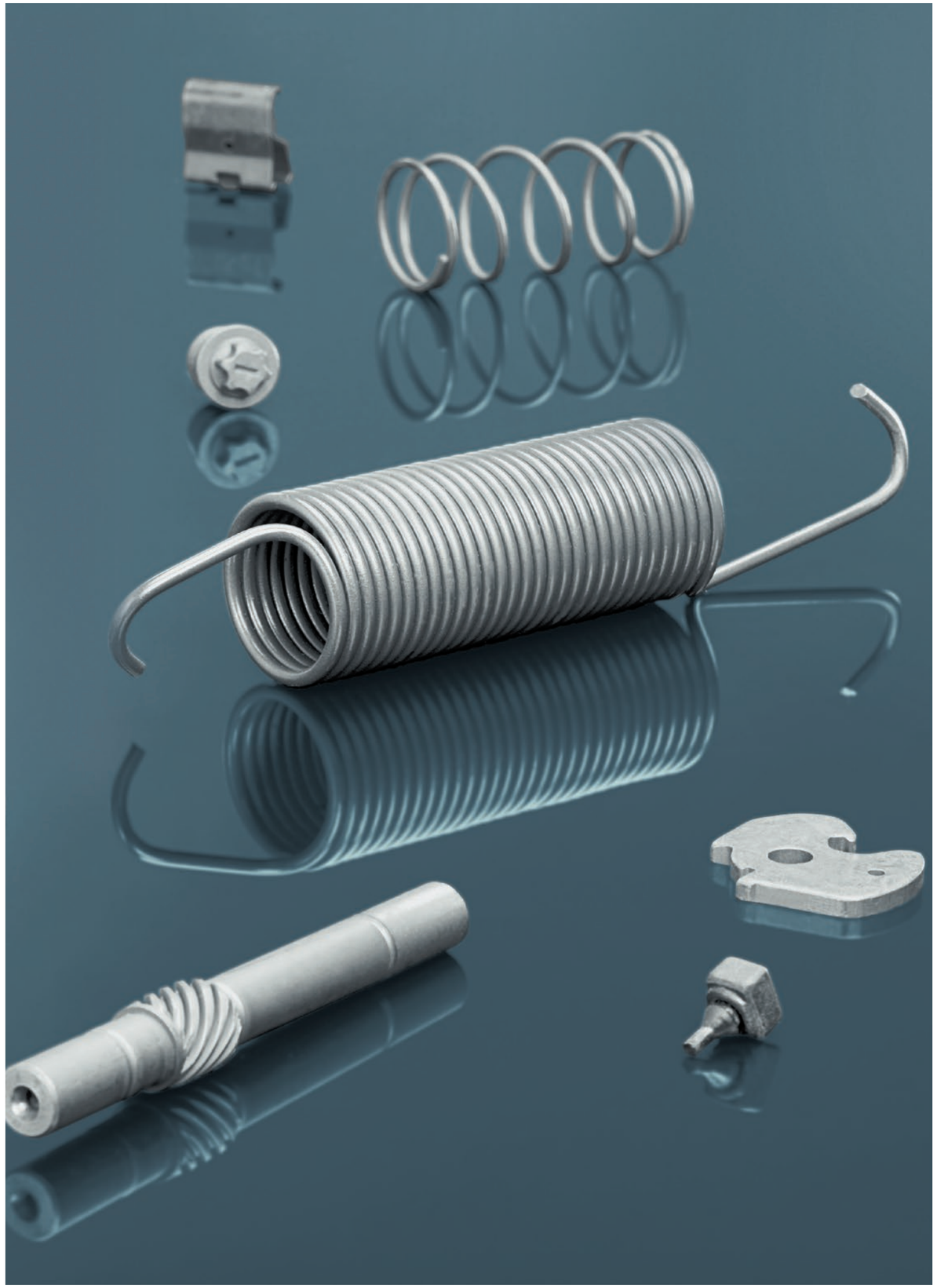


Anti-friction coatings

BECHEM – Lubrication solutions for industry

As the oldest German manufacturer of industrial lubricants, BECHEM is one of the leading producers of high-quality special lubricants and metalworking fluids today.

BECHEM products stand out through innovative formulations in the most diverse industrial applications – in machining and forming for metalworking processes, in coating technology and as for-life lubricants in various technical components.

A strong network of distributors and several national and international production sites ensure that BECHEM products are readily available worldwide.

Tomorrow's technologies. Today.

APPLICATIONS

- Automotive industry
- Plain bearings
- Thread lubrication
- Sanitary fittings

PROPERTIES

- High temperatures
- High loads
- Compatible with plastics
- Noise dampening
- UV tracer
- Corrosion protection

All indications and values correspond to latest know-ledge and do not represent any product specification

BECHEM anti-friction coatings – a smooth solution

Berucoat AF, Berucoat AK and Berucoat FX offer a lot of advantages, highest quality properties and custom application possibilities for all industries, especially for bulk material and commodities, metals, elastomers, plastics and leather applications.

