



Technical Information HC-TI 1

Additives for Detergents, Cleaning and Care Products

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Introduction

Cleaning and care products are used predominantly on hard surfaces including objects made from metal, glass, stone, ceramic, wood, plastic, rubber, and leather. These surfaces can be coated or sealed.

Detergents and fabric softeners are used on significantly softer surfaces, such as textiles.

Within cleaning products and detergents, differentiation is made between products for **domestic use** and those for **commercial cleaning**. Commercial cleaning can be divided into industrial and institutional cleaning and covers products for the professional cleaning of industrial and office buildings, hospitals, and professional vehicle cleaning.

Liquid detergents, cleaning, and care products each have an entirely different **consistency** depending on the area of application. They range from transparent, low-viscosity products such as glass cleaners to transparent, viscous products such as dish soap, to particle-containing, opaque and sometimes paste-like products such as scouring agents.

The range of detergents, cleaning, and care products is frequently divided up into the following **application categories**:

- Cleaning products for kitchens
- Cleaning products for bathrooms
- Cleaning products for living rooms
- Floor polishes
- Leather care
- Vehicle cleaning and care products
- Industrial cleaning products
- Detergents and care products for fabrics

The properties of detergents, cleaning, and care products can be substantially improved by incorporating suitable additives. The BYK additive portfolio provides products with a variety of effects.

Rheology additives increase the viscosity of liquid products and are used to optimally adjust the flow behavior for the required application. Using these additives helps to prevent solid particles (e.g. abrasives, encapsulated fragrances) from settling. Another exciting application of rheology additives is in sprayable cleaning products that do not run down vertical surfaces and make longer exposure times possible.



Several cleaning and care agents such as scouring agents, car polishes, and polymer containing care products comprise solid particles that can agglomerate given inadequate stabilization in the product. This reduces the effect of the particles and causes visual defects in the product. **Wetting and dispersing additives** can prevent these undesirable effects by stabilizing the finely distributed particles in the cleaning and care products.

Wax additives form a protective layer on surfaces. This has a positive effect on the buffability, gloss, and water repellency of care products such as car, furniture, flooring, and shoe polishes.

Surface additives enable the thorough and rapid wetting of surfaces, and improve the leveling of care products, to produce a smooth and flawless film.

The use of **defoamers** enables care products to wet hard surfaces without bubbles, resulting in a flawless coating once dry. Not only is foam control highly important in many cleaning and care product applications, it is also important during their production.

Regardless of the required effect, using sustainable additives is highly important. For this reason, developing additives that can be used in Ecolabel-certified products is a major focus at our company.

Wax Additives for Floor Polishes

The surface care sector covers the markets of polishes for cars, leather, and furniture as well as floor polishes. Many properties of the products used in the care sector can be optimized by incorporating suitable additives. BYK offers a range of **wax additives**, **defoamers**, and **surface additives** to manufacture high-quality care products and to achieve the best possible surface and effective protection. When formulating polishes that contain solids and/or abrasives, suitable **rheology additives** and **wetting and dispersing additives** can help to optimally stabilize finely distributed particles.

Floor Polishes

Floor polishes that are used in industrial and institutional fields are primarily aqueous systems.

Floor polishes are applied to protect the floor covering and form a consistent film once dry. This provides a uniform and level surface. The polish film gives the floor an aesthetic appearance and acts to protect against mechanical wear. Key performance characteristics are improved by using **wax additives**, including mechanical and dirt resistance, slip reduction (anti-slip) and the filling capacity on scratched substrates.

Wax additives can also be used to adjust the desired degree of gloss.

“Wax” is a technical term used to describe a broad group of organic materials that come from a variety of sources (Figure 1). The categorization of a material as a wax is not based on chemical composition but rather on common physical and mechanical properties as follows:

- Waxes are solids with a melting point above 40 °C (usually between 50 °C and 160 °C)
- They have a low melt viscosity (below 10 Pa/s at 10 °C above the melting point)
- They melt without decomposing
- They can be polished with pressure

Overview of Various Wax Types

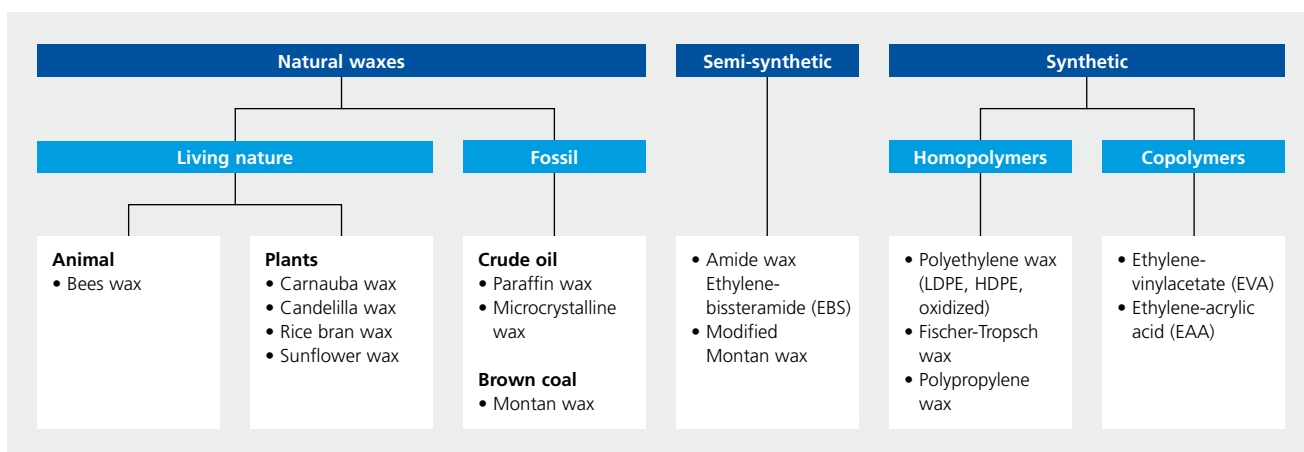


Figure 1

Their polishability is highly interesting for the use of **wax additives** in floor polishes. Figure 2 shows how typical wax properties are dependent on the melting point and polarity.

In many cases solid waxes cannot be directly applied to a surface due to their shape and size as processed material (Figure 4). As a result, preparations of smaller particle size material, known as **wax additives**, are produced from the bulk. In wax additives, particles are finely distributed in a liquid phase (water or organic solvents) or as micronized waxes in powder form. In this form it is easier to handle and incorporate the waxes into a formulation and therefore onto a coated surface.

Our main wax additives for floor care products are the **AQUACER** products. These are wax emulsions with particle sizes below 1 µm. They are ideally suited to high-shine systems, as they have no negative impact on the gloss.

The **AQUACER 1075** and **AQUACER 1076** products were especially developed for floor polishes and tailored to the market requirements. AQUACER 1075 is a high density polyethylene wax that provides the floor polish with excellent mechanical resistance while improving the resistance to disinfectants and cleaning products. AQUACER 1076 is based on polypropylene wax and is used to adjust surface slip (anti-slip). In combination with AQUACER 1075, the desired balance between surface protection and anti-slip effect can be achieved. The ideal ratio is heavily influenced by the polymer resin used in the formulation.

Due to their submicron particle size, AQUACER 1075 and 1076 provide a high gloss finish. One way to compare the mechanical resistance imparted by different proportions of waxes and resin is to evaluate the gloss before and after marring the surface. A common way to do that is the use of a Crockmeter (Figure 3) in which coarse paper is rubbed against the surface in a linear fashion. A higher gloss retention (% change in gloss before and after rubbing) is a measure of the mechanical resistance of the floor polish; the higher the retention the better.

