BYK
Additives & Instruments

Technical Information CP-TI 1

Additives for Aqueous Floor Polishes

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Content

Introduction

Floor polishes for industrial and institutional (I&I) use are mostly aqueous systems today.

Important properties of such systems are good foot traffic resistance, low dirt affinity, excellent anti-slip, and good filling power on scratched substrates. High gloss and good buffability are often required, but, depending on the specific application, a matt appearance may also be desired.
The coatings must be easy to clean (wet and dry) without being damaged, which means they have to be resistant against mild cleaners. When used in hospitals, doctor´s offices, or nursing homes, a good resistance against alcohol-based cleaners and disinfectants is additionally required.
Since it is necessary to apply a new coating at longer intervals, the old coating should be easy to remove without leaving any residue. Strong alkaline cleaners are especially utilized for such basic cleaning.

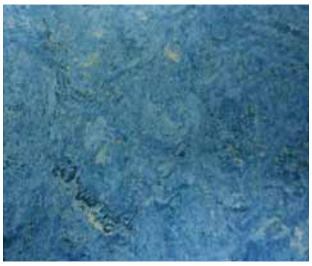
Floor polishes for soft substrates such as
• PVC
• linoleum
• rubber
• parquet, laminate flooring

are generally high gloss, while floor polishes for hard substrates such as
• granite
• marble
• ceramic
• terrazzo

are more often designed to provide a matt appearance.

Main components of aqueous floor polishes are polymer emulsions and waxes. The coating is applied in one or more layers. So-called "self-shine" (or dry-bright) emulsions with a wax content below 15% exhibit high gloss immediately after drying and do not need to be polished.
However, it is possible to refresh the surface by using a buffing machine. Formulations with a higher wax content (40-80%) have a matt appearance after drying and must be polished with a buffing machine to achieve the required high gloss.
If the coating was formulated to provide a matt surface, then increased gloss due to foot traffic or cleaning operations is not desirable. The matt appearance should be maintained for the entire life of the coating.






Composition of Aqueous Floor Polishes

Aqueous floor polishes are multi-component systems. Besides water, the main ingredients are polymer emulsions and waxes in the form of emulsions or dispersions.

Polymer emulsions provide the required mechanical and chemical resistance: excellent foot traffic resistance and resistance against everyday cleaners. Besides non-crosslinked emulsions, polymer emulsions that can be crosslinked (figure 1) with metals (e.g. Zn) are also used. This crosslinking is reversible under alkaline conditions so the polymer film is easy to remove with strong alkaline cleaners.

Wax emulsions and dispersions have a strong influence on the performance of floor polishes as well. Buffability, low dirt pick-up, surface slip (anti-slip), and foot traffic resistance are most prominent. High gloss systems require wax emulsions with small particles, whereas dispersions with larger particles are used to provide a matt appearance.

The performance profile of a floor polish can be optimized by adjusting the wax/polymer ratio (figure 2).

To guarantee that a closed and highly resistant polymer film is formed during the drying process, it is important for the application temperature to be above the minimum film forming temperature (MFT) of the polymer emulsion. Only then can the polymer particles coalesce perfectly. Volatile (temporary) **plasticizers**, such as diethylene glycol monomethyl ether, are used to reduce the MFT and yield an excellent film formation. These plasticizers evaporate together with the water while the floor polish dries. Permanent plasticizers, such as tris (2-butoxyethyl) phosphate (TEP), are incorporated into the polymer film and are used when the polymer film should be more flexible throughout its entire life.

Surface-active substances reduce the surface tension of the liquid floor polish and are used to improve substrate wetting. **Defoamers** are used to avoid the formation of foam in the production and application.

Aqueous systems are always prone to micro-organism contamination. **Preservatives** are added to the formulations to prevent mold and mildew growth.

To produce high-performance floor care products, BYK has developed a range of **surface additives, defoamers** as well as **wax emulsions and dispersions,** which are presented on the following pages.

