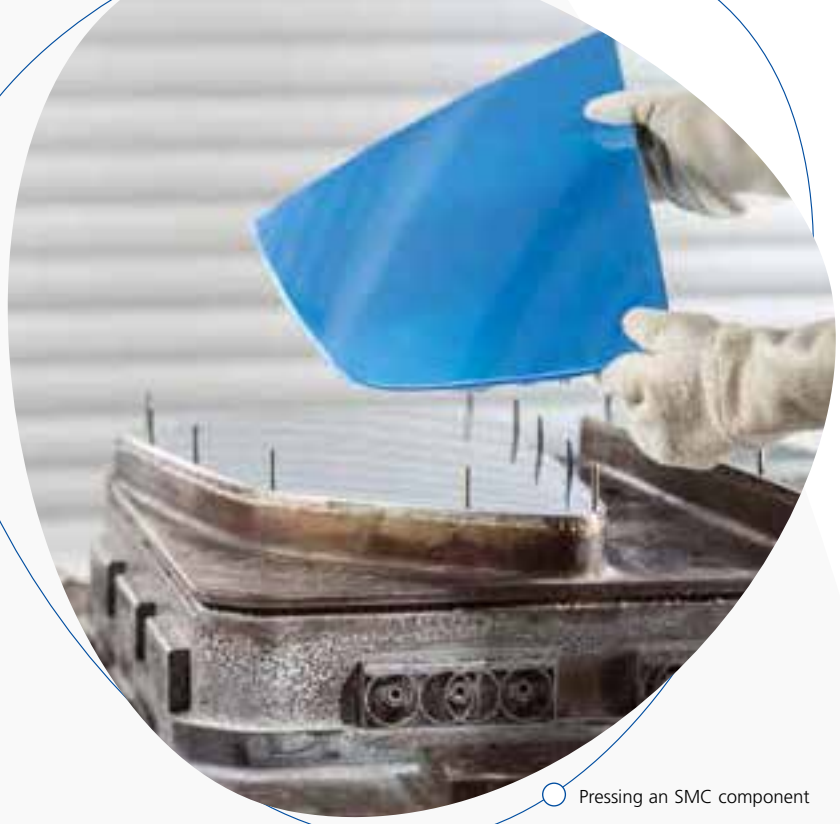
In coatings, our additives support adhesion to the substrate, thereby ultimately increasing the efficiency of their moisture and corrosion protection.

In plastics applications, coupling agents improve the mechanical properties and the resilience of the materials. They provide improved cohesion between the resin matrix on the one hand and the fillers or fiber materials contained within it on the other.

BYK-C is the BYK coupling agent brand of products used in thermosets. They can be used in fiber reinforced or highly filled formulations. As one example, BYK-C 8001 optimizes the mechanical resilience and durability of the fiber reinforced resins in rotor blades.

The SCONA plastics modifiers also belong to the coupling agent product group. They improve fiber reinforced plastics or wood-plastic composites (WPC) by stably incorporating the reinforced fillers in the polymer matrix and thereby significantly enhancing the mechanical properties of the composites.

Testing mechanical strength



Pressing an SMC component

Processing additives
Advantages for the entire value chain

Our tailor-made processing additives support plastics manufacturers and processors when processing all standards of plastics such as PVC, thermoplastic compounds, or thermoset systems. In all cases, our additives provide important assistance in many of the work steps.

The applications are particularly versatile and aligned to the respective manufacturing processes. For example, thanks to improved fiber wetting, processing additives reduce the infusion time in applications such as resin transfer molding (RTM) or vacuum assisted resin infusion (VARI), and they simultaneously improve the quality of the component. In the SMC/BMC area, processing additives are used to improve release while increasing process safety. The rheology control of two-component systems is yet another application field.

Processing additives are also used in further areas such as in VOC and odor reduction in thermoplastic applications, stabilizing substance mixtures such as emulsions, or configuring separation properties.

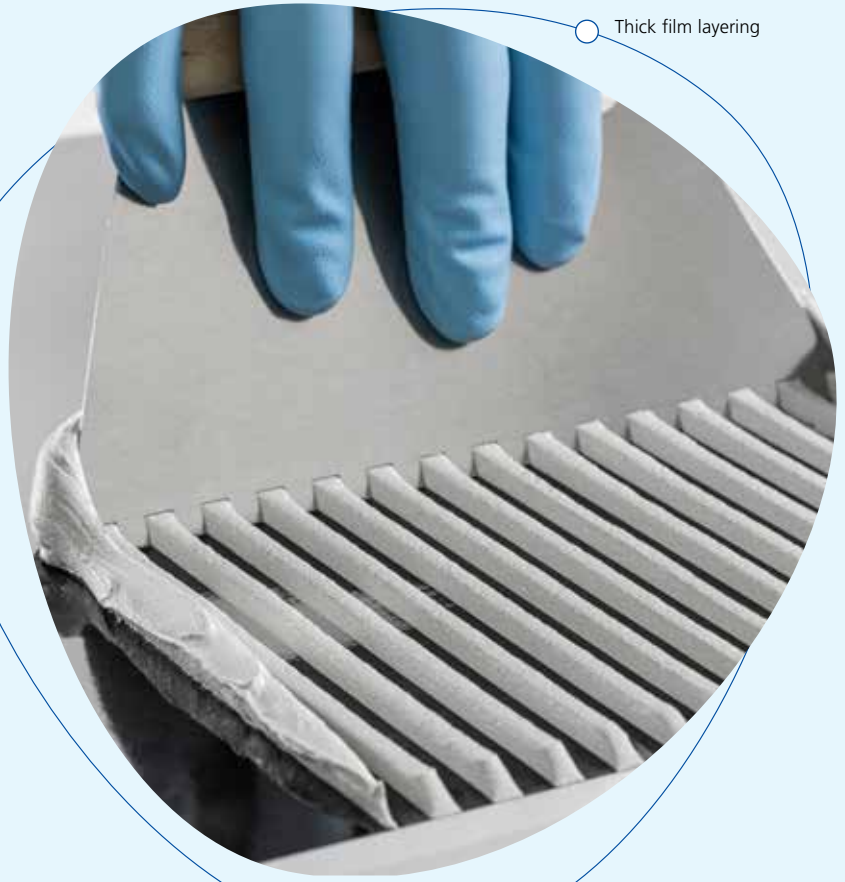
Rheology additives
Adjusting flow properties as required

Rheology additives control the flow behavior of the most varied of liquids. This includes adjusting the processing viscosity of colors and coatings as well as household products or liquid raw materials for the plastics industry. Gas and oil production is also a typical application area. Another key advantage of using rheology additives is that they improve the storage stability of liquid formulations by preventing the settling of solid components as well as separation and phase separation.
For this, we employ different, complementary technologies to fulfill our customers' requirements for aqueous and polar as well as solvent-borne and nonpolar systems. Our product portfolio includes liquid and solid additives based on ureas, amides, and polyurethanes, as well as naturally and organically modified phyllosilicates. Our objective is to meet customers' individual requirements as regards the rheological properties profile, while at the same time complying with rising market requirements in terms of quality and sustainability – regardless of whether colors, coatings, plastics, adhesives, cleaning agents and detergents, or other fields of application are concerned.

Viscosity measurement with an agitator system

Products for special challenges

Our customers' applications are constantly presenting us with new challenges. And so, we are continuously expanding our portfolio. Based on our wide-ranging rheology knowhow, we are steadily enlarging the family of boosters (rheological synergists) for inorganic rheology additives in order to meet the various requirements. We are also developing additives for new fields of application – for example to improve barrier properties.



Thick film layering

Rheological synergists
Enhancing rheological effectiveness

Rheological synergists enhance the action of other additives, and, when combined with inorganic rheology additives, they can significantly improve their efficacy. They are especially employed where an inorganic rheology additive alone is unable to meet demands, or to reduce the dosage of the rheology additive. Typical areas in which they are used are where particularly thick layers are applied in a single work step, as is customary, for example, in fillers, adhesives, heavy duty corrosion protection, or plastics. Even in very low dosages, rheological synergists can greatly improve the effects of inorganic rheology additives, thus making a more costeffective formulation possible. There are further benefits arising out of the lower dosage of the inorganic components as regards the stability of the formulation. On account of the numerous systems present on the market, differing chemical synergists are necessary that can be used specifically for the respective applications.

Our **automated laboratory reactors** can produce up to 12 samples in parallel. The system increases the repeatability and reproducibility ofsample production and is used inparticular for statistical test planning.

Added value for our customers

Our innovations aim to create added value for our customers and their products and applications. This is made possible by a global Research and Development (R&D) team supporting our customers locally in the various parts of the world.

The centerpiece of our innovation management in all of this is the Idea2Product process that, apart from taking technical and customized application requirements into consideration, also focuses on regulatory provisions and specifications relating to sustainability. With our technical experts and their profound understanding of what our customers and markets require as well as the longstanding experience of the specialists in our three technology groups Wetting and Dispersing, Rheology, and Surface, we seek to provide products which will lay the foundations enabling our customers to move ahead into a sustainable future.

In order to develop new products in close cooperation with customers, BYK has set up a global research network that is constantly being expanded. The largest team is based at the headquarters in Wesel, Germany. Further R&D units exist in the Netherlands, the USA, Great Britain, China, and Japan. This allows us to process projects in close coordination with our customers and to move ahead rapidly with them.