Melting Points, Polarity and Properties of Different Waxes

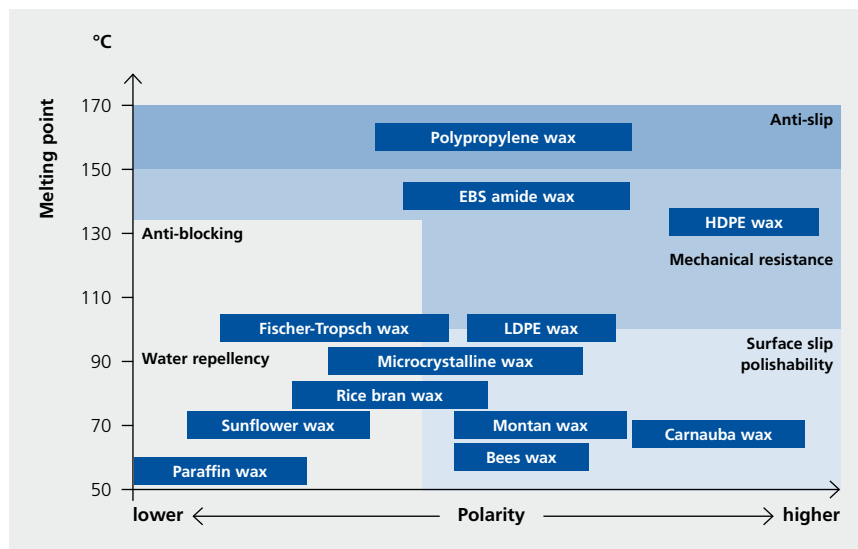


Figure 2

Crockmeter Test for Mechanical Resistance



Figure 3

Appearance of Waxes



Figure 4

Wax Additives for Floor Polishes

Gloss retention when using AQUACER 1075 (HDPE), AQUACER 1076 (PP) and various combinations of the two, is shown in Figure 5. These examples are in a metal salt-free floor polish.

Wax additives also affect the surface slip of floor polishes. The slip can be determined using a coefficient of friction device like an "Altek 95". A defined weight is pulled over the surface and the resistance is measured. Figure 6 shows the impact of different wax bases. AQUACER 1075 (HDPE) was selected as a reference value. The change in slip when using AQUACER 1076 (PP) and their various combinations is shown in %.

AQUACER 1075 increases mechanical resistance for floor polishes. AQUACER 1076 has a positive influence on the anti-slip effect. A combination of **AQUACER 1075** and **AQUACER 1076** can be used to adjust the properties of floor polishes to meet the desired application.

In contrast to these products, **AQUAMAT 1400** is a wax dispersion with coarse particles (> 1 µm), making it ideally suited to reducing gloss. Adding just 3 % of wax to the formulation provides good matting without causing residual glossy areas in the film after mechanical stress.

Floor coatings need to produce consistent leveling following application. To guarantee this, film-forming floor polishes, particularly containing polymer dispersions, additionally employ **leveling agents** that offer good wetting and spreading.

Gloss Retention of a Floor Polish after Crockmeter Test

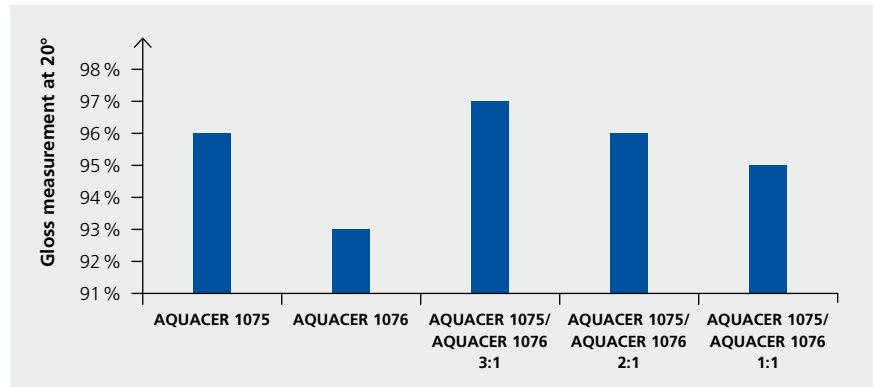
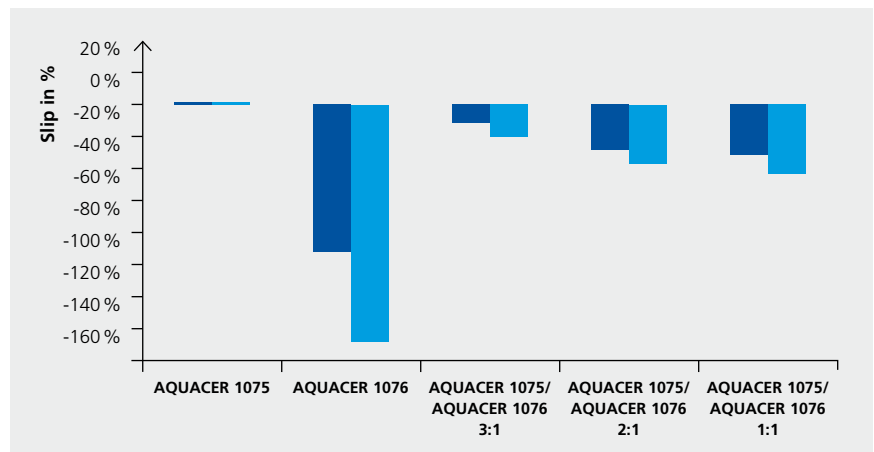


Figure 5

Slip Reduction by Waxes Measured with the Altek 95 Testing Device



■ Zinc containing
 ■ Metal salt-free

Figure 6

Surface Additives for Floor Polishes

Floors are made from materials with different surface energies. However, a homogeneous protective film will only be obtained if the floor surface is thoroughly wetted. To achieve good wetting, the surface tension of the water-borne floor coating needs to be lower or equal to the surface energy of the substrate. At room temperature, the surface tension of water lies in the range of 70 mN/m, whereas the surface energies of typical floor coverings lie in the range of 20–50 mN/m. To avoid application problems, it is therefore often beneficial to lower the surface tension of the floor coating by adding surfactants or **surface additives** that reduce the surface tension. A liquid “spreads” over a substrate surface if the adhesive force to the substrate is greater than the cohesive forces within the liquid (Figure 7).

Fluorinated surfactants are often used in polishes, although their persistence means they have negative environmental properties. Silicone surfactants are more sustainable alternatives and also enable excellent wetting and spreading.

Correlation Between Adhesion, Cohesion and Spreading

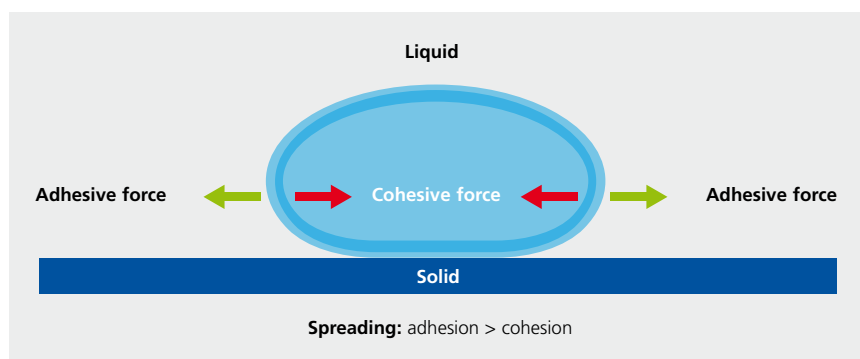


Figure 7

An important subclass of these additives are polyether modified polysiloxanes (Figure 8). By specifically modifying the polysiloxane with hydrophilic polyethers and hydrophobic alkyl chains, the hydrophilicity of the structures may be precisely adjusted. Silicone surfactants (Figure 9) are especially suitable for aqueous systems. They only differ from the polysiloxanes described above in their significantly lower molecular

weight. The polar/non-polar surfactant structure is therefore particularly effective, and also explains their impact in aqueous formulations. Foam stabilization is barely observed. Another advantage for floor polishes is that silicone surfactants do not increase surface slip. In addition to silicone additives, silicone-free products that are based on alcohol alkoxyates are also available.