Metal-crosslinked Polymer Emulsion

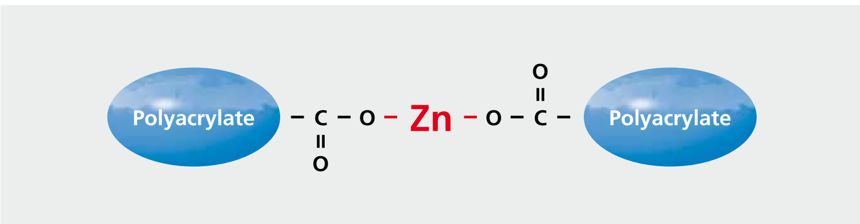


figure 1

Influence of the Wax/Polymer Ratio

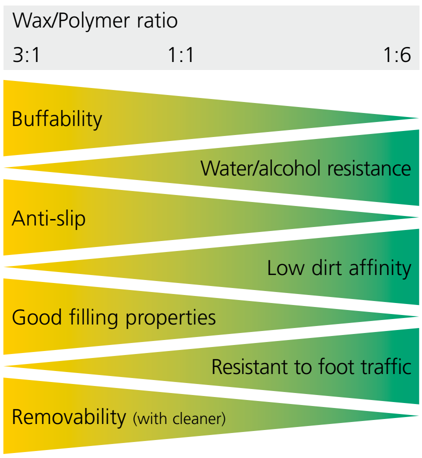


figure 2

Surface Additives

Surface additives are used to prevent surface defects when a liquid coating is applied on a solid substrate.

Substrate wetting is the highest priority for floor polishes. A homogeneous protective film is formed only when the substrate is wetted perfectly. Wetting defects drastically reduce the performance of any floor polish system. Wetting defects drastically reduce the performance of the floor care product. Wetting depends primarily on the surface tensions of the materials involved. The surface tension of the liquid must be less than the surface tension of the substrate. Wetting defects will occur when the surface tension of the liquid is higher. Aqueous formulations are especially critical in this respect because they have a relatively high surface tension due to the water content (figure 3). Floor polishes are applied on a wide range of substrates with very different surface properties. It is therefore beneficial to reduce their surface tension with suitable surface additives in order to avoid wetting problems in most application cases.

Silicone-based additives are widely used for surface tension reduction; these silicones are generally polyether-modified polysiloxanes (figure 4, left). In most cases, such polymeric silicone additives also increase the surface slip of the solid coating film. This side effect, however, is not very desirable, especially in floor polishes.

Silicone surfactants (figure 4, right) are a special type of silicone-based additives, specifically designed to be used in aqueous systems. Their distinctly lower molecular weight differentiates them from the polymeric silicones described above. These additives have a very pronounced surfactant structure (polar/non-polar), which explains their excellent efficiency in aqueous systems. Foam stabilization (which is a potential problem with some polymeric silicones) is practically non-existent. The big advantage for floor polishes: silicone surfactants do not increase surface slip.

Besides silicone additives, silicone-free additives are also available. Fluorosurfactants are utilized in many of today's formulations to reduce surface tension. These materials can create foam problems, and they are increasingly being replaced by fluorine-free alternatives, mainly due to ecological considerations.

Our BYK range of recommended surface additives for floor care products can be found in figure 5. BYK-3400 and BYK-349 are based on silicone surfactants. BYK-3455 is a polymeric silicone with a very special chemical structure. In contrast to normal polymeric silicones, this additive does not increase surface slip, which makes it a very valuable product for floor polishes.

Floor polishes need to have good leveling properties, which means good substrate wetting and good spreading across the substrate. Formulations based on ionic-stabilized acrylic emulsions often do not perform very well in this respect. The situation can be improved with the leveling resin BYK-3499 (modified maleic resin). In addition, this resin makes it easier to remove the polymer film with alkaline cleaners when a completely new coating needs to be applied.