Reaction mixing pump

OptiMax™

Autosampler for loading the NMR spectrometer (NMR = Nuclear Magnetic Resonance)

For many years, BYK – in conjunction with ALTANA – has been a supporter of the **Global Product Strategy (GPS)** and the **Responsible Care Initiative** of the International Council of Chemical Associations (ICCA).

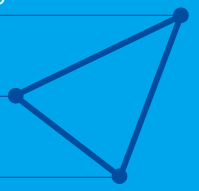
The specialists in our three technology groups Wetting and Dispersing, Surface, and Rheology, and our "Biotechnology" and "Applied Plastics Development" competence clusters work within Research and Development on new additives. The Technology and Product Transfer team, in coordination with Production, then ensures their fast and smooth implementation as marketable products and facilitates their production on an industrial scale. The product transfer is supported by the Regulatory Affairs and Analytics departments – an essential step when launching new products on the market.

Our three technology groups:

Wetting and Dispersing

Rheology

Surface



Sustainable from the outset

Our Idea2Product process has two objectives: On the one hand, we seek to respond swiftly to new market demands; on the other, we want our innovations to be sustainable and safe. To achieve both these goals, we rely on the Portfolio Sustainability Assessment (PSA) and the digitalization of our R&D organization.

As small an impact as possible on the environment is just one of several criteria that are examined in the PSA approach of the World Business Council for Sustainable Development (WBCSD). We therefore test for biodegradability and the risk to aquatic organisms at a very early stage of the development work in order to have a direct influence on these.

The center of focus of our bio-analytics is on tests with freshwater algae and with microorganisms that are used in wastewater treatment plants. We only engage outside providers to conduct these tests for the final products, whereas we use the internal skills in our biotechnology lab for the many samples in the course of the development work – resulting in huge time savings.

The digitalization of our R&D organization is built on two pillars: "SmartLab" and statistical experiment design using the design of experiments (DoE) method. The latter helps ensure the high reproducibility of our test results. The semi-automated reaction control of established standard reactions with SmartLab makes work processes much easier. At the same time, the use of integrated online analytics allows for a better understanding of new reactions and provides more detailed information than ever before – an optimized synthesis protocol makes syntheses more reliable and more sustainable. What is more, the computer-assisted test implementation ensures greater precision and reproducibility, whereas direct contact with chemicals is reduced. All in all, this method facilitates a more efficient scale-up of lab products, thereby speeding up the Idea2Product process.

SmartLab facilitates:

- Semi-automated reaction control
- Online analytics
- A computer-assisted test implementation

SmartLab: computer-aided versatile reactors for flexible experiment design

Through the **cultivation of freshwater algae** in the presence of the test substance, the water hazard of our additives can be determined. In addition to end products, raw materials or intermediate stages can also be tested.

Unique worldwide: innovative additive development with high throughput screening

Can laboratory activities be automated and digitalized? The clear answer is: yes. Our new HTS facility is proof of the fact. It is unique worldwide. It enables us to prepare and test up to 80,000 samples per year. This means we have doubled our application technology capacities in one fell swoop.

This constitutes a key competitive advantage for our customers in the coatings, plastics, or adhesives industry. With our help, they can considerably reduce the time to market of their new products. For, when we test our additives in series in their formulations in order to determine the right product and the right dosage, we now only need a few days – as opposed to several months in the past.

HTS stands for high throughput screening. This opens the door to a whole new dimension of application technology at BYK. One major advantage: The fully automated facility saves our lab team the drudge of routine activities, freeing them up to spend the time needed to develop innovative and differentiating solutions for our customers. At the same time, the amount of time required for preparing samples is substantially reduced and it is possible to test several different samples in parallel.

By way of example, we can test 50 different additives – such as defoamers or wetting and dispersing agents – in three different dosages as well as three different pigments in two different dosages for a new coating within just a few weeks.

The automated tests we conduct with the facility include the measurement of pH values, particle size distribution, foam formation, and flow behavior. And, depending on the application, samples are produced by draw-down, pouring, or spray application and cured by means of UV, oven, or air-drying. The samples are then tested in a fully automated process for gloss, color, and flow.

In total, we can generate a huge number of samples with tens of thousands of data points for each project within a few weeks. This provides us with a comprehensively structured database – including additive ranking. Based on this ranking, we select the top performers, the dosage of which we then subject to fine-tuning in the respective application laboratories.

The HTS facility in figures

Up to **220** samples in
24 hour
16 robots
32 modules
27 functions

Pouring a sample

Rub-out test on a coating

Labeling a sample

Our **HTS facility** can be used to automate all activities involved in series testing of our additives.The facility incorporates professional, specific appliances and it assumes operations such as filling and pouring. This means our test series can be conducted within a few weeks – instead of months in the past.

Practical tests for valid results

Valid additive recommendations must be relevant to the applications. That's why we test our additives for architectural coatings in our customers' formulations under conditions that are as close as possible to those in practice.

Only when we understand how the end products will behave in specific applications, are we able to provide our customers with reliable advice. Test results should be reproducible in order to make sound statements about the effect of our additives in the respective paints and coatings. That's why our equipment also includes brushes, rollers, and spray guns.

The range of additives for architectural coatings is diverse and includes wetting and dispersing agents, defoamers, rheology and surface additives, and our specially developed formulations for multi-color paints. We use versatile test procedures to replicate various loads as realistically as possible. This results in objective measurements used to precisely document the effects of our additives.

For example, we use a draw-down test to give us an accurate picture of the processing and leveling quality of the coatings that we have previously adjusted with our rheology additives. The optimum leveling of the coating is what creates an exceptional aesthetic result.

Regulatory information:
Many of our additives for aqueous systems fulfill the requirements of various ecolabels.

Multi-color-paints (MCP)

Rub-out test

Foam test with foam roller

Did you know that ...
... our additives based on patented phyllosilicates improve color paste acceptance, processability, and rheology?

The **airless process** is a reliable application method for applying greater layer thicknesses over large expanses. In this process, our defoamers prevent the development of disruptive micro foam, thereby making the procedure more efficient.

Application with the leveling applicator

Besides physical characteristics, rheological properties are the measure of all things in construction material formulations.

Spread or slump flow

are especially important criteria for formulators.

Application with the leveling applicator

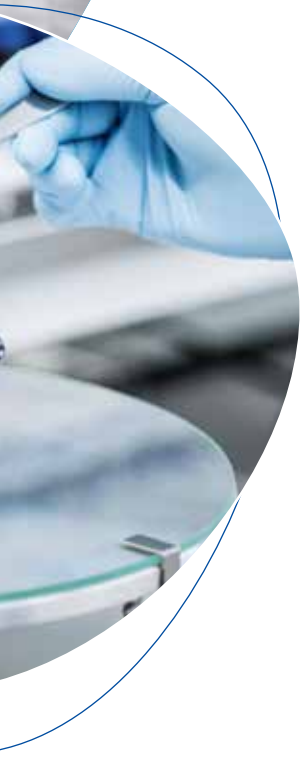
Measuring compressive strength

Consistency test with flow cone (flow cone test)

Our product portfolio offers a wide range of liquid and powdered additives that fulfill regulatory requirements.

Construction chemicals applications

Whether in the private sphere of a person's home or apartment, in infrastructures with bridges and roads, or in the workplace – construction chemistry products are omnipresent and we cannot imagine our world without them.



Building materials have a long history. Present-day demands on the construction industry for more modern, longer-lasting, sustainable, and recyclable solutions give rise to new materials and technologies.

BYK is a competent technology partner in the building material additives sector, supporting customers and partners in developing and optimizing top-quality construction materials and industrial products. Additives can optimize specific processing properties and the functionality of construction material formulations, thereby vastly facilitating their application for those using them.

The use of additives makes all the difference. They give a material its distinctive characteristics, benefiting the processing properties as well as the functionality of the construction material formulations.

The use of rheology additives, for example, can enable the thixotropic or pseudoplastic behavior of the respective construction material formulation to be precisely adjusted. In this case, we use a Hägermann table to establish consistency and water demand on the basis of flow spread and, as a consequence, the influence of our additives on the rheological properties of plasters and mortars. For self-leveling compounds, on the other hand, we deploy a flow cone to determine the slump flow.

Wetting and dispersing agents can help improve the release of fillers and pigments. They reduce viscosity and make higher filling levels possible. The group of defoamers is of assistance to developers in controlling air entrainment, thereby helping optimize flow and surface properties.

The groups of additives mentioned above can also control the hardening properties and final strength of diverse construction material formulations. All construction material formulations – whether plasters, adhesives, self-leveling compounds, or hybrid systems – also need to meet certain requirements with regard to compressive and/or flexural strength. Using our compression and bending testing machine, we determine whether and to what extent our additives have an influence on these parameters. For tile cement applications we use our pull-off tester.

We recommend our **powdered defoamers** for low-emission building products that comply with EC 1 PLUS.

Just like everyday life

The spiked roller is used to release air in the freshly applied, still wet floor covering. We reproduce this final work step in the laboratory.

Curing test

Dry sample

Defoamer testing

Our portfolio offers a broad selection of silicone- and aromatic-free additives.
Our VOC-free products fulfill regulatory requirements.

Our testing proves these floors can withstand anything

Floors in industrial buildings, laboratories, or parking areas are subjected to considerable stresses. They often have to fulfill many requirements. Their surfaces must withstand the heaviest of mechanical loads, be chemically resistant, and, nowadays, also be virtually emission-free.