Polyether Modified Polydimethylsiloxane

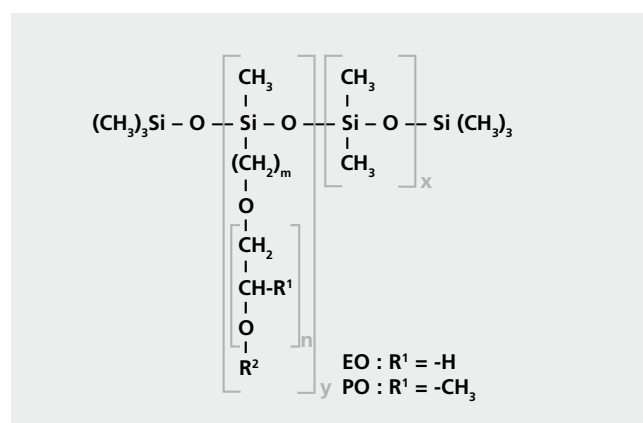


Figure 8

Silicone Surfactants

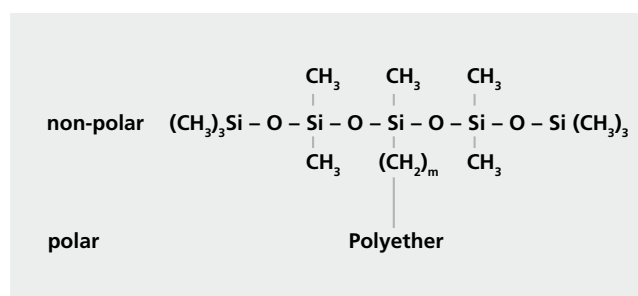


Figure 9

› Surface Additives for Floor Polishes

In Figure 10, the effect of surface tension on the wetting of a PVC floor is shown. The left side shows a water droplet without additive, which does not wet the substrate. By adding a suitable silicone surfactant, good spreading can be achieved within seconds (as shown on the right side of the image).

The effect of a suitable surface additive on a floor care product's leveling is shown in Figure 11. The photo on the left shows a surface coating without a suitable surface additive. It displays inadequate leveling. The photo on the right shows the same coating formulation with considerably improved leveling as a result of adding a small amount of a suitable silicone surfactant.

Wetting of a PVC Flooring by Water Without and With Silicone Surfactant



Figure 10

Improvement in Leveling of a Polish by Usage of a Silicone Surfactant



Figure 11

Defoamers for Floor Polishes

Defoamers for Floor Polishes

Applying a floor care product with a mop produces foam bubbles that are stabilized by the surface-active substances in the care product. Defoamers are used to prevent foam formation during the production and application of floor care products. A key feature of all defoamers is their targeted and controlled incompatibility with the medium that is to be defoamed. A defoamer that is too compatible has only a minor or even no defoaming effect. Too much incompatibility causes

defects such as turbidity or leveling issues. Choosing the correct defoamer is therefore a “balancing act” between compatibility and incompatibility. BYK offers **silicone defoamers**, **silicone-free polymer defoamers**, and **mineral oil defoamers** to provide optimum solutions for different systems.

The effects of a suitable and an unsuitable (too strong) defoamer are displayed in Figure 12. The left section of the image shows a gloss card upon

which a floor polish without defoamer was applied. On the surface of the maintenance film, the dried foam bubbles can be seen as surface defects. The center gloss card shows the surface of a polish with a defoamer. There are no dried foam bubbles, but other surface defects such as cratering caused by poor wetting are clearly visible. On the right gloss card, a floor polish containing a suitable defoamer is applied. There are virtually no foam bubbles and no other visible surface defects.

Impact of Defoamers on the Surface Quality of a Floor Polish

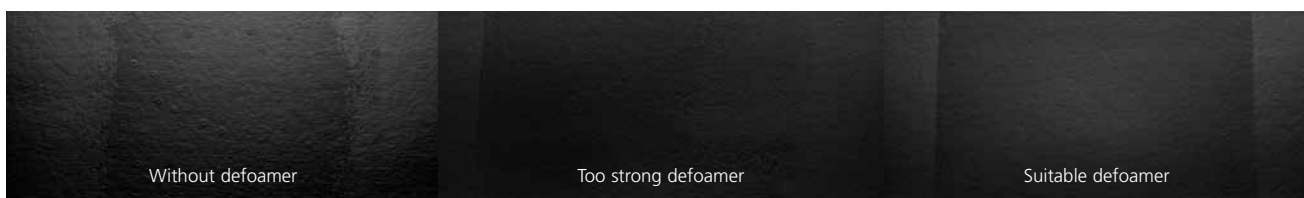


Figure 12

Product Recommendations for Floor Care Products

Foot Traffic Resistance	Mechanical Resistance	Anti-slip	Filling Capacity	Wetting	Defoaming	Matting	Anti-settling
AQUACER 1075 AQUACER 1076 AQUACER 519	AQUACER 1075 AQUACER 519	AQUACER 1076 AQUACER 528	AQUACER 1031 AQUACER 1075	BYK-345 BYK-349 BYK-3450 BYK-3455 BYK-DYNWET 800 N*	BYK-1724 BYK-011* BYK-1679 BYK-1723 BYK-1740*	AQUAMAT 1400	OPTIGEL-WX LAPONITE-RD RHEOBYK-7420 ES

First recommendation Second recommendation

*Silicone-free

Figure 13

Additives for Leather Care

Leather Care

Leather is a long-lasting natural product. Only with the right kind of regular care, adapted to the specific leather, will it retain its shape and protective functions for the long term. Oils and waxes keep the leather supple, preserving its value. Leather care for smooth leather consists of waxes, oils, emulsifiers, and rheology additives.

Rheology additives are used to adjust the required consistency of the care products. These are either pastes,

creams, or liquids. Wax forms a major component of a leather care product.

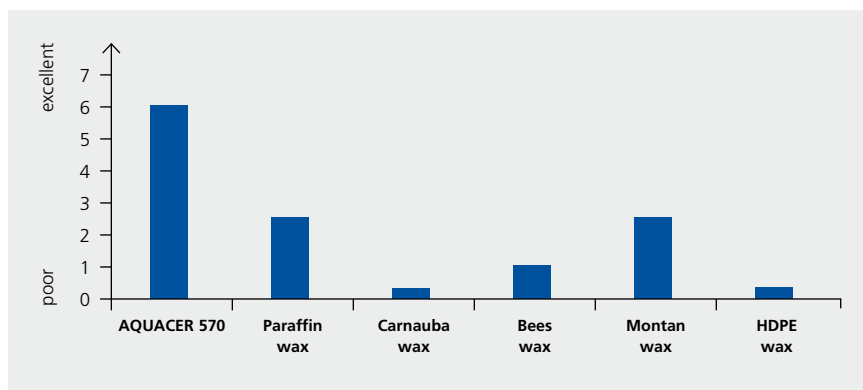
Wax additives based on mineral oil products such as paraffin and microcrystalline waxes have been used to protect surfaces for many years. For sustainability reasons, however, the focus for new developments is increasingly on “green” products, based on renewable resources.

In many cases, beeswax or carnauba wax are used in sustainable care products. A useful addition is sunflower

wax. As a result of its composition, it improves the hydrophobicity while also increasing the leather’s oil resistance.

The sunflower wax emulsion **AQUACER 570** is an innovative, new, and sustainable **wax additive** developed to meet the demand for environmentally friendly products. A modification with carnauba wax creates a finely distributed wax emulsion with a particle size of < 500 nm. **AQUACER 570** naturally has a very pale color.

Influence of Different Wax Bases on Oleophobicity



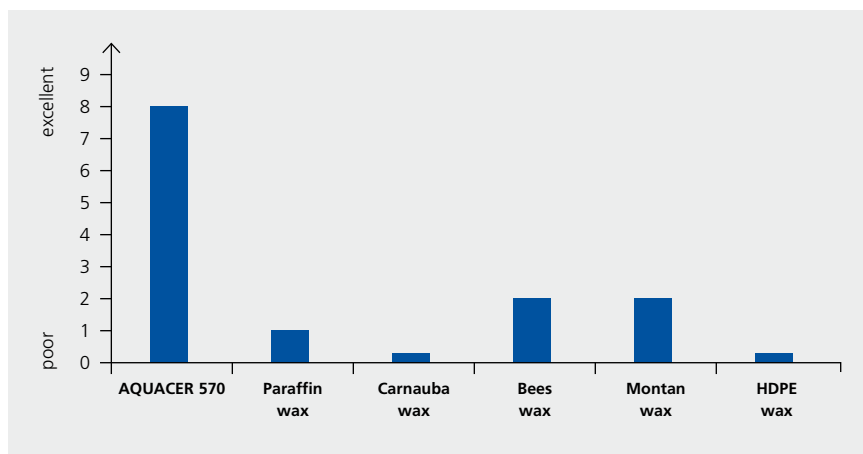
Leather polish, 5 % solid wax

Figure 14

A key criterion for good leather care is excellent oil resistance. Soiling caused by food quickly causes stains that are difficult to remove. As a practical test for oil resistance, long-chain alkanes are applied to the surface as test liquids. A surface is considered oleophobic if oil does not penetrate the surface. The test liquids are arranged in decreasing order of polarity. The higher the achieved values, the higher the oleophobicity. As seen in Figure 14, AQUACER 570 offers better oleophobicity than other common surface care waxes.