Insufficient Substrate Wetting

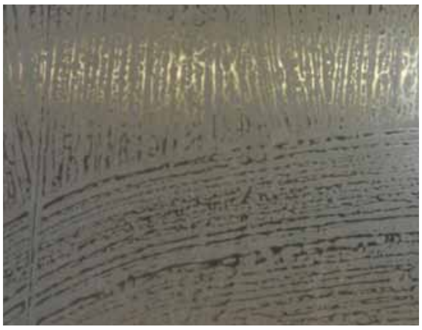


figure 3

Chemical Structure of Silicone Additives

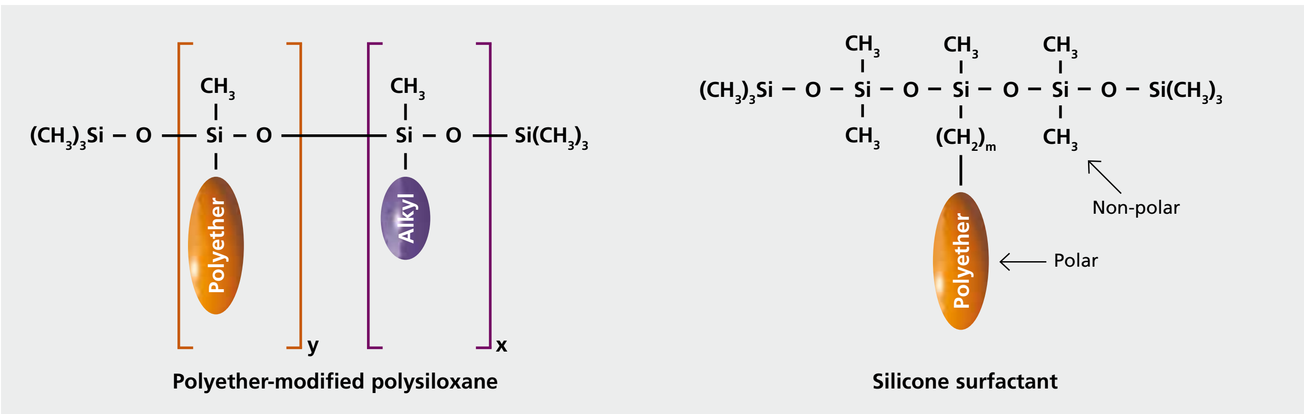


figure 4

Substrate Wetting and Reduction in the Surface Tension

	Substrate wetting			Reduction of surface tension
	Plasticizer content of the formulation			
	0 %	0–5 %	> 5 %	
BYK-349	■			■
BYK-3400			■	■
BYK-3455		■		■

■ especially recommended

figure 5

Leveling Resin for Floor Care Products Based on Ionic-stabilized Acrylates

	Better leveling (wetting, spreading)	Removability of film (alkaline cleaners)
BYK-3499	■	■

■ especially recommended

figure 6

Defoamers

Foam bubbles are stabilized by surface-active substances in the foam lamella and, as each care product formulation contains materials of the most diverse chemistry and origin, you can usually expect the undesirable formation of foam.

Defoamers are used to prevent foam forming 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 problematic defects such as clouding or cratering. Choosing a suitable defoamer is therefore a kind of "balancing act" between compatibility and incompatibility.

Defoamers for aqueous systems often contain additional hydrophobic solids which are used to reinforce the defoaming effect. It is often the case that silicas are used, but in many BYK defoamers the more effective polyureas which are based on a patented technology are used instead.

Silicone defoamers which are based on hydrophobic polysiloxanes are widely used and highly effective. The polysiloxane is emulsified in polyglycol in the standard defoamer **BYK-028.** Water serves as the carrier in the more inexpensive defoamers **BYK-044** and **BYK-1679,** which have been specially developed for care products based on acrylate dispersions.

The second large group of defoamers is that of the **silicone-free polymer defoamers,** which instead of polysiloxanes use other incompatible polymers as the active substance. **BYK-011** and **BYK-014** are particularly suitable for high-quality aqueous floor care products. **BYK-1740** is a "green" defoamer, based on renewable raw materials for state-of-the-art environmentally friendly care products.

In addition, there are **mineral oil defoamers** which are based on aliphatic mineral oils. For floor care products, we recommend **BYK-038** from this group, a defoamer where the defoaming effect has been further intensified by the addition of a small amount of silicone.

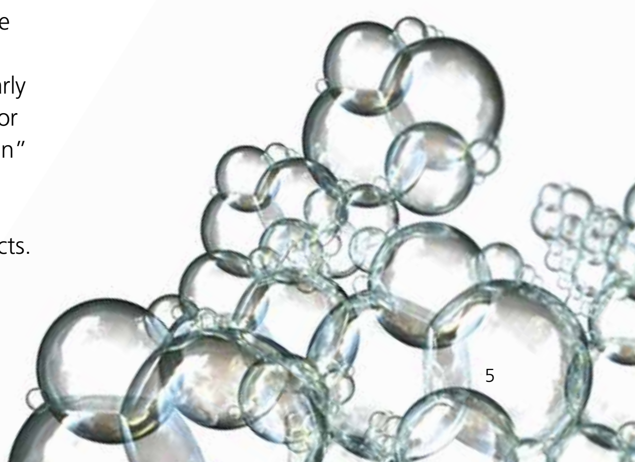
Choosing a Defoamer

Silicone defoamer	Mineral oil defoamer	Silicone-free polymer defoamer
BYK-028 BYK-044 BYK-1679	BYK-038	BYK-011 BYK-014 BYK-1740