Ultimately, these properties are achieved by selecting the appropriate additives. Our rheology additives and defoamers support an uncomplicated, blister-free processing of thick-layered highly viscous systems – thus preventing the formation of foam bubbles or so-called "pinholes". When our wetting and dispersing additives are used, a stable distribution of the pigments is achieved, even when the compound is poured. And our surface additives ensure scratch resistance and resilience by controlling the surface tension. Many of our products comply with various regulatory requirements.

We determine which additives suit our customers' respective formulations by completing various tests. These include, for example, a dissolver with adjustable vacuum system that allows for realistic testing.

We measure the curing process using a gel timer. For air release, we rely on tried-and-tested methods such as using a spiked roller to tackle foam bubbles in the freshly laid floor covering.

Application with a scraper

Tip:
Our additive recommendations for epoxy coatings: BYK-1796 and DISPERBYK-2152 TF

Answers to burning questions

The coil oven can reach temperatures of up to 400 °C. We use it to test the behavior of our additives in relation to the extremely short baking times and peak metal temperatures of coil coatings.

Realistic tests save time and expense

Coil coating systems are usually very large. However, our knowledge of the relevant processes and our practical test methods mean that we can simulate and precisely replicate these processes in the laboratory. The results achieved can then be transferred directly to the industrial application.

As realistic a reduction and simplification as possible of the production processes in the manufacturing industry forms the solid basis of our research for new and optimized paint additives – and enables us to respond quickly to acute customer problems.

The baking oven in the coil coatings service laboratory enables us to comply with all our customers' relevant production parameters, such as peak metal temperatures, and precise compliance with the required baking time.

The rationalization and optimization potential of products and processes can thus be established at the laboratory stage, reducing time-consuming and costly test runs by the customer. In concrete terms, this means precise answers in the form of product and dosage suggestions, and starting point formulations that our customers can easily reproduce.

Our portfolio is tailored to all conventional coil coating systems: solvent-borne, aqueous, radiation-curing, and PVC plastisols.

Abrasion test

Coating application on a metal sheet

Tip:
We use our tests as a basis to develop precise dosage suggestions for customer formulations.

Increase the surface quality using targeted additive packages

Can coatings must fulfill numerous demands. On the inside of the can, they form a protective coating between the metallic can wall and the contents. On the outside, through improved scratch resistance and abrasion resistance, they protect the can from damage during transportation and storage.

Can coatings also fulfill a wide range of decorative functions. It is the coating in the first place that enables the production of cans and ensures their formability. Our additives help to fulfill these requirements.

When new product developments are made, we test the efficiency of our additives in a variety of coating systems. As a result, we can make individual recommendations for every application. By using targeted additive packages, the quality of a can coating can be significantly increased; and by illustrating its efficiency in the form of different market-typical test methods, we can narrow down the choice for our customers – according to the motto "less is more". In most applications, our additives are required to be food contact compliant, and products are selected on this basis.

The measurement of the surface slip is a fundamental test. Here, the coefficient of friction (COF) is established by applying a defined weight at a defined speed across the coating surface. Measuring the COF allows the efficiency of wax additives and silicones in the coating to be assessed.

A scratch test such as the Clemen test, for example, establishes the scratch resistance of a coating. The harder and more scratch-resistant a coating, the more durable and tougher the subsequent can.

Regulatory information:

Lots of our additives for can coatings comply with specific food contact regulations.

Our additive recommendation:

The PTFE-free wax additives CERAFLOUR 1050, CERAFLOUR 1051, and CERAFLOUR 1052 form the first generation of a new family of modern wax additives that offer an excellent alternative to waxes containing PTFE.

Scratch test

Smooth gliding

We use the mobility tester to simulate the stresses to which the can coatings are subjected. By means of the COF (coefficient of friction), we discover which of our wax and surface additives will best suit the customer's requirements.

Application of coating samples with the

airless spray application:

Which additive combination and which dosage is ideal for a good appearance and efficient defoaming? To answer these questions, we apply the samples with the customer's preferred application method – fast and using the required parameters.

Pigment grinding with the Dispermat

Cross-cut test to determine adhesion

Different requirements – and always the right solution

The spectrum of applications for industrial coatings is vast. It ranges from coatings for agricultural commercial vehicles to smartphones, from glass bottles to toys.

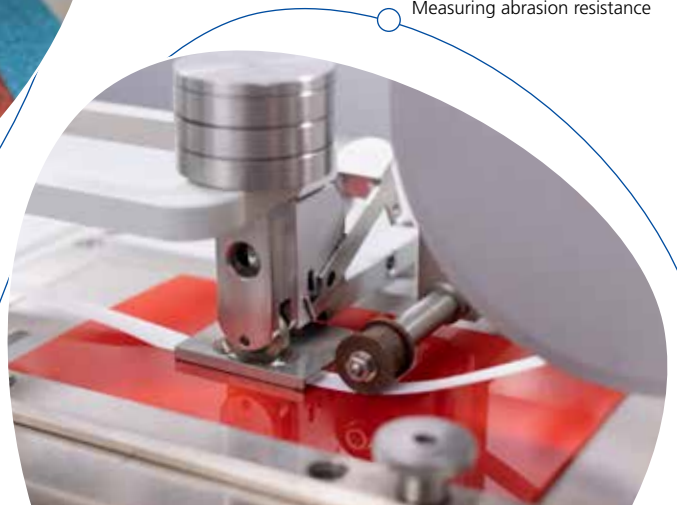
Our additives optimize the coating in all end uses. This necessitates specifically defining the most suitable additives for each application. Depending on the application, for example, mechanical strength, visual impression, or flexibility might be the key criterion. We use state-of-the-art measuring and analysis equipment to determine which of our additives has the respective optimum effect for each of the applications in question.

We use this testing as a basis for recommendations on the use of wetting and dispersing additives, surface additives, defoamers, rheology additives, and adhesion promoters. And we can also provide precise information on the correct dosage.

The Dispermat® is an important aid in producing different pigment grinds. It simulates the mills used in production, while requiring considerably less material. The pigment concentrates and mixtures produced by this method are tested for properties such as pigment stabilization, development of color strength, and settling behavior. Our broad portfolio of wetting and dispersing additives offers a solution for all pigments to optimize the required properties.

Modern coating technologies are used so that spray application can be varied for highly diverse parameters while also complying with current regulations on VOC and high solids. This engenders a wide range of angles from which problems and solutions can be approached. Due to the high material pressure in airless spraying methods, for example, there is a need for powerful yet compatible defoamers to remove the air that is introduced from the system again. Since we adapt massively to customers' requirements, we are able to reproduce the positive effects of our additives and to test and evaluate them in the widest possible range of coating formulations.

The scratch and abrasion resistance of coatings is of great importance in many sectors, and we use various specialized testing methods to check for this. One example is to simulate smartphones being scratched in pockets, or when they come into contact with cloth or paper. The properties can be optimized using surface additives or wax additives. Here too, the combination of selected tests helps us determine and define the positive effects of our additives.



Measuring abrasion resistance

Our additive recommendation:
BYK-1880 constitutes the start of a success story based on a new technology in the field of specialized defoamers. This development enables excellent results in eliminating micro foam, and is especially successful in coating systems for airless and air-assisted airless spray application.

The best choice for sustainable coatings

Since powder coatings are free of solvents or volatile organic compounds (VOC), they are extremely environmentally friendly and there is a huge interest in them in many industries. With our additives, we meet practically all the demands of this rapidly growing market.

Changes in the quality of the raw materials, formulations, or even production procedures can easily lead to quality defects in the powder coating. We therefore recommend our extensive laboratory service to manufacturers aimed at identifying the additive best suited to their purposes.

The production and processing of powder coatings is complex and involves premixing, extruding, breaking into pieces, grinding, sieving, spraying, and cross-linking.

It is important that the various steps – the formulation, the production, and the processing – are coordinated so as to achieve the desired quality in the end product.

Whether transparent or opaque, very glossy or matt, smooth-running or structured, it is always also a question of selecting the correct additive.

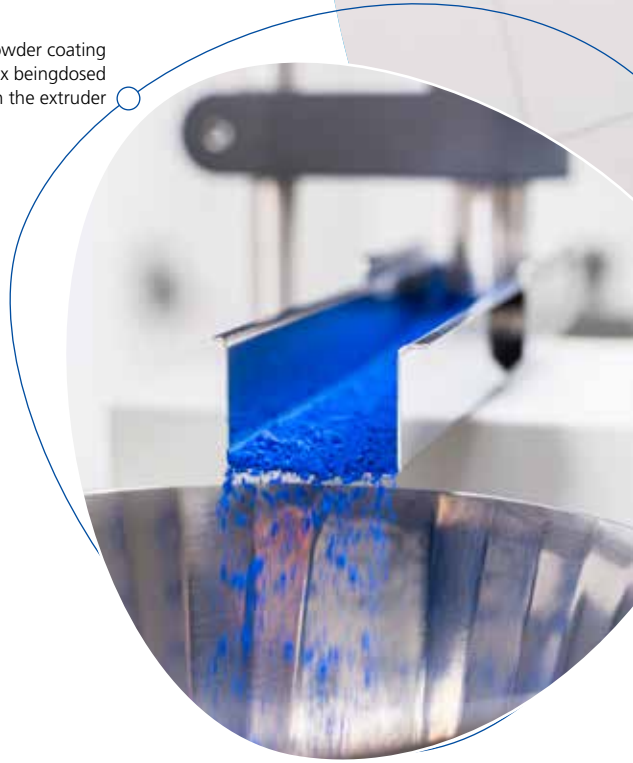
Extruding is an important core process in the manufacture of powder coatings. The premixed material that is steadily filled into the extruder already contains everything that is critical for the subsequent properties of the powder coating. At around 110 °C, the solid recipe components (pigments, fillers, and additives) are optimally mechanically broken down and homogeneously incorporated into the melted binder. The extrudate experiences extreme shear as it passes between the screws and walls of the extruder. To guarantee the intended optical (color and gloss) and mechanical (impact strength, and flexibility) properties of the powder coating, the extruding process needs to be flawless. After leaving the extruder, the finished extrudate is immediately pressed between two cooling rollers and instantly brought down to room temperature. It is easy to break the solidified melt into chips and, in a further stage of the process, to grind and sieve it into the desired powder coating.