In addition to oleophobicity, the hydrophobicity of leather surfaces is also a key quality criterion for leather care. A static method to determine hydrophobicity is based on the use of water/isopropanol mixtures as test liquids. The ratio of water to isopropanol varies in increments of ten from 0–100 wt. %. As in the oleophobicity test, higher values show improved hydrophobicity. Figure 15 shows the results of the static hydrophobicity test. AQUACER 570 offers better hydrophobicity than other common surface care waxes.

Influence of Different Wax Bases on Hydrophobicity



Leather polish, 5 % solid wax

Figure 15

A leather surface is considered hydrophobic if the test fluid forms a drop on the material and neither spreads on nor penetrates the leather (Figure 16).

A key measurement parameter to quantify the hydrophobicity of a surface is the contact angle of a water droplet to the surface. To investigate the influence of AQUACER 570 on the hydrophobicity of a leather care product, multiple care formulations were produced that differed only in the type of wax used. All waxes used were added with the same quantity of solids. By using **AQUACER 570**, the contact angle compared to other **wax additives** can be significantly increased (Figure 17). This highlights the improved hydrophobic effect.

Static Hydrophobicity Test on LEFA Substrate (Leather Fiber No. 15801)



Figure 16

Contact Angle Measurement on Leather Polish

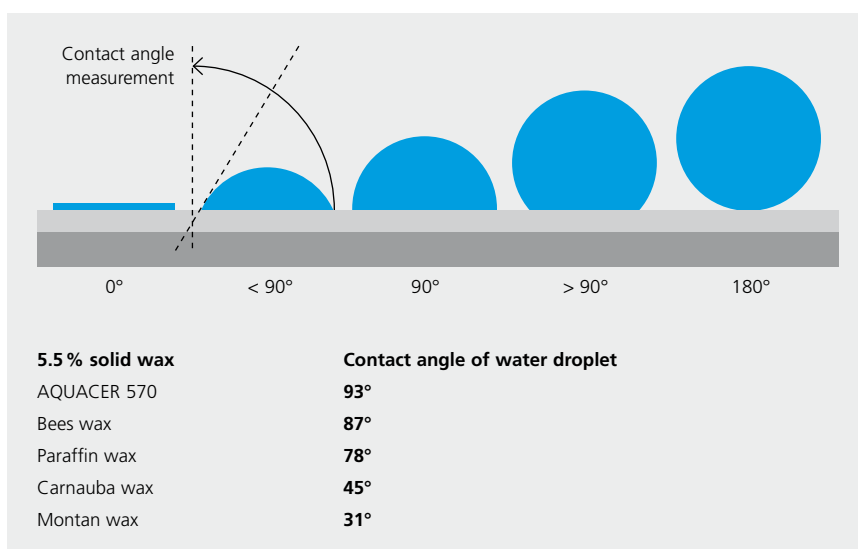


Figure 17

Product Recommendations for Leather Care Products

Water Repellency	Oil Resistance	Flow Behavior	Leveling	Defoaming
AQUACER 570 AQUACER 561 AQUACER 565	AQUACER 570	LAPONITE-RD & RHEOBYK-HV 80 OPTIGEL-WX	BYK-349 BYK-3450	BYK-1724 BYK-1723

First recommendation Second recommendation

Figure 18

Additives for Car Care

Car Care

Exterior car care products can be targeted for specific applications depending on the needs of the consumer. In general they are used to make the car “look better” and/or provide protection to the exterior paint coatings. More specifically though, they can be designed to give high gloss, give a matte finish, fix scratches, give a wet look, or to improve mirrored finishes. Car polishes can be used to improve damaged areas in the coating using abrasives. To remove deep scratches and “seeding”, abrasive pastes containing fine-particle, soft aluminum oxides with a particle size of 1–4 µm can be used. Smaller scratches in the coating that cause a hologram effect with direct sun irradiation can be removed using

finishing polishes. These contain silica or kaolinite with a particle size of 1–2 µm.

Wax additives and **silicone additives** are used along with abrasives in finishing polishes to achieve both a smooth surface and high gloss. Long-term sealants are abrasive-free car polishes that also contain wax additives and silicone additives. Rapid care products that produce a wet look and aim to remove minor amounts of dirt contain special **silicone additives**.

The solid materials contained in abrasive pastes and finishing polishes can be dispersed into their primary particles using **wetting & dispersing additives**. Stabilizing particles in their discrete form reduces tackiness and provides uniform buffing.

Polyacrylate-based dispersing additives have been shown to be particularly suitable. **DISPERBYK-2015** and **DISPERBYK-191** are products that contain special adhesive groups to deflocculate the abrasives.

Settling of the abrasives can be prevented by using suitable **rheology additives**, with which both the yield point and the flow behavior of the polish can be adjusted to the required level. Natural clays are frequently used in car polishes. The additive **OPTIGEL-WX** is ideally suited for preventing the settling and syneresis of abrasives in car polishes. At the same time, it can be used to adjust the desired viscosity (Figure 19).

Prevention of Settling and Syneresis in a Car Polish Using OPTIGEL-WX

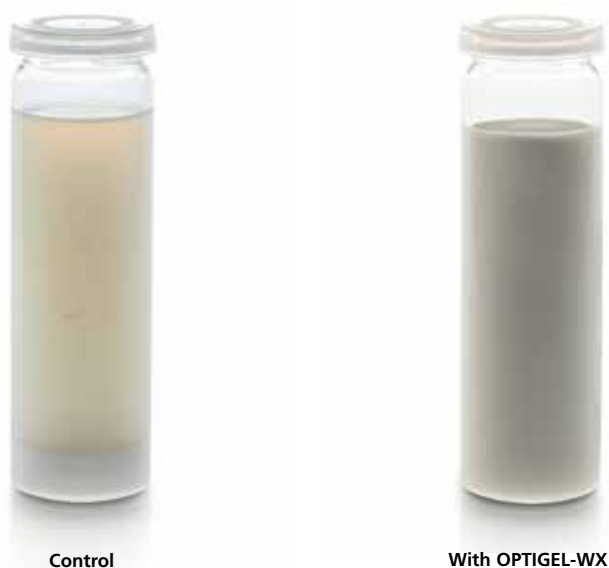


Figure 19

In the finishing polishes and long-term sealants field, **wax additives** are used to adjust the surface properties. By combining a carnauba wax additive such as **AQUACER 565** with an LDPE wax additive such as **AQUACER 1031**, a hard protective layer can be produced on the surface. Car polishes that combine **AQUACER 565** and **AQUACER 1031** prevent a hologram effect as the wax additives fill the micro-scratches caused by polishing (Figure 20).