← Increasing defoaming effect

incompatible — compatible

figure 7



Wax Emulsions and Dispersions

There is no generally accepted definition of waxes. A chemical description is not very meaningful, because the involved chemistries can be very diverse (figure 8) and not helpful in distinguishing waxes from "non-wax" materials.
"Wax" is a broad technological term used to describe a group of organic compounds. Physical and technical properties are more suitable as definitions:

- Waxes are solids with a melting point above 40 °C (typically between 50 and 160 °C)
- They have a low melt viscosity (not more than 10 Pa·s at 10 °C above the melting point)
- They melt without decomposition
- They can be polished under slight pressure

The last point is naturally quite important for floor polishes. Figure 9 shows how typical wax properties are related to the melting point and polarity of the waxes.

Our wax recommendations for floor care products are summarized in figure 14. The **AQUACER** products are wax emulsions with particle sizes below 1 µm and good transparency (figure 10), which are recommended for glossy formulations. They are often based on polyethylene waxes, with the exception of AQUACER 595 (polypropylene wax) and AQUACER 528 (ethylene/acrylic acid copolymer wax) and AQUACER 1021 (ethylene/vinyl acetate copolymer wax). **HORDAMER PE 02** is a primary polyethylene dispersion and not a wax in the strict sense. It can be used like a wax emulsion in floor polishes.

When less surface slip is required in floor polishes (anti-slip effect), this can be achieved with waxes. Figure 11 shows the efficiency of various products in this respect.

AQUAMAT 1400 is a wax dispersion with coarser particles (> 1 µm) and is ideally suited for matting purposes. Sedimentation of the particles, which can be often observed when silica-based matting agents are used, does not happen with this wax dispersion (figure 12). Even at just 3 % wax in the formulation, it provides a good matting effect and the gloss does not increase when the film is polished (figure 13).