In our three global powder coatings laboratories (in Germany, China, and the USA), we can reproduce every process step from premixing to coating of the powder coating, so that we have a reliable basis for our additive recommendations. We work directly with our customers to find solutions to problems – both with standard formulations that display unexpected problems when the parameters are changed, and with new developments that enable our customers to tap into new markets.

Tip:

Our recommendation for degassing and outgassing surfaces: Our CERAFLOUR family helps avoid these various problems.

Introducing our additives



Powder coating premix beingdosed in the extruder

The premix

is already an important process in manufacturing powder coatings. Our additives are thoroughly integrated into the formulation and are therefore able to take their full effect during further processing.

The entire range of coating procedures in one laboratory

Automotive coatings must fulfill the most varied of functions. Aesthetics are just as important as protection against weathering and other stresses.

Depending on the function of the coating, our customers use a variety of application methods. We therefore strive to replicate the entire range of coating procedures that are currently used in the automotive industry or in repair shops on a laboratory scale in order to offer our customers long-lasting support.

For example, we have our own ESTA (electrostatic application) equipment which produces an efficient coating, just like in industrial practice. It enables us to reproduce coating programs realistically in accordance with the manufacturer's instructions, and test the effect of our additives in customer formulations. It is only by reproducing manufacturers' latest application procedures as closely as possible that we will achieve the results our clients require.

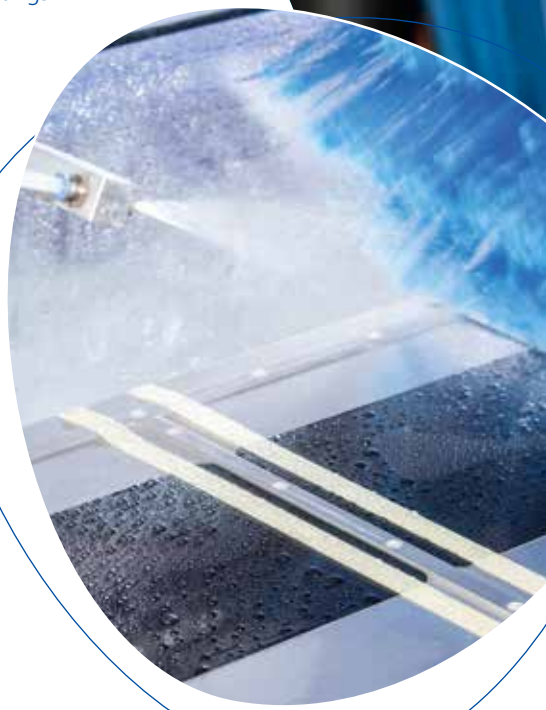
In addition, we use our CED unit to check the behavior of our additives in the cathodic electrodeposition. The CED unit uses an electric field to apply a coating to a metal sheet. In doing so, the coating is applied directly to the phosphated metal substrate during the dipping process. The application of coatings for aircraft or passenger trains can also be replicated in our laboratory. We use spray guns to simulate the spraying procedures which are standard in the industry.

Various tests to control parameters such as leveling, the orientation of effect pigments, and adhesion, round off our test arsenal. This also includes our car wash test – a special laboratory facility which we use to replicate the conditions in a car wash. Taken together, these diverse procedures allow us to solve specific practical issues. By working in close collaboration with our customers, we help them formulate their coatings.

Tip:
Our VOC-free additives improve the environmental properties of coating systems.

Cathodic electrodeposition (CED)

Our recommendation for effect coatings:
AQUATIX and LAPONITE additives optimize the orientation of effect pigments in aqueous coatings.



Car wash test

Spray guns

Up to **60,000** rpm is the speed of the high-speed rotational bell in our ESTA (electrostatic application) equipment. It is capable of faithfully replicating the coating programs of automotive manufacturers.

The most efficient way to coat wood is in a **curtain coater**. Wood is drawn through a curtain of liquid coating on a conveyor belt. This necessitates a special additive selection to maintain stability in the coating curtain.

Protection and shine for various types of wood

Wood is a natural material that comes in many variations. There are differences between tree species and – within the same tree species – depending on regional origins. However, wood-based materials such as MDF, which is widely used in colored items of furniture, are also immensely important.

Untreated and color-coated MDF

Our global positioning in additives for wood coatings rests in part on our expert knowledge of the demands placed by the various types of woods. We are thus able to provide specific regional products – such as in China, for example, where we also have our own research laboratories. In addition to the protective function of coatings, what is particularly paramount is their visual appearance. In recent years, the trend has moved away from the traditional high-gloss industrial wood coatings towards satin gloss and even deep-matt systems. Besides spraying and rolling, these are increasingly being applied in curtain coating processes. The matted systems pose a challenge in terms of viscosity, especially where solvent-free UV coatings are involved. The market for them and for water-based coatings has long since been the fastest growing of all.

The wealth of requirements is reflected in our constant development of highly specialized, optimized paint additives. Our employees' expertise and the practical technical equipment in our service laboratories enable us to create new solutions for our customers' requirements. When combined with tailor-made BYK additives, high-quality and innovative furniture and parquet varnishes benefit from improved wetting of the most varied of woods, the ideal pigment and matting agents or perfected matting control, optimized leveling of the coating without air entrapment, greater scratch resistance, and adjustable surface slip.

LED-UV curing in a protective N_2 atmosphere

Tester to determine scratch resistance

Our additive recommendation:

Radiation-curing coating systems harden quickly and are either free from or low on solvents. Since they lack volatile components, they demonstrate only minimal film shrinkage or none whatsoever. This renders matting such systems extremely difficult. BYK offers additives that permit increased use of silica-based matting agents in the application method without thereby influencing the coating properties. We also offer an expanding range of largely bio-based organic matting agents that, besides outstanding matting and mechanical properties, also have only a negligible influence on viscosity.

Corrosion protection at its best

Anyone wishing to ensure optimum corrosion protection for steel constructions or the longest possible resistance of marine paints to salt water makes use of additives. These can have a decisive influence on the functionality of coatings, thereby providing the desired protective function. Reliable statements on such aspects, however, can only be made in the laboratory.

To prove the effect of our additives, we use precise guidelines to conduct tests simulating natural stress and strain. Our tests are based on international norms such as DIN EN ISO 12944 on corrosion protection. We use a variety of different testing methods and equipment for this. These include condensation water and salt spray tests, fire protection and adhesion tests, but also color measurement, rheological tests, and electrochemical impedance spectroscopy (EIS).

In the course of screening or development work, we also apply our know-how for our customers' benefit. This saves them time and expense since, based on our test results, we are able to recommend a selection of additives to them that are suited for their respective applications.

By means of EIS, for example, we demonstrate what effects our additives have on the functionality of marine and protective coatings. We test 40 samples in parallel in order to find out which product in which dosage is going to offer optimum protection for the coating film against salt water penetration. We use the pull-off test to measure the adhesion of a coating to the substrate or the adhesion between two coatings. One of the ways we test the effect of our additives in intumescent fireproof coatings is by exposing them to a naked flame, including long-term exposure to fire.

Key guidelines

We test our additives on the basis of the following guidelines:

- Corrosivity categories in accordance with DIN EN ISO 12944
- Condensation water test in accordance with DIN EN ISO 6270-1
- Salt spray test in accordance with DIN EN ISO 9227
- Mechanical loads in accordance with DIN EN ISO 1520
- Ball-drop test in accordance with DIN EN ISO 6272

Long-lasting fireproofing with intumescent coatings

Electrochemical impedance spectroscopy (EIS)

Corrosion protection metal sheets

Testing our additives with respect to their possible influence on the corrosion protection properties of coating systems is a fundamental requirement for the successful recommendation of additives in the Marine and Protective Coatings end use.

Pull-off test

Replicating spread coatings precisely

It can take significant time to transfer laboratory results to customer production lines. However, with our spread coating line, we can shorten the timeline considerably.

We can optimize the formulations specified by customers for various PVC-plastisol applications in targeted test runs that are as close as possible to production conditions. The materials can be applied both in a direct coating on the textile carrier as well as, with the aid of reverse coating, on release papers. Alongside the assessment of impregnation, foam behavior, and surface properties, we are able to metrologically detect the viscosity of the material used during the coating.

The recorded values give us the certainty that customers can use optimized or newly developed formulations in their production without complications.

Coating thicknesses
Using our test procedures, we can test coatings from 0.1 mm to 5 mm.

Tip: With our low-emission additives and solvent-free dispersing agents, we support our customers in the development of environmentally friendly products.