Prevention of Holograms by Wetting and Dispersing and Wax Additives

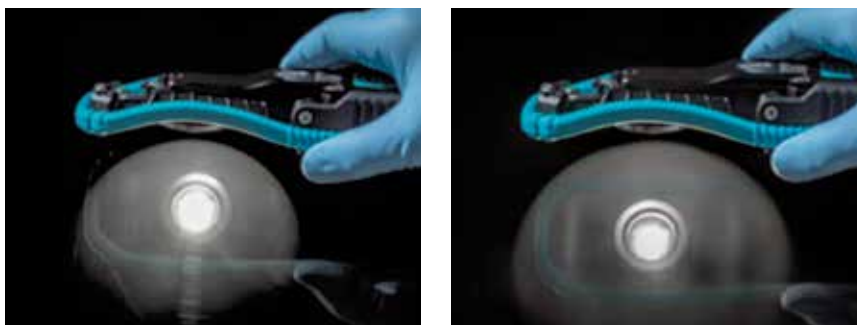


Figure 20

If easy polishability is required so that the polish can also be applied by hand, then a wax with a lower melting point is used. **AQUACER 561** based on beeswax or **AQUACER 570** based on sunflower wax are ideally suited for this purpose. With **AQUACER 561**, sealed surfaces have water-repelling properties. The water droplets formed flow faster and cannot dry on the coating (Figure 21).

Water Repellency by Usage of AQUACER 561



Unpolished surface

Surface sealed with AQUACER 561

Figure 21

All car polishes contain silicones. BYK has a broad range of silicone-based **surface additives** that can achieve different effects. Silicone surfactants enable better surface wetting and have a low impact on surface slip. If a smooth surface with high slip is required, a different line of silicone additives is available.

Product Recommendations for Car Polishes

Deflocculation of Abrasives	Anti-settling	Surface Protection	Anti-hologram	Easy Polishability	Surface Wetting
DISPERBYK-191 DISPERBYK-2015 BYK-154	OPTIGEL-WX LAPONITE-EP	AQUACER 565 AQUACER 570 AQUACER 1031	AQUACER 565 AQUACER 1031	AQUACER 561 AQUACER 570	BYK-348 BYK-3456

First recommendation Second recommendation

Figure 22

Additives for Vertical Cleaning

The surface cleaning sector covers the markets for **domestic households** as well as **commercial cleaning**, which is further categorized into industrial and institutional applications. In the private sector, predominantly aqueous cleaning products with different pH values are used. While alkaline cleaning products with good grease-dissolving power are mostly used in kitchens, acidic cleaning products with a high descaling capacity are required in wet rooms such as bathrooms. Cleaning products for living rooms are largely set to be neutral. Industrial cleaning sometimes employs cleaning products based on solvents.

In addition to the different chemical properties of the cleaning products, the demands on the flow properties also vary. Floor cleaning agents should enable easy wetting of the substrate and quick leveling. Cleaning products for sloped or vertical surfaces should adhere to the surface being cleaned as long as possible to facilitate good exposure. The desired flow behavior of the cleaning products can be adjusted using **rheology additives**. Combined with **wetting and dispersing additives** they also stabilize solid-containing products like scouring agents and enable the use of transparent packaging.

Cleaning Vertical Surfaces

Cleaning very dirty vertical surfaces is particularly challenging. These surfaces are frequently cleaned using spray cleaners. The demands on the flow behavior of the cleaners are high as it is desirable for the active to remain on the vertical surface upon application, guaranteeing a long exposure time for the cleaning product. Yet, they still need to be easy to spray.

Clays and modified ureas give a shear-thinning flow behavior with a yield point. The imparted yield stress permits high layer thicknesses on vertical surfaces without dripping or running. The low viscosity at high shear forces

makes application easy (e.g. by spraying) and the time-dependent return to high viscosity (thixotropy) provides adequate opportunity for good leveling (Figure 23). Synthetic clays such as **LAPONITE-RD** need only a very short time to regain viscosity as they have small particles that can quickly realign at the end of shear. Modified urea like **RHEOBYK-7420 ES** often need a slightly longer time to regain viscosity and enable a targeted adjustment of leveling following application. Due to their liquid format they can also be added post production. Both clays and modified ureas can be used in transparent products.

Viscosity Curve of a Thixotropic Material

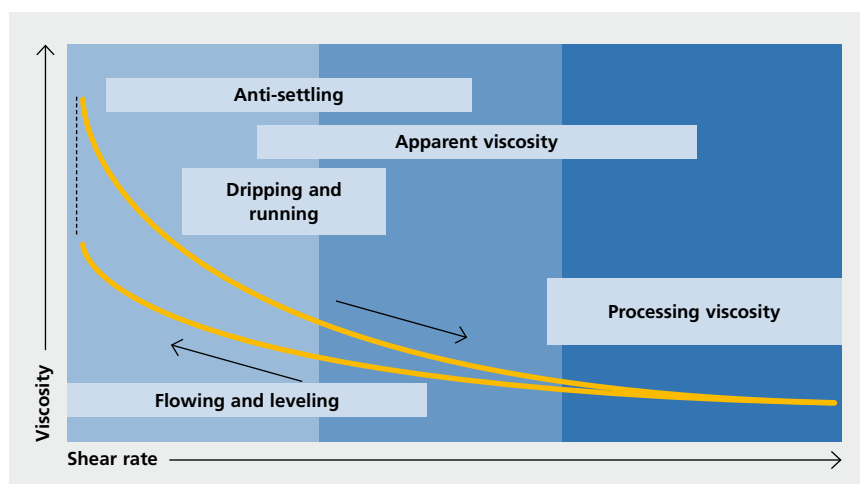


Figure 23

The rapid recovery of rheology once shearing has ended makes synthetic clays valuable additives for various applications. Another major advantage over other rheology additives such as polysaccharides is the good

sprayability. Due to its particle size, using LAPONITE-RD achieves both a good spray pattern with fine droplets and even distribution of the cleaning product in addition to its superb adhesion to vertical surfaces (Figure 24).

Mild cleaning agents must be used in certain applications, such as when cleaning sensitive surfaces. Long adhesion of the active to the surface is essential to thoroughly remove even heavy grime. This can be optimally achieved using LAPONITE-RD, which enables a wide range of applications and provides optimum solution options even in difficult scenarios. Examples of these applications include removing insects on cars and cleaning heavily soiled metal surfaces in kitchens.

LAPONITE-RD: Good Spraying Pattern and Adhesion to Vertical Surfaces

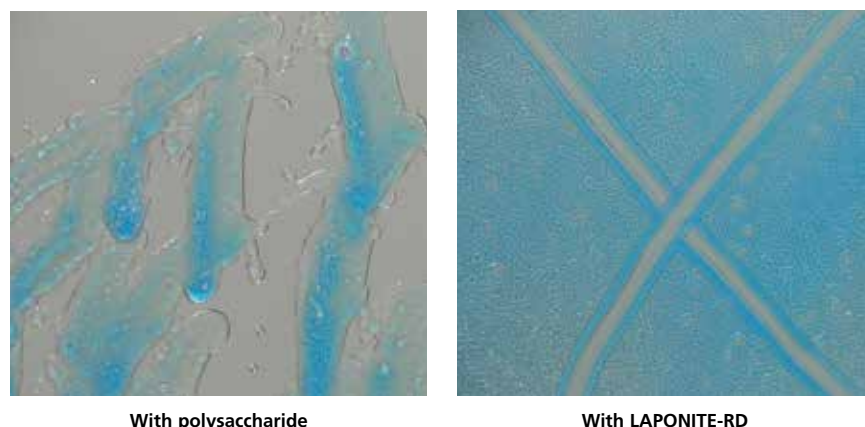


Figure 24

Product Recommendations for Aqueous Cleaning Products

	pH Value	Vertical Cleaning	Viscosity	Post Addition	Transparency	Defoaming
Cleaning products for living rooms	6–8	LAPONITE-RD OPTIGEL-CK RHEOBYK-7420 ES	OPTIGEL-CK LAPONITE-RD OPTIGEL-WX RHEOBYK-7420 ES RHEOBYK-H 7625 VF	RHEOBYK-7420 ES RHEOBYK-H 7625 VF	LAPONITE-RD RHEOBYK-7420 ES	BYK-1723 BYK-1724 BYK-014* BYK-1770
Cleaning products for wet rooms	< 0–5	RHEOBYK-7420 ES LAPONITE-EP OPTIGEL-WX	OPTIGEL-WX LAPONITE-EP RHEOBYK-7420 ES	RHEOBYK-7420 ES	RHEOBYK-7420 ES	BYK-011* BYK-1679 BYK-1723 BYK-1724
Cleaning products for kitchens	8–12	LAPONITE-RD OPTIGEL-CK RHEOBYK-7420 ES	RHEOBYK-7420 ES RHEOBYK-H 7625 VF	OPTIGEL-WX LAPONITE-EP RHEOBYK-7420 ES RHEOBYK-H 7625 VF	LAPONITE-RD RHEOBYK-7420 ES RHEOBYK-H 7625 VF	BYK-1770 BYK-014* BYK-016*

First recommendation [Second recommendation](#)

*Silicone-free

Figure 25

Rheology Additives for Solvent-borne Cleaners

Cleaning with Solvent-based Products

Even though the majority of cleaning products are water-based, solvent-based cleaning agents are still used in special applications. They are often highly desirable when working with metals and other materials that are attacked by acidic or alkaline aqueous cleaners. Solvent-based cleaning products are predominantly used in industrial applications (for example, at production sites or in workshops) to clean engines, tools, and water-sensitive parts. They also remove stubborn dirt such as paints, coatings, adhesives, or oil and grease.