Origin of Waxes

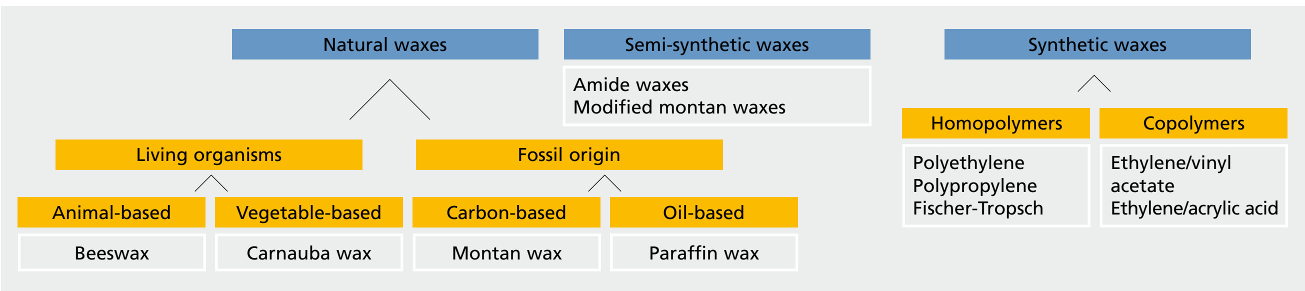


figure 8

Wax Properties

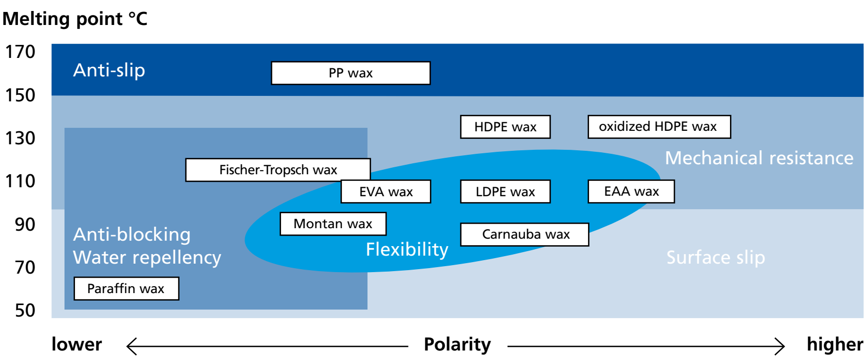


figure 9

Transparency of AQUACER Types

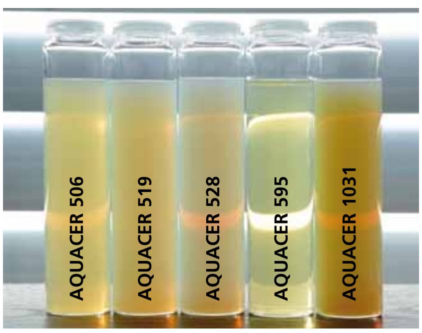
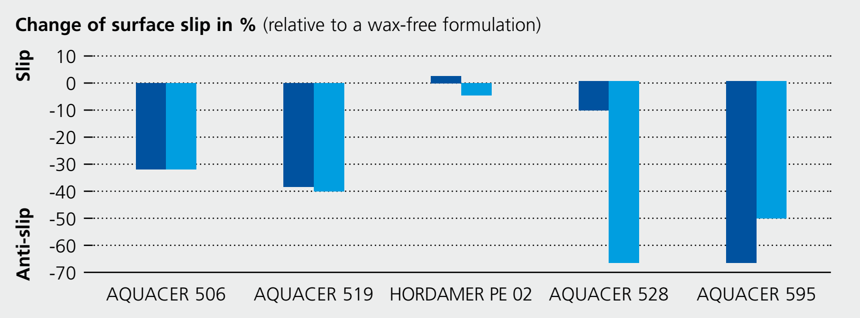


figure 10

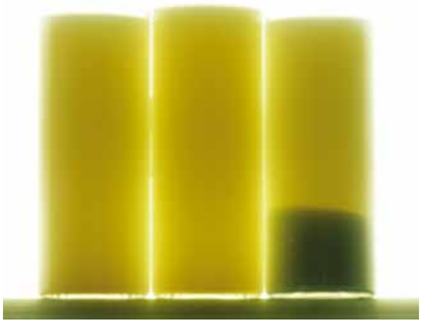
Slip/Anti-slip Effect of Various Wax Additives



Acrylate-based floor polish — figure 11

1.5% | 8% solid wax

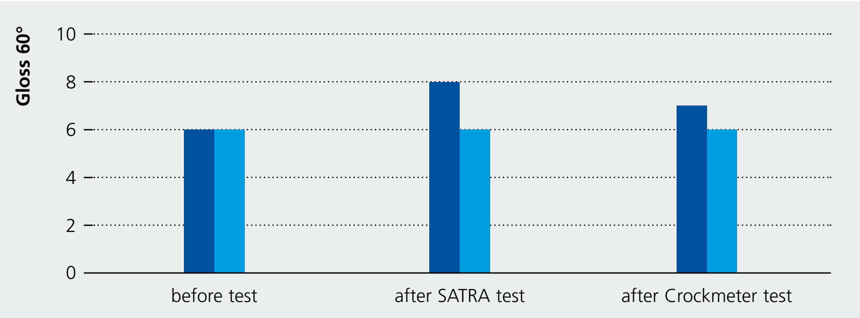
Sedimentation



Acrylate-based floor polish — figure 12

Left: with standard PE wax emulsion
Center: with AQUAMAT 1400
Right: with silica matting agent

Matting with AQUAMAT 1400: No Gloss Increase after Polishing



Silica matting agent (2.5%) | AQUAMAT 1400 (4% solid wax) — figure 13

Wax Additives to Adjust Surface Properties

	Buffability	Matting	Anti-slip	Foot traffic resistance	Dirt pick-up resistance	Filling properties
AQUACER 506	■		□	□	■	□
AQUACER 519	■		□	■	■	□
AQUACER 528	■		■		■	□
AQUACER 595	■		■		■	□
AQUACER 1021	■			□	■	■
AQUACER 1031	■			□	■	■
AQUAMAT 1400	■	■			■	
HORDAMER PE 02				■	■	□

■ recommended □ suitable — figure 14

For more information about our additives and instruments, as well as our additive sample orders please visit:

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