Spread coating line with gelling drums, oven, and lamination facility

Vacuum dissolver

Our spread coating laboratory facility can coat
ten meters of substrate per minute,
thereby realistically replicating industrial conditions.

Coating head with optional viscosity measurement

Laboratory dryer with coating unit

Our **flame retardant synergists** help prevent cable sheathing from burning quickly. That is why we repeatedly expose the material samples to an open flame – in accordance with the requirements of the UL 94 flammability test.

Seminal solutions for thermoplastics

The specialists in our thermoplastics laboratory are not only able to choose from a wide-ranging portfolio consisting of couplers, modifiers, surface-active products, and various additives compounded for specific applications. They also have years of experience at their disposal in special process technologies (including skin-core extrusion and compacting processes) as well as a machine park to match (for example, single and double-screw extruders, injection molding machine, sheet line, burning chamber).

On this basis, they develop solutions that offer sustainable added value for our customers in a whole range of application fields, including adhesion, heat and UV stabilization, nucleation, flame retardancy, and recycling. We use special tests to determine in detail exactly where this added value lies.

On the fire safety front, for example, our flame retardant synergists, which include BYK-MAX CT 4260 or CLOISITE-20 A, assist the cable industry in conforming to the stringent fire prevention requirements. The easily processed additives help reduce the flammability of halogen-free cable sheathing, and they thus prevent the flames from spreading in the event of a fire breaking out. As a means of verifying this, we test the customers' formulations with our additives in a burning chamber. This involves repeated exposure – in compliance with UL 94 testing requirements – of the samples to an open flame. We are thus able to determine what additive dosage is necessary so that the flame is immediately extinguished and no burning material drips off.

In terms of circular economy, our recycling additives as well as our compatibilizers contribute towards reprocessing various thermoplastics-based recyclates in a way that can prevent their downcycling. Consequently, the materials can be used once more in high-grade applications such as conventional starter batteries or other components in the automotive sector, but also for outdoor furniture. Where our products are also particularly helpful is in the restabilizing of compounds based on polypropylene or polyethylene recyclates. We establish thermal or heat stability by subjecting material samples, to which our additives have been added, to artificial heat ageing, whereby typical temperatures can be 120 °C or 155 °C. We then use a measuring instrument to test the residual strength of the materials.

We test the mechanical and visual qualities of a non-separable PA and LLDPE recyclate mixture by processing variously prepared material samples to a film on our sheet line. This enables us to verify that the blends which have been compatibilized with our modifiers deliver excellent results.

Recyclates

Burning chamber

Tip: Our process additives help to reduce VOC emissions.

Regulatory information:
Many of the products in our portfolio for liquid coatings and solid masterbatches comply with FDA guidelines and fulfill EU and other national guidelines.

Stress test for molding compounds

Additives optimize the material properties of sheet molding compounds (SMC). In our lab, we demonstrate exactly how they do it.

In our SMC line, components defined by the customer – such as resins, fillers, and reinforcement fibers for the production of molding compounds – are optimized using our additives in targeted test runs. After this, the mixture is shaped in our 1,000-ton press and then tested in terms of surface properties, better coating adhesion, color homogeneity, and emission behavior.

The processability of compounds during molding or the testing of mechanical properties using top-end testing devices are just a few of the stages on the road to customer-optimized additive formulations and improved SMCs. Ultimately, the only composition that will make its way to the customer in practice as a compound formulation, going into series in the desired shape and form, is the one that offers all-round satisfaction.

Tip: For higher filler loads in fire protection formulations, we recommend a combination of the processing additive BYK-P 9065 and the low-emission wetting and dispersing additive BYK-W 9011.

Tip: Our processing additives BYK-P 9065 and BYK-P 9080 improve process safety while at the same time ensuring greater processing efficiency.

SMC line with glass and carbon fiber cutting system

SMC press with a maximum of 1,000 tons of press force

Our **SMC pilot plant** is used to optimize customer formulations as well as to test our new additives for sheet molding compounds.

Custom-made for BYK: We use this

fiber spray gun

to test how our additives behave in our customers' materials.

The optimum additives for every shape

Boat hulls, swimming pools, or bathtubs are made of glass fiber reinforced plastics (GFRP). These constitute part of our thermosets department.

As far as surfaces are concerned, virtually any component can become problematic. This particularly applies to thermosets such as boat hulls, swimming pools, or bathtubs made of glass fiber reinforced plastics (GFRP). Our additives for this group of plastics ensure our customers – and ultimately the end consumers – an optimum product in terms of stability or surface quality and processing. To make sure that we meet up to this high standard, we simulate the typical production processes of our customers in our service labs almost every day.

Light and stable glass fiber reinforced plastics can take on virtually any shape. Because of this combination of qualities, they are predestined for use in a wide variety of technical applications. We can replicate all of our customers' problems in the laboratory with our fiber spray gun. In reproducible test runs, we establish the optimized additive selection and dosage in each case. Consequently, this means perfect application properties, even and stable colors and flow properties, less trapped air, and optimized styrene emissions.

The formulations developed in this manner can then be replicated by the customers in their own plants under production conditions. The benefits of this accumulated experience are enjoyed not only by our global sites. Via technical service requests, training, and seminars, we happily and regularly pass on our practical knowledge to our customers.

Producing a test specimen

Vacuum infusion

Regulatory information:
Our portfolio contains a broad selection of additives that comply with FDA guidelines and fulfill EU and other national guidelines.

Tip: Thanks to their properties, our additives optimize processing and product quality.

Strong tests for lightweight components

Fiber reinforced plastics must be able to withstand considerable mechanical loads, especially when they are used in the structural components of rotor blades in wind turbines or in vehicles. That is precisely why we subject them to tests in the dynamic testing machine, for example.

In doing so, we repeatedly compress and stress the component refined with our additives in all directions and in several successive cycles. This way, we can prove that our coupling agents are doing their job well in our customers' formulations. They generate solid and dependable bonds between fibers and resins that are also exceptionally durable. We provide our customers with the data gained in these tests.

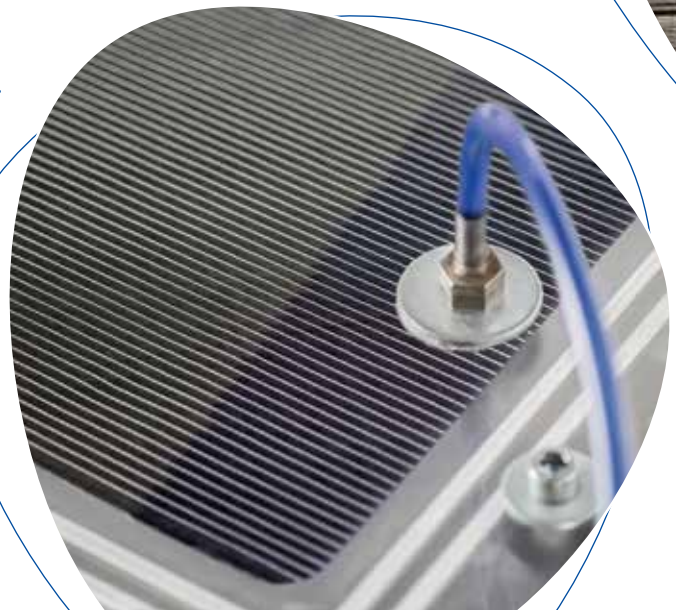
It is not only our adhesion promoters that play a key role in the production of advanced composites, but also our fiber wetting additives. They improve the quality of the finished components. Incorporated resins, they ensure that the liquid saturates the fibers quickly and completely – without any air inclusions or other defects.

We prove that our processing additives accelerate the production process with the aid of various tests which also show how easily components refined with our additives can be released from their molds.

Did you know that ...

... thanks to their higher strength, our coupling agents in the 8000 series can save on materials?

Carbon fiber composite bending test



Infusion with carbon fiber

With the

dynamic testing machine,

we reproduce the varied mechanical loads to which lightweight materials are subjected. The critical question here is: Do our coupling agents improve customers' formulations?

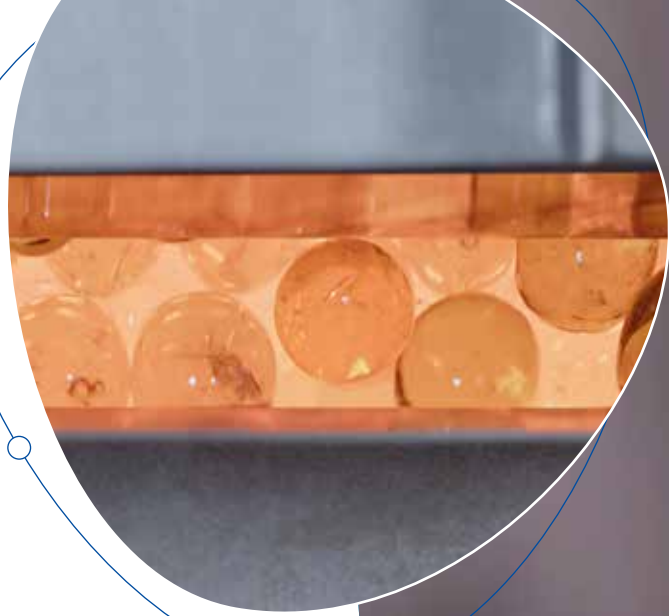
Glass fiber from A to Z

Fiber sizing is an essential component in the production of glass fiber and for its use in fiber reinforced plastics.