Organophilic clays are suitable for adjusting the flow behavior of solvent-based cleaning agents. They can be obtained via organic modification of natural, hydrophilic clays. Essentially, the BYK portfolio can be subdivided into two product categories:

- Organoclays based on bentonites (**CLAYTONE**)
- Organoclays based on a mineral mixture (**GARAMITE**)

CLAYTONE bentonites form a three-dimensional network in solvents, based on hydrogen bonds between the edges of the platelets (Figure 26). Conventional types require the addition of polar activators to gel, i.e. to establish the hydrogen bonds. These are small polar molecules such as alcohols, acetone, water, or propylene carbonate, in quantities of 20–60 % based on the clay. **Self-activating types** do not need any activator and are also easier to disperse (Figure 27).

GARAMITE-type organophilic clays are very easy to incorporate and do not require any polar activators to form a gel. Their rheology is insensitive to fluctuations in polarity, for example, when adding different fragrances.

GARAMITE products are organoclays based on a **mineral mixture** from rod-like sepiolite minerals and platelet-shaped bentonite minerals (Figure 28).

Network Formation Via Hydrogen Bonds

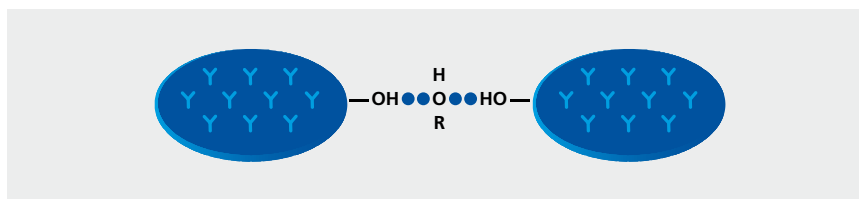


Figure 26

Conventional and Self-activating Organoclays

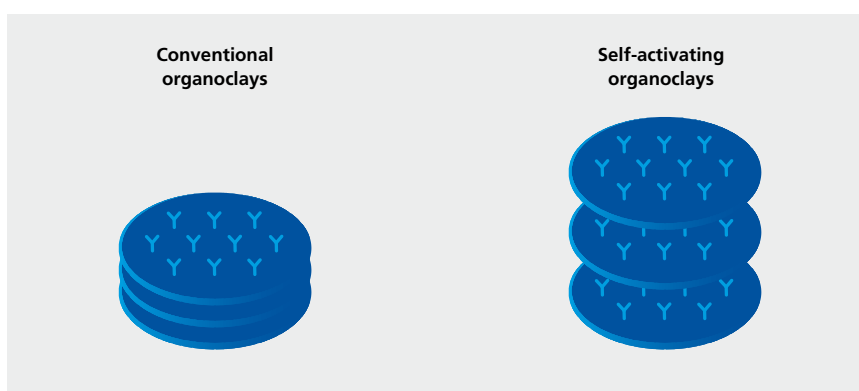


Figure 27

GARAMITE

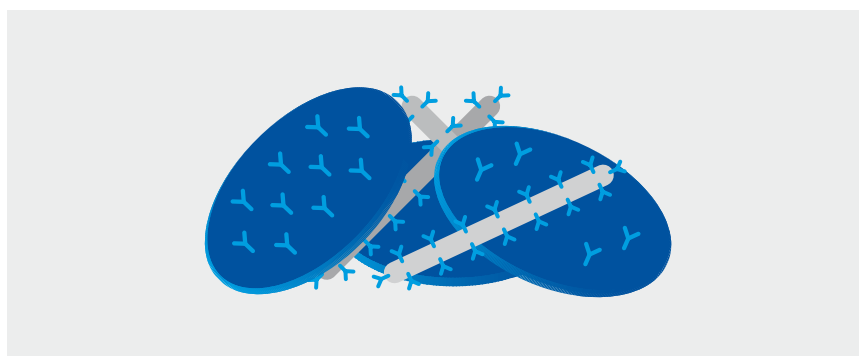


Figure 28

They have a range of special properties in solvent systems, which distinguish them from conventional organoclays.

Both types are described in the following table for different polar solvents and oils in cleaning products and detergents (Figure 29).

Selecting the most suitable organoclay is based first on the polarity of the organic medium and second on the available incorporation conditions.

The modified urea varieties **RHEOBYK-7410 ET** (for medium-polarity to polar systems) and **RHEOBYK-7411 ES** (for non-polar systems) are liquid rheology additives that can also be added at the end of the manufacturing process. For alcohols and other water-miscible solvents, **RHEOBYK-7420 ES** can also be used in some systems.

RHEOBYK-430 is suitable for solvent-borne and solvent-free, medium-polar systems to improve sag resistance and anti-settling properties. As these additives generate thixotropic flow behavior, they are suitable for stabilizing solids in the cleaning agents. Modified urea based additives can also be added post production and used in transparent products.

Product Recommendations to Adjust the Rheology of Solvent-based Cleaning Agents

Polarity of Solvent	Viscosity	Easy Incorporation	Anti-settling	Post Addition
Low	GARAMITE-7303 CLAYTONE-AF	RHEOBYK-7411 ES GARAMITE-7303	GARAMITE-7303 RHEOBYK-431* RHEOBYK-7411 ES*	RHEOBYK-7411 ES RHEOBYK-431
Medium	GARAMITE-1958 CLAYTONE-HY	RHEOBYK-7410 ET GARAMITE-1958 RHEOBYK-430	GARAMITE-1958 RHEOBYK-430* RHEOBYK-7410 ET*	RHEOBYK-7410 ET RHEOBYK-430
High	GARAMITE-7305 CLAYTONE-APA	RHEOBYK-7410 ET GARAMITE-7305	GARAMITE-7305 RHEOBYK-7410 ET*	RHEOBYK-7410 ET

First recommendation Second recommendation

Figure 29

*Possible in transparent products



Additives for High-Solid Cleaning Products

Cleaning with High-solid Products

The most common type of solids in cleaning agents are abrasive substances that are used in stainless steel polishes as well as in scouring agent products. Fine-particle silica or clays with rounded particle shape can be used as metal polishing agents. Besides abrasive substances, encapsulated fragrances or decorative substances can also be used as particles in cleaning products. Particles are generally stabilized via suitable rheology additives such as clays or modified ureas (Figure 30).

Scouring agents contain 15–50% calcite as an abrasive additive to gently and mechanically remove stubborn dirt in kitchens and bathrooms. When storing scouring agents, the abrasive substances can settle in the bottle and cause a separation of liquid at the surface (syneresis). By adding **OPTIGEL-WX**, settling and syneresis are effectively prevented without excessively increasing viscosity or affecting the application properties. Figure 31 shows a scouring agent without suitable additives compared with a scouring agent with suitable additives, as they appear after several days' storage in a glass bottle.

Defoamers such as **BYK-014** prevent the foam stabilization of the incorporated air.

Wetting and dispersing additives such as **DISPERBYK-199** can deflocculate the calcium carbonate used and enable a finer distribution of the individual particles. This improves the flowability of the product in production and application. The differences of a scouring agent with and without additives are shown in Figure 32.