Sophisticated performance

Anti-friction coatings are touch dry lubricant solutions which, in their formulation, resemble common industrial varnishes. They contain solid lubricants as pigments, resins as bonding agents as well as solvents. Predominant pigments are MoS_2, graphite and PTFE. Modern AF coatings meet many specific requirements. Increasingly nano-technologies are used. Besides the selection of individual raw materials the concentration in volume of pigments is important for lubricating efficiency and corrosion protection of the AF coatings. AF coatings should preferably be applied through spraying and immersion on thoroughly degreased surfaces. Other methods are possible as well, such as varnish drum method, immersion centrifuges, electrostatic or automatic spraying methods, application by pressure or roller and various well-known methods in the industry for drying and hardening processes.

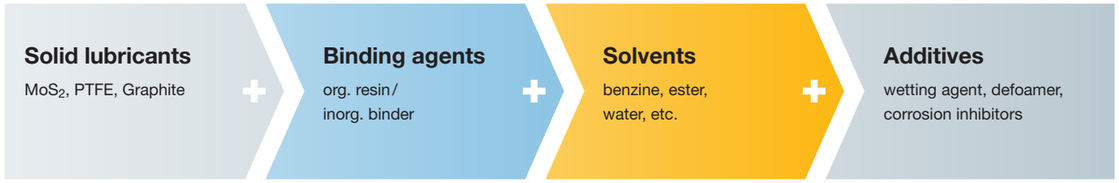
Thoroughly tested

The BECHEM laboratories are equipped with state-of-the-art testing equipment for every application, for example determining friction and wear or testing the anti-squeak properties of BECHEM lubricants. This gives customers the certainty of selecting and using anti-friction coatings from the BECHEM range that are ideally tailored to their requirements.

Solid lubricants in anti-friction coatings

Based on their separating effect, which is strong between the friction partners even at extremely low relative speeds and under high loads, solid lubricants are primarily used in anti-friction coatings for limiting and mixed friction applications.

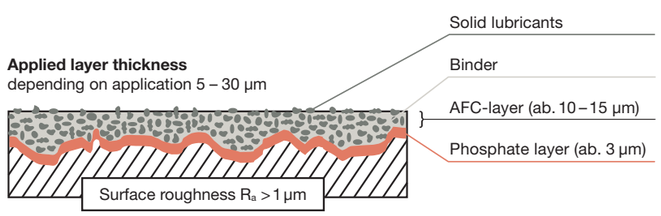
Construction

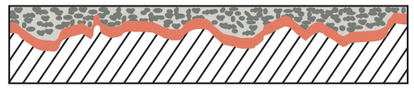


Solid lubricants

Properties	MoS_2	Graphite	PTFE
Colour	Black	Black	Transparent / white
Structure	In form of thin layers	In form of thin layers	Spherical
Service temperature range	-180 °C to +450 °C (in vacuum up to 1.100 °C)	-35 °C to +600 °C	-180 °C to +260 °C
Adhesion on metal	Very good	Low	Low
Electric conductivity	Very low	High	None
Corrosion protection	Deteriorates	Deteriorates	Improves
Resistance	High against radiation and chemicals	High against radiation and chemicals	High against chemicals
Resistance against humidity	Sensitive	Non-sensitive	Non-sensitive
Tribologic	Especially in case of high loads prevention of fretting, running-in required	Synergy with MoS_2	Anti-adhesive properties, especially at low loads, synergy with MoS_2

Layer scheme





Applications

BECHEM anti-friction coatings are developed specifically for the highest of requirements and challenges, tailored to the application. Applying the latest technologies in both raw materials and testing results in products that meet both technological challenges and high customer demands.

When developing innovations, BECHEM has set out to assess all formulations, research new methods and take entirely new approaches. This also includes continually optimizing and extending practical performance testing for products. BECHEM is a strong production partner, offering both expertise and product innovations.