In collaboration with colleagues in Germany, the Netherlands, and the USA, we develop film formers that significantly improve the processability and enhance the mechanical properties of composite materials by strengthening the bond between the fibers and the polymer matrix.

We produce our own MAH-grafted polymers – and film formers from them – specially for the manufacture of glass fiber sizing for chopped and continuous fibers. These can also be directly applied and tested in our own facilities. For this purpose, we use our glass fiber pilot plant and the associated application and testing laboratories. This allows the process to be observed in its entirety from the production of the fiber to its end use in the two typical areas of application, thermoplastics and thermosets.

Our laboratories are equipped with all the instruments that are needed to test fiber and system quality and to evaluate the mechanical properties of manufactured test specimens. The R&D capacities and 100 percent in-house production ensure short development times and customized products for our customers, supplied from our production sites in Europe, the USA, or China.



Glass melting

Microscope for assessing fibers

Glass fiber pilot plant in Earth City

Process proximity

Our pilot plant enables our productsto be tested directly on glass fiber produced in-house.

The tensile test – such as a **peel test** – is the simplest method for testing the effect of an adhesive. A maximum of ten specimens in the material testing machine suffices to produce valid results.

Production of adhesive samples

Tailor-made properties

Evaluation of the flow behavior with a rheometer

Mechanical testing of an adhesive

The effectiveness of adhesives depends on several factors. They must perfectly wet the substrate and be easy to process. Their flow behavior – especially on vertical surfaces – is critical.

Our additives help adhesive manufacturers to adjust these different parameters precisely and, if required, according to a customer's individual requirements. Our special measuring and testing equipment accurately demonstrates the desired adhesive properties.

We test to what extent our surface additives influence the mechanical properties of an adhesive, and we do so by using tests such as the tensile test. The greater the force required to destroy the specimen, the stronger the adhesive force, and, in addition, the more effective the action of our additives.

We use our materials testing machine to simulate, among other parameters, two different tearing processes. In the tensile shear tests, two material specimens which are adhered to one another are torn apart in the vertical plane. Peel tests, on the other hand, determine how easy or difficult it is to peel a material at right angles from another.

At the same time, we test to see which effects other additives we recommend to our customers have on adhesion. So, for example, we can demonstrate that silicone defoamers make it a good deal easier to produce the adhesives, and simultaneously have no negative effects on adhesion.

We use the rheometer to test flow behavior. It takes just a few milliliters of adhesive to discover how it will behave on a vertical surface at high speed and with a precisely defined layer thickness. As uncomplicated as this test may be, evaluating the results is much more demanding, because it requires a great deal of expertise and metrological proficiency to interpret the results correctly.

In the end, our customers receive a very precise picture of how their product – optimized with our additives – behaves in the different phases of the adhesive process. Consequently, the rheometer results provide an outstanding foundation for subsequent tests under real conditions.

Tip: BYK-1640 and BYK-093 are particularly suitable as defoamers for aqueous adhesives such as floor adhesives or PSA (pressure-sensitive adhesives).

Regulatory information:
For food contact, we offer a broad range of additives which fulfill the requirements of guidelines such as the FDA guideline 175.105.

Perfectly lubricated

Additives turn oil into a highly efficient lubricant for the industry.

Firstly, our defoamers help avoid bubbles forming when the lubricant is put in motion. This ensures, for example, that the metals are thoroughly and evenly lubricated. Secondly, our wetting and dispersing additives make sure that solid components, such as graphite in forge lubricants, distribute well. And thirdly, our rheology additives prevent these particles from settling.

The selection of the appropriate additive is critical for the success of the application. With the aid of the foam tester, we can discover which qualities the defoamer must have to ensure it has the ideal effect in the oil.

Greases, however, require a high resistance to be able to withstand the mechanical loads and high temperatures to which they are subjected. Based on the type of base oil used in the grease, we identify what thickeners can be considered and produce a grease sample in a colloid mill. We process this using a walker in order to simulate the mechanical load. Finally, we use a penetrometer to measure the consistency of the grease on the basis of precisely defined stipulations. This is how we establish whether the grease that has been optimized using our additive has reached the NLGI class and can withstand the requirements of the application.

Tip:
There is a suitable defoamer for every API class of base oils.

Tip:
For each base oil there is a suitable organoclay as a thickener for the grease.

Consistency measurement with a penetrometer

Mechanical loading of the sample with the walker

Preparation of a grease sample with a colloid mill

Testing defoamers:

We test additives for lubricants by testing different base oils. This enables us to identify the appropriate product for every API class.

If we want to know how our additives optimize the transparency, quality, and leveling properties of flexo inks, we create a test print on our **flexographic laboratory machine**.

The result is evaluated on the basis of the grid points.

Welcome to our mini printing plant!

Printing and packaging products are mass-produced and expected to hold up to handling and storage conditions without damage to their appearance. Our wax additives refine overprint varnishes and our surface additives impart good slip to ensure the printed surfaces withstand abrasion and mechanical stress.

But we also offer a lot for the layers of color beneath. This is where wetting and dispersing agents come into play. They allow pigments to be finely distributed – in solvent-borne and water-based or even in UV-curable colors. Rheology additives enable the optimum flow behavior for each printing procedure. And defoamers ensure an absence of bubbles in both the production and the processing of the colors.

In our laboratory for printing inks, our tests enable us to replicate virtually every requirement that the various printing procedures (flexographic, offset, gravure, and screen printing) can produce. We use the results to identify the additive mixture that will suit the ink; in doing so we also take into consideration the regulatory requirements.

We use the high-performance shaker to quickly grind up to 20 pigment samples with different wetting and dispersing additives in parallel and then use the data to determine the perfect additive for the respective pigment dispersion. To visually evaluate the quality of the ink as well as its transparency, we use the appropriate application device for each printing method. These include the laboratory printing machine for flexographic inks as well as the color application device for offset inks.

In terms of the quality of the overprint varnish, there are two test procedures. We prove scratch resistance with a rub tester. The tester rubs the surface that has been provided with our wax additives up to 1,000 times in order to establish the resulting abrasion. The slip, which is required in many types of packaging, can be proven using the friction peel test.

Printing test device

Friction coefficient tester

Regulatory information:

Our VOC-free products fulfill the regulatory standards. We also offer a varied selection of additives for inks for food packaging.

Our additives have been optimized for these printing procedures:

- Offset
- Gravure
- Screen
- Flexographic

Stable – even under pressure

Industrial inkjet printing supports the most varied of applications: from labels, textiles, and tiles to large-scale banners and 3D printing. Due to the spectrum of procedures and devices, there is also a wide variety of inks.

All inkjet inks have the same two key requirements. They call for pigment dispersions that work with the tiny nozzles in the printing heads when the inks are applied to the substrate under high pressure. And it is also necessary to be able to store the inks for a longer time. This applies to solvent-borne, water-based, and UV-curable systems.

Our wetting and dispersing additives support these properties. They ensure a finely distributed, long-term stable pigment dispersion. Our surface additives improve the printability ("jettability") of the systems. And our wax additives and defoamers also contribute considerably to optimizing the inks. We use a series of tests to establish in detail how the respective suitable additive cocktail must be designed – there are no standard solutions.

To begin with, we use the particle size analyzer to measure the size and size distribution of the pigment particles. With the results, we are then able to assess the quality of the pigment dispersions and select the most suitable dispersing additive.

The rheology of the pigment dispersion is an important additional parameter, as it influences the flow behavior of the finished inks. The flow should be as Newtonian as possible. We establish this using the rheometer. On the other hand, we can follow the path the ink takes and the drops contained in it with our lab printer. This enables us to make precise statements about the printability of the inks, a feature that is primarily influenced by our additives.

Tip: The high-molecular-weight wetting and dispersing additive BYKJET-9131 has been specially designed for magenta, cyan, and yellow pigments, and BYKJET-9133 for carbon black pigments.

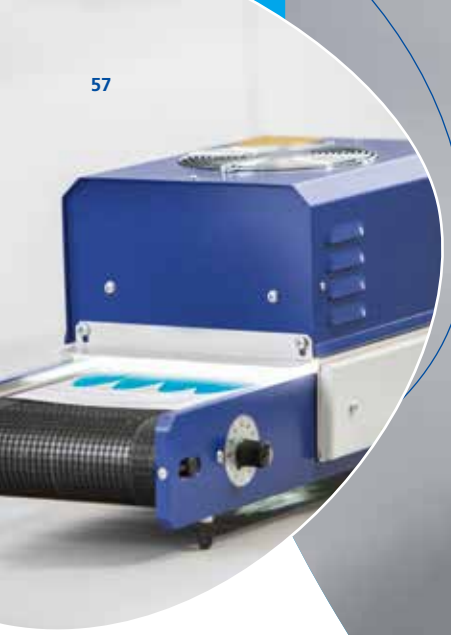
Our additives support these processes:

- Drop on demand (DoD)
- Continuous inkjet (CIJ)

Particle size analyzer

UV curer

Anton-Paar® rheometer



Laboratory mill

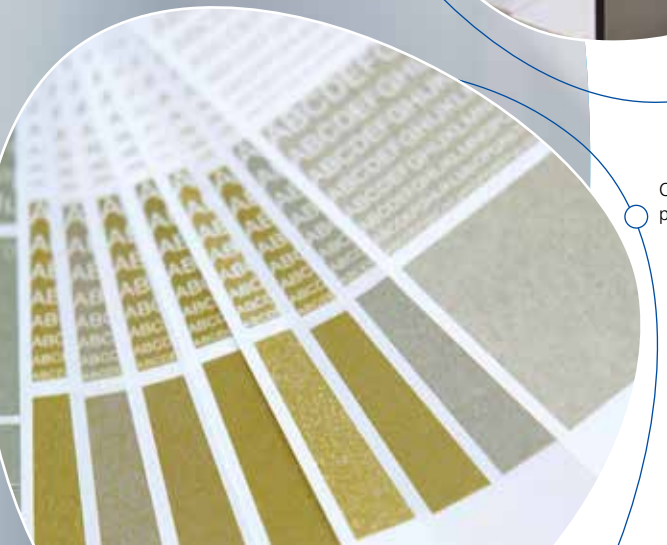
Our **lab printer** is equipped with a built-in camera that is used to analyze the drop formation of the inks. The printed image is only faultless if the surface tension is correctly set – our additives help here too.