No Settling/Syneresis with Clays

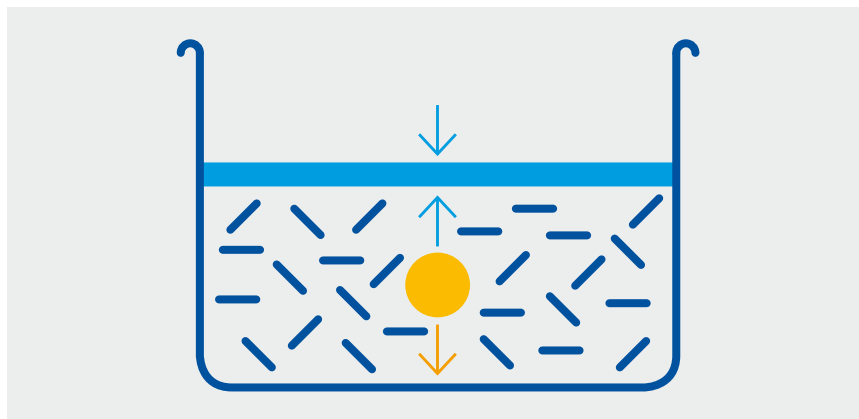


Figure 30

Excellent Storage Stability with OPTIGEL-WX



Figure 31

Calcium Carbonate Filled Scouring Agent with DISPERBYK-199 and BYK-014

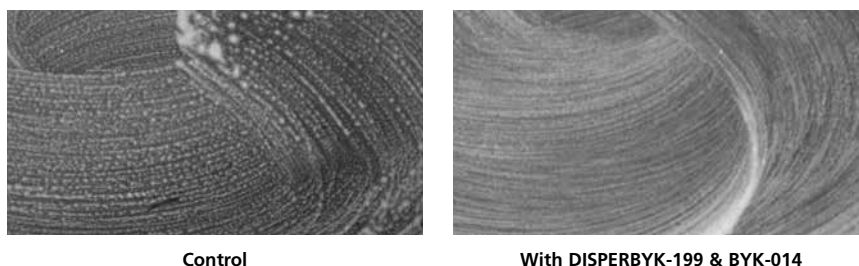


Figure 32

Stabilization of non-abrasive capsules in cleaning products

Abrasives are not the only solids that can be incorporated into cleaning products. Depending on what the cleaning product will be used for, the particles may be decorative or have a functional purpose. The function of the particles ranges from encapsulating fragrances to absorbing undesirable substances. For transparent cleaning products it may be most suitable to use modified ureas or a combination of synthetic clays and acrylate thickeners. A particularly effective combination of synthetic clays and acrylate thickeners is the use of **LAPONITE-RD** with **RHEOBYK-HV 80**. A detailed description of this combination can be found in the section on stabilizing fragrance capsules in liquid detergents. A liquid alternative to using clay based additives is provided by modified ureas that can also be post added. In aqueous cleaning products, a variety of particles could be stabilized in the

Anti-settling by Use of Rheology Additives



Figure 33

cleaning products, particularly when using **RHEOBYK-7420 ES**.

Figure 33 shows a cleaning product in which cellulose capsules were stabilized

using suitable rheology additives. On the left side of the figure, the blank sample without rheology additive is shown.

Product Recommendations for High-solid Cleaning Products

Dispersing of Particles	Anti-settling and Anti-syneresis	Defoaming
DISPERBYK-199 BYK-154	OPTIGEL-WX RHEOBYK-7420 ES* LAPONITE-EP RHEOBYK-HV 80 & LAPONITE-RD*	BYK-011 BYK-014 BYK-1611 BYK-1724

First recommendation [Second recommendation](#)

*Possible in transparent products

Figure 34

Rheology Additives for Liquid Laundry Detergents

The fabric care sector includes the markets for washing powder, liquid laundry detergent, and laundry softener. Both powder and liquid laundry detergent can be divided into all-purpose detergents for general application and mild or special detergents for delicate fabrics. All-purpose detergents are grouped into

products that contain bleach for white laundry and color-care products for colored laundry. For sustainability reasons, there is a trend in fabric care towards lower washing temperatures and reduced water consumption. The properties of increasingly complex detergent and care products can be optimized using additives.

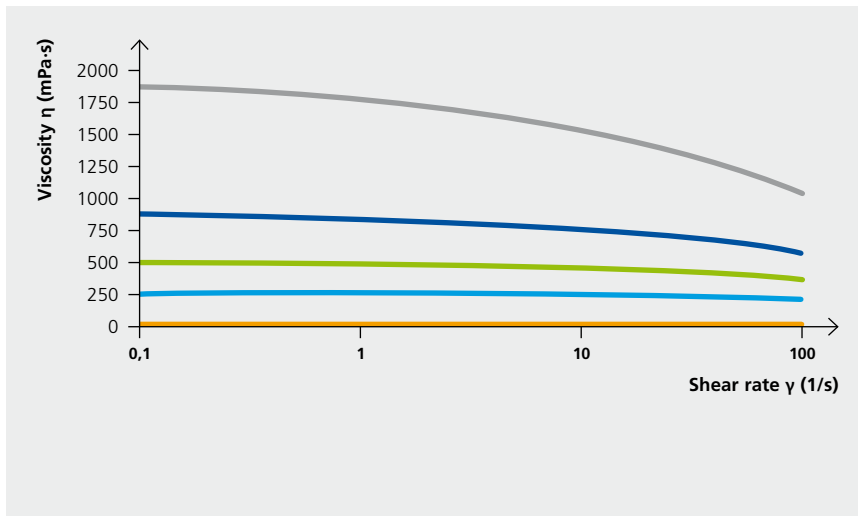
Fabric Cleaning

Liquid products are being increasingly used to wash and care for fabrics. If particles need to be suspended in liquid detergents or liquid softeners, or the viscosity needs to be increased, special rheology additives are added as stabilizers and thickeners.

Adjusting the Flow Behavior of Liquid Detergents

The flow behavior of the product plays an important role in liquid laundry detergents. The detergent needs to be easy to pour into the dosing cap. It cannot be too thin or too viscous. A high viscosity without the effect of shear forces is not desired either, as consumers are used to detergents with a certain flow behavior and consistency. Besides the practical reasons, there are also marketing reasons to selectively adjust the viscosity. There are numerous requirements on the additives used. They need to tolerate high levels of surfactants, produce Newtonian flow behavior, and they must not impact the clarity or transparency of the laundry detergent. **RHEOBYK-HV 80**, a HASE (Hydrophobically Modified Alkali Soluble Emulsion)-type polyacrylate thickener meets all these criteria and can be used to selectively adjust detergent viscosity (Figure 35).

Adjusting the Rheology of a Laundry Detergent Using RHEOBYK-HV 80



- Diluted detergent concentrate without additive
- Diluted detergent concentrate with 1.4% RHEOBYK-HV 80
- Diluted detergent concentrate with 1.8% RHEOBYK-HV 80
- Diluted detergent concentrate with 1.9% RHEOBYK-HV 80
- Diluted detergent concentrate with 2.0% RHEOBYK-HV 80

Figure 35

Stabilizing Fragrance Capsules

Fragrances are used in encapsulated form in many liquid detergents, and these need to be stabilized without greatly increasing the viscosity or significantly affecting transparency. HASE-type polyacrylate thickeners are often used in combination with a

synthetic clay. Combining the products **LAPONITE-RD** and **RHEOBYK-HV 80** has proven to be particularly suitable as it increases the yield stress of the detergent without impairing the flowability. In this way encapsulated fragrances can be finely distributed in the detergent without settling at the

surface or at the bottom (Figure 36).

The synergetic effect of the additive combination is based on linking the polymer chains of the HASE thickener using the **LAPONITE** platelets (Figure 37).