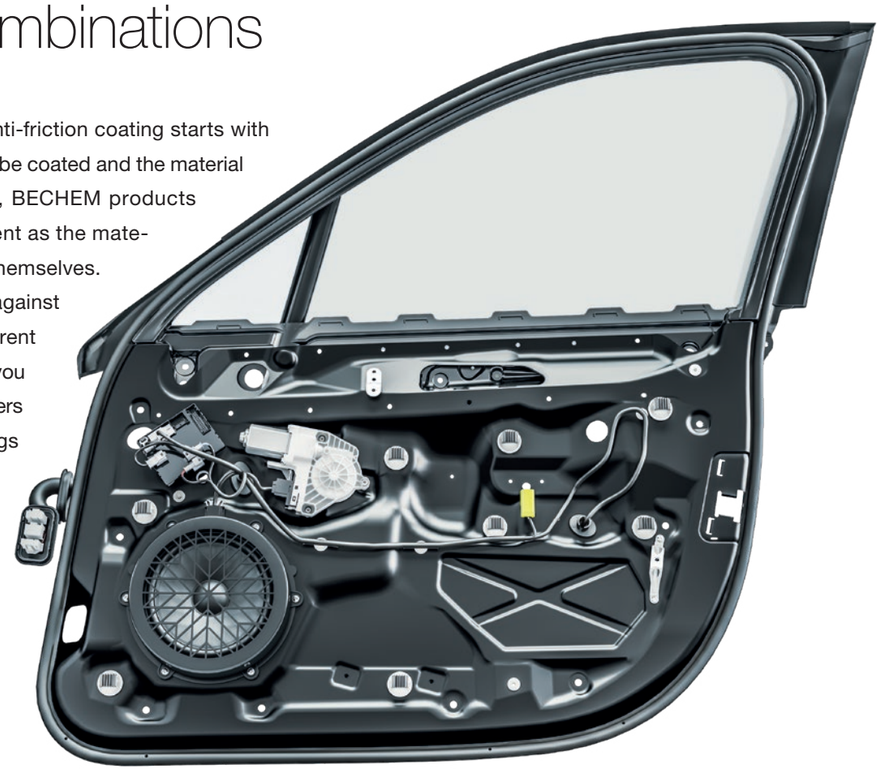
Characteristics

Anti-friction coatings have established themselves as reliable construction elements for dry coating films in various applications. In view of the increasing automation possibilities in production and assembly, anti-friction coatings are gaining importance in the various industries. Today the anti-friction coatings are applied as support for the running-in process of machine elements subjected to extreme loads, such as assembly aid, or for maintenance-free for-life lubrication. Such a wide range of applications often requires tailored solutions developed by BECHEM.

Properties	Dry lubricants	Liquid lubricants
Vacuum application	Very good	Almost impossible
Low temperature range	Good	Unfavourable
High temperature range	Very good	Not suitable
Low speeds	Low influence	Bad
High speeds	Limited	Good, hydrodynamic
Flammability	None	Generally high
Ionising radiation	Good	Bad
Environmental risks	Very low	Difficult to dispose
Contamination	Low	Creeping

Material combinations

The selection of a suitable anti-friction coating starts with the analysis of the material to be coated and the material of the friction partner. Thus, BECHEM products are designed to be as different as the materials and material partners themselves. Leather or wood is rubbing against the same or completely different material partner, regardless if you use metal, plastics, or elastomers – for almost all material pairings BECHEM has the right solution.



Compatibility

Besides the required sliding properties on the different materials, compatibility with the material to be coated is of importance. BECHEM therefore already makes sure during the development of the anti-friction coatings that they are compatible with the materials intended for the application and that there will not be any undesired chemical reactions.

Tensile testing machine to check tensile strength of elastomers and plastics in contact with our lubricants.

Pre-treatment

The surface treatment of the materials to be coated is of utmost importance, since this is the basis for adhesion and lifetime of the anti-friction coating. An optimal adhesion can be achieved with a surface treatment specifically tailored to the anti-friction coating and the construction part. Depending on the requirements with regard to adhesion and lifetime of the coating it is sometimes sufficient to carefully remove grease residues, dust, dirt or rust.

Zinc-nickel treatments, phosphating and sand blasting are particularly suitable for pre-treatment of metal materials. All processes produce a rough or porous surface and thus a mechanical fastening of the anti-friction coating, resulting in a considerably improved adhesion.

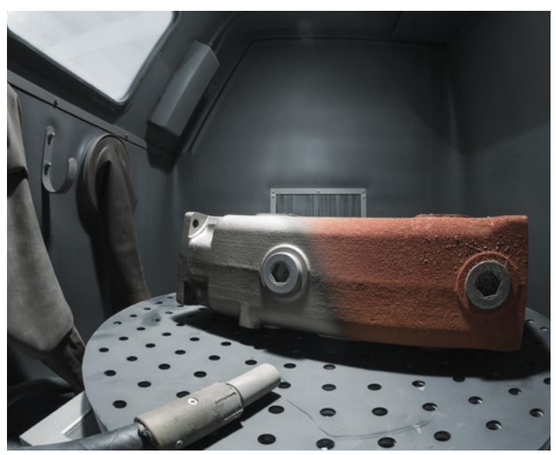
During zinc-nickel treatment and phosphatizing, an additional corrosion protection is formed on metallic surfaces, which can be enhanced using tailored BECHEM anti-friction coatings.

For plastic materials, roughening of the surface can lead to better adhesion. Various physical processes, such as plasma and corona treatment or flame impingement, are used to produce polar chemical groups on the material surface, which facilitate excellent adhesion of the anti-friction coating.

» Surface treatment is of vital importance. «

Phosphating

20 µm



Sand blasting

Applications

Anti-friction coatings made by BECHEM can be applied with the conventional application methods, such as spraying, dipping, drumming, brushing or dip centrifuging. In general the application process depends on the construction part geometry and the attainable properties of the anti-friction coating.

BECHEM offers custom consultation in selecting the most efficient application method that best fits the application.

Spraying

This most common application technology can be used to coat virtually any component geometry, applying a uniform layer thickness.

Spraying