We use the

foam tester

to validate the behavior of our defoamers in the paper coating colors.

Device for analyzing paper surface energy



One printing ink – different paper qualities

Added value thanks to special surfaces

Paper is often considered to be a mere commodity product. However, the addition of a coating to the paper surface can increase the value of the product by improving its quality properties.

Equally, the application of a coating may allow the development of new functional properties that permit the paper to be used in new and higher value application fields. The coating may, for example, improve and optimize the printing quality on the paper, lend barrier qualities to the paper, or facilitate its use in special printing applications, such as inkjet, thermal, and carbonless copying applications. In all cases, additives are essential to developing optimized solutions.

Our wide-ranging additives assist in the production of an optimized coating color, improve the coating process, enhance the performance of base papers, and deliver special functionality. Our products include wetting and dispersing additives, defoamers, rheology modifiers, surface active agents, wax, and phyllosilicates.

We employ extensive analysis techniques in order to assess the properties of a paper surface and understand its impact on the paper's performance in different applications. Based on these analyses, we develop improved surfaces with optimized performance. Equally, in key applications, we assess the actual performance properties of the papers to demonstrate what type of improvements can be obtained.

Our FULACOLOR products:

Our additives based on acid leached phyllosilicates produce reactive and absorbent paper coatings, e.g. for inkjet printing applications.

So that seeds trickle – grain by grain

Seeds trickle through large sowers and into the earth – and it is essential to ensure that the grains do not stick to one another.

Grains can be prevented from sticking together if the coatings, which the producers apply anyhow to protect the plant, have been optimized accordingly. That is where our additives come in.

Our wetting additives support the coating process by reducing the surface tension of the particles. Our rheology additives optimize the flow behavior of the seed coating and our wax additives prevent dust development, because they generate smooth, hard surfaces.

To test the effect of our products in our customers' formulations, we replicate the seed coating process. To do this, we use a pickling machine. We then subject the coated grains to the shaker test, for example: We measure the angle produced when we cause a small pyramid of grains to trickle. The smaller it is, the better, giving the starting shot for our grain marathon!

These additives prevent dust development:
AQUACER 581
AQUACER 583

! The smaller the angle, the better the seeds will trickle. We use the **shaker test** to establish this.

Shaker test

Surface wetting of leaves

Industrial seeds

In the **pickling machine**, we replicate the process through which the grains of the seed are coated. We use the results to then identify the most suitable wetting and rheology additives for the respective seed coating.

Our lab's own **washing machine**

completes many washing cycles every day in order to evaluate the effect our additives have. When this involves us testing our defoamers, the question is what the right dosage is to ensure that the right amount of foam remains to give end customers that truly clean sensation.

Wash, clean, and polish, please!

How do you evaluate the test results? If necessary, by touching and feeling. That is the only optimal way to determine the softness of washing as achieved by our PURABYK-P 5540 additive.

First, we subject the cotton textiles to exhaustive washing tests. We then invite impartial test persons to give their opinion on how the result feels to the touch. By these means, we can calculate exactly how high the dosage of our products needs to be to make a two-in-one product of the washing powder – a combined detergent and fabric softener.

Defoamers are indispensable for washing and cleaning agents. One of the ways we determine what the right dosage is for the respective formulation of detergents is by using our dynamic foam analyzer (in short: DFA). This device delivers precise data on how quickly the foam will break down again thanks to our additives.

Polishes can be refined using our surface and wax additives. We have several testing methods at our disposal with which to find the additive that is suited for each of the respective applications. With the crockmeter, for example, we simulate abrasion wear to floor coverings from exposure. And we test polishes for automotive coatings using our commercially widely available polishing machine. On the basis of various settings (pressure, rotation diameter), we establish how the gloss or color depth after polishing the metal sheets will benefit from our additives.

Testing of polishes

Dynamic foam analyzer (DFA)

Regulatory information:

Products with an Ecolabel are very much in demand amongst end customers. Please contact us if you wish to obtain such certification for any of your formulations. We will provide you with the respectively relevant regulatory information for our defoamers, rheology additives, and waxes.

Renewable resources:

Our wax additives help to protect surfaces against abrasion and wear or to create slip resistance. Besides the traditional products on a PP or PE basis, we are constantly expanding our portfolio with natural waxes (for example rice bran, sunflower, and carnauba waxes).

Where strong shear forces prevail: The droplet size of emulsions is reduced in the

homogenization process.

Rheometer

pH meter

Cosmetic specimen

Recipes for care and beauty

Creme or paste, gel or lotion: Each skin care product has its own specific flow behavior that can be excellently regulated using our rheology additives.

In our most recently inaugurated laboratory for personal care applications, we concentrate our attentions on cosmetics products such as skin care, sun screen, and deodorants. In doing so, we support our customers in their own development work and give them recommendations and/or suggestions for the use of our additives.

We are able to choose from a widely varied portfolio of additives for cosmetic formulations. These include thickeners based on phyllosilicates that change the rheology of products. In order to develop formulations step by step in our laboratories, they are equipped with devices that are widely used in the cosmetics industry such as stirrers, homogenizers, rotor-stator systems, and pH meters.

When producing emulsions, we use the homogenizer to reduce the droplet size. We test how our respective additives can be incorporated. Are low or high shear forces ideal? Which production method leads to the most stable product? And we are also ultimately interested in the question: Will the product create a pleasant skin sensation? This we determine with the help of sensory tests in which trained test persons grade the product according to prescribed criteria.

Once the method of incorporation and dosage of the selected additive have been decided on, further tests follow. We check the stability of the products using centrifugal and storage tests, determine the skin sensation using sensory tests, and establish the flow behavior by means of rheological measurements.

pH value

Our recipes are solidly tested. The pH value of the skin care formulations lies within the skin-neutral range of 4.1 to 5.8.

Our additive recommendation:

In the rapidly growing natural cosmetics market, certification such as COSMOS or NATRUE, for example, is becoming ever more important. These additives are well suited for natural formulations: GELWHITE-H, OPTIGEL-CL, PURABYK-R 5510, RHEOBYK-7590 PC.

Resistance is pointless

Lithium-ion cells have become a staple part of our everyday mobile lives – from smartphones to electric vehicles, they are to be found in the most diverse of products. Our additives are playing an increasingly important role in the manufacture of these batteries. They optimize the production process and ensure improved properties in the products.

For example, our wetting and dispersing additives facilitate the dispersion of conductive carbons such as carbon black and carbon nanotubes (CNTs). This renders possible the production of homogeneous electrode pastes for the manufacture of improved anodes and cathodes. Surface additives, in turn, optimize the substrate wetting. They reduce surface tension and improve the flow of the pastes. By means of this, they ensure a quick, trouble-free separator coating. Defoamers, rheology additives, and binding agents complete our portfolio.

To enable exact validation of the effect of our formulations in our customers' applications, we use various test procedures such as are applied in the battery industry. Examples of these are battery cell charging and discharging curves, electrochemical stability tests, as well as voltage, impedance, and resistance measurements.

Every battery laboratory has its own so-called glove boxes, in the protective atmosphere of which we produce classic button cells as well as single layer pouch cells. We then test the impact of our additives on the cells' performance.

Besides diverse analytical methods and working in a protective atmosphere, we also make use of various process techniques. We work with Dispermats, shakers, planetary mixers, and high-pressure homogenizers in order to optimize the additives for different process technologies.

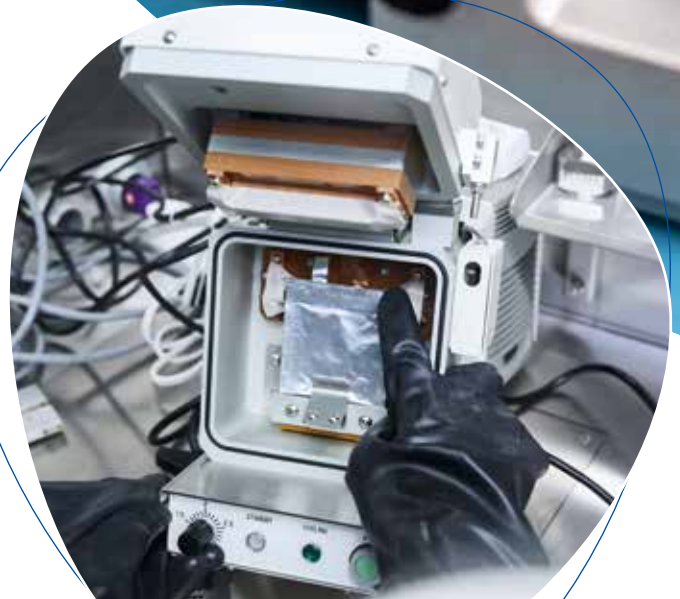
Tip:
The "BYK-ET" portfolio is specially designed for the battery industry.