Stabilization of Fragrance Capsules in Detergents



Detergent without capsules



Detergent with capsules without additive



Detergent with capsules and additives

Figure 36

Interaction of LAPONITE with HASE Thickeners

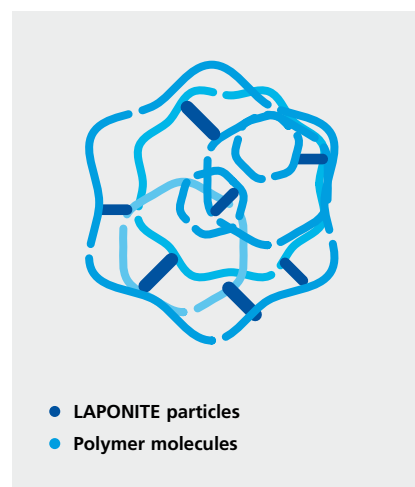


Figure 37

If handling of powdered clays is not desired, the liquid version **LAPONITE-SL 25** can be used in

combination with **RHEOBYK-HV 80**. Another liquid alternative to the described thickener combination is

RHEOBYK-7420 ES. This product is a liquid rheology additive based on modified urea that can also be post added.

Product Recommendations for Liquid Detergents

Thickening/Body	Anti-settling	Post Addition
RHEOBYK-HV 80 OPTIGEL-WX RHEOBYK-H 7625 VF	LAPONITE-RD & RHEOBYK-HV 80 RHEOBYK-7420 ES	RHEOBYK-7420 ES RHEOBYK-HV 80

First recommendation Second recommendation

Figure 38

Rheology Additives for Fabric Softeners

Fabric Softening

To prevent freshly washed laundry from feeling stiff after air-drying, a softener can be added to the laundry along with the detergent.

Liquid softeners contain cationic surfactants, primarily biodegradable esterquats that interact with the negative charges of the fibers, thereby counteracting a stiffening of the fabric. As with liquid detergents, it is also important to adjust the softener viscosity so that it is easy to dose. Many rheology additives such as anionic polyacrylates are not compatible with cationic surfactants. However, non-ionic associative thickeners such as **RHEOBYK-H 7625 VF** and **RHEOBYK-7420 ES** can be used. These additives cause a strong increase in viscosity in the low shear range and provide shear thinning flow behavior. The rheology effect is based on the association of the hydrophobic segments of the additives between each other (Figure 39). RHEOBYK-7420 ES and RHEOBYK-H 7625 VF are Ecolabel-compliant rheology additives, which are compatible with cationic surfactant systems, such as softeners. The products are liquid and are easy to dose, even as a post additive. The choice of the most suitable additive depends on the formulation. Figures 40 and 41 show the rheological effect of the additives in two different commercial softeners.

Associative Thickening Mechanism

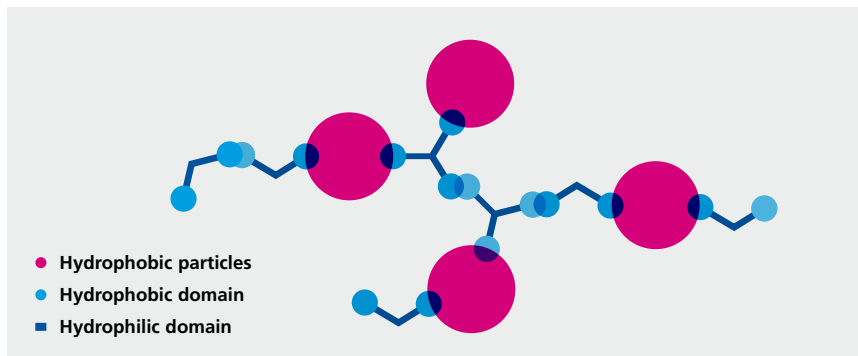
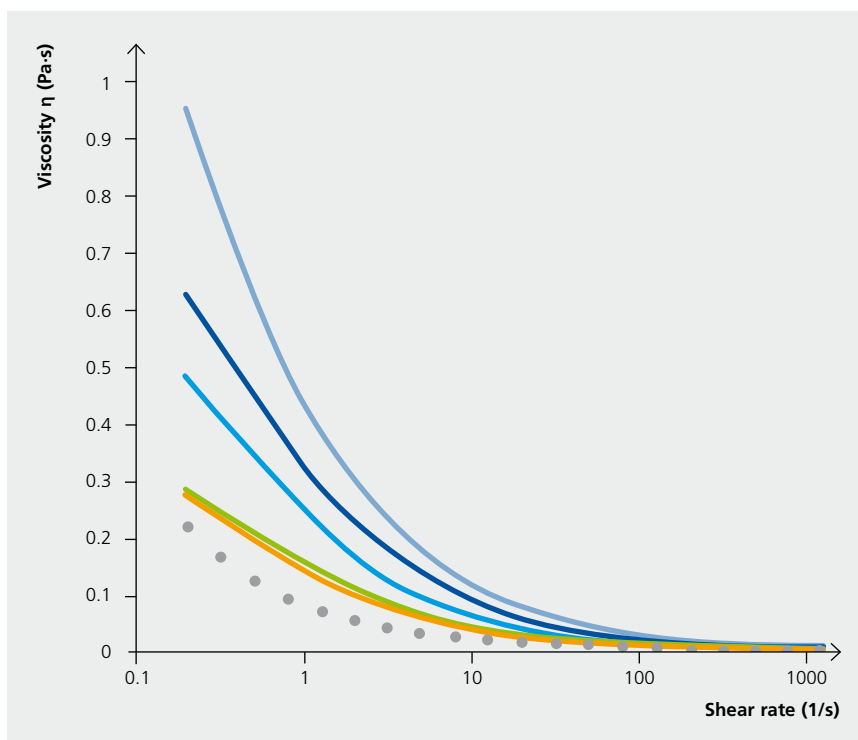
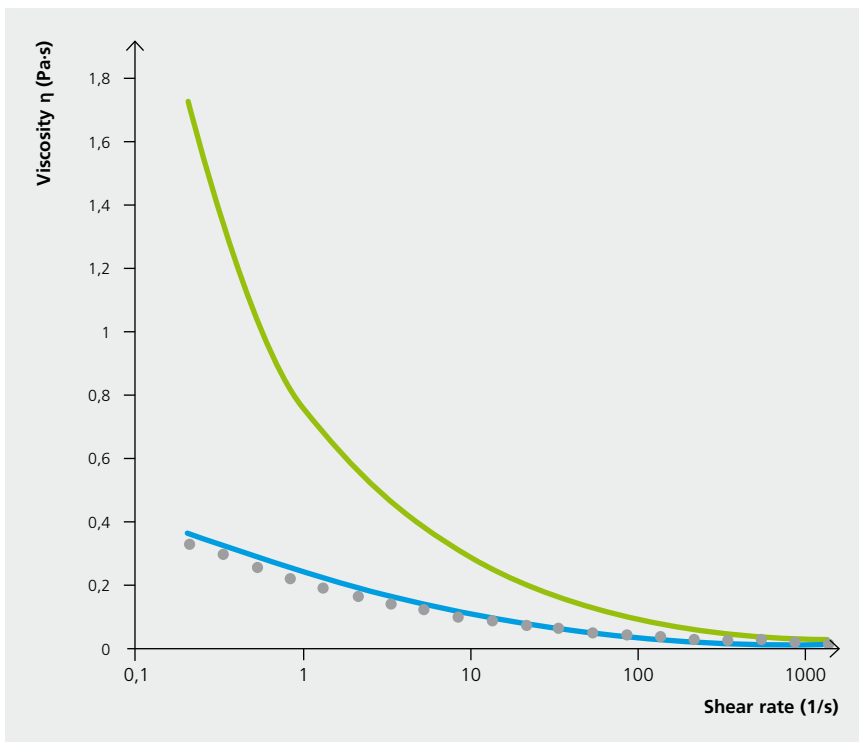


Figure 39

Viscosity Curves of a Commercial Fabric Softener Thickened with RHEOBYK-H 7625 VF and RHEOBYK-7420 ES



Viscosity Curve of a Fabric Softener with Medium Viscosity Thickened with RHEOBYK-H 7625 VF



- Commercial softener 2
- Commercial softener 2 + 0.5 % RHEOBYK-H 7625 VF
- Commercial softener 2 + 0.2 % RHEOBYK-7420 ES

Figure 41

Product Recommendations for Fabric Softeners

Thickening/Body	Anti-Settling	Post addition
RHEOBYK-H 7625 VF RHEOBYK-7420 ES	RHEOBYK-7420 ES	RHEOBYK-H 7625 VF RHEOBYK-7420 ES

First recommendation Second recommendation

Figure 42

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Additive Guide



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