Working in the glove box

View of the laboratory in Amagasaki

Graphene or carbon nanotubes serve as conductive materials in the coating pastes of battery electrodes. On behalf of our customers, we test how our wetting and dispersing additives perform in their pastes. That way, we identify the formulation that is best suited to prevent the agglomeration of particles and thereby improve the conductivity of the electrodes.

Sample preparation



Test run

In the **roller kiln**, we simulate the conditions that drilling fluids are exposed to in a drill hole. Once our rheology additives pass this test, we know that they are suitable for use in the drill hole.

Equipped for heat and pressure

The deeper the drilling, the higher the temperatures in the drill hole – and consequently the higher the demands on our additives for drilling fluids. They must have particularly high thermal stability – only then they can fulfill their rheological function at every stage of the drilling process.

With the help of our test procedures, we can identify the precise additives for our customers that perfectly suit the temperatures in the drill hole as well as the fluids used.

We use two methods to establish thermal stability: the roller kiln and the filter press. The roller kiln simulates the effects of high temperatures on the drilling fluid while it is circulating in the drill hole, where temperatures can reach up to 260 °C. The fluids are rolled for 16 hours at high temperatures in the kiln to test their thermal stability before we recommend them for use in the field.

The filter press is used to test the filtration rate and quality of the filter cake that forms during the course of the drilling process. The various conditions in the drill hole – such as high pressure and high temperatures – can also be imitated in the filter press. This test gives us information about the behavior of the additives under realistic conditions.

Once we have identified the formulation, our next step is to accurately adjust the viscosity, yield point, and gel strength at the respective specified temperature. For this purpose, we test the drilling fluid that has been optimized with the additive in a rotating viscometer. This procedure can also be used to measure the dynamic settling behavior of solids.

Tip:
Our CLAYTONE products can be used to create targeted rheological properties for different temperatures. The result is highly efficient drilling fluids.

Our additive recommendation:
To stop extreme viscosity, we recommend BYK-GO 8702 for oil-based drilling fluids and BYK-153, BYK-155/35, or BYK-155/50 for water-based products.

The pour point test

We use this to determine which additives keep the raw oil flowing even at lower temperatures.

Cold finger test

More oil from every drill hole

Our additives facilitate unrestricted oil production, ensure the equipment remains intact, and efficiently separate the production phases from each other. This allows for maximization of the extraction output.

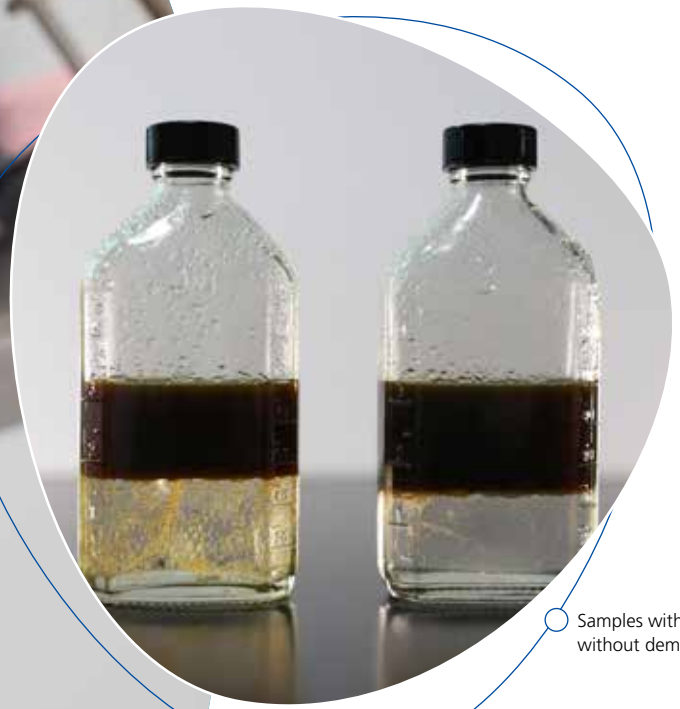
When added to the crude oil, our paraffin solutions ensure unrestricted production processes. They prevent clumping and deposits that can occur in the conveyor pipes or during transportation as the oil cools down on its way to the earth's surface. Our wetting and dispersing additives can also be deployed to protect the pipes against corrosion.

We use standard tests – such as the pour point test – to help replicate various situations in the oil production. This test shows at which temperature the cooling crude oil is still fluid. Admixing our additives keeps the oil flowing, even when the ambient temperatures are considerably colder.

The cold finger test gives information about how the composition of our polymers must be designed in order to prevent paraffin deposits.

When it comes to complying with the strict refinery stipulations, a crucial operation in oil production is the separation of water and oil. Being able to separate an emulsion quickly facilitates maximum extraction. Our additives are adapted to customers' specifications so that the best demulsifier can be formulated for the respective oil field. We also have special demulsifying kits available on request.

Information on the additives:
Our newly developed additive portfolio includes pour point depressants and wax inhibitors for various types of crude oil.



Samples with and without demulsifier

Regulatory affairs

There are many facets to our expertise

Even at a very early stage of our Idea2Product process, we give particular attention to ensuring that new developments comply with the regulatory requirements of the application.

This is only possible given the continuous monitoring of global provisions for chemicals, a worldwide network of specialists, and close cooperation. Immediately following the laboratory phase, new product developments are entered in a previously defined chemicals register in order to secure their marketability. As part of our Global Product Strategy (GPS), we support our customers during the product launch with standardized documentation on a wide range of topics.

BYK global regulatory service

Learn about BRIEF

Each product is only as good as the service that accompanies it. That is why we support our customers beyond matters of application technology. With our global regulatory service, we also make it easier for customers to select their raw materials with a view to their target markets and applications.

Regardless of their production location, our customers can rest assured that our additives comply with the guidelines of their region with regard to product safety, health concerns, and environmental protection. This also applies to the provisions of special markets, for example in those areas with food contact.

Lots of information is detailed in a BRIEF document (BRIEF = BYK Regulatory Information Extensive Form) that exists for each additive. Details about the processing and the safe handling of our products can be found in the technical data sheets as well as in the safety data sheets.

You can contact our regulatory service specialists on **byk.com/contact**. They will provide the required information to buyers and developers who are testing new formulations. They also support specific projects with their expertise on product safety and the registration of substances.

BYK customer seminars

Compact practical information about additives

Which formulation is correct? How can it best be incorporated, and which methods or equipment can be used to test the results? Customer seminars, which BYK offers regularly to customers from different regions and for different target groups, provide answers to these practical questions concerning our additives.

The participants acquire compact knowledge at these events - often extending over several days and usually held at our location in Wesel. Using practical demonstrations, our technical experts show how the additives work and how they contribute to the optimization of processes and product properties. In many cases, equipment from BYK Instruments is used for success monitoring and information is given on how to operate them.

In addition to this, we also offer compact, free WEBseminars on the widest possible range of additive applications for our customers from around the world.

Seminar participants have the opportunity of discussing topics and exchanging ideas with the relevant BYK specialists from the application and sector-oriented end uses who are also in charge of them during the supporting program and in the seminar breaks.

Laboratory and production tours, along with a visit to the new high throughput screening facility, enable participants to learn more about the application of additives.

Regardless of the product groups covered in the seminar, our experts also take into consideration the participants' sector-specific requirements. Moreover, in special national seminars, they discuss specific regional details and regulations. And as needed, we offer additional special "Meet the expert" sessions with employees from research and development, the laboratories, product marketing, or sales.

Further training in dialog with experts:

Those participating in our customer seminars should be a good match in terms of their prior knowledge and sectoral mix. In order to convey training content in a group setting, we compile a targeted guest list and send out personal invitations for each seminar. Our experienced seminar team plans a program that is tailored to the participant group, with sufficient time for individual specialist discussions. It is no wonder that even long-standing customers have come to appreciate our seminars as practical further training for their employees.


Same standards
worldwide

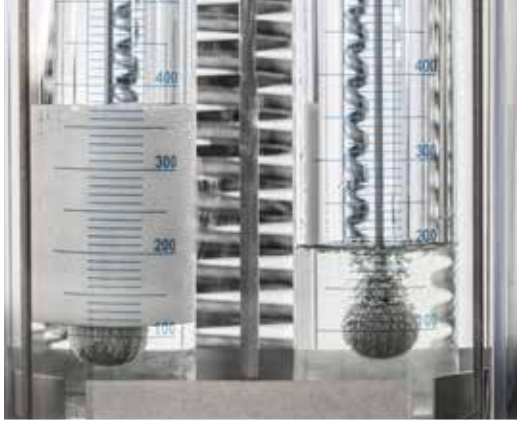





Whether in Germany, China, USA, India, or Korea: Our laboratories offer the same service worldwide. The equipment in all of them is in line with the latest technical standards. But it is the people at BYK who make the difference, using their expertise and commitment to develop differentiating additive solutions for our customers' challenges day after day. Our employees are not only experts in their field, but also passionate innovators who ensure that BYK is always one step ahead.

To find your closest BYK laboratory with additive experts, please follow this link: **byk.com/worldwide**.





B-2 EN 06/2025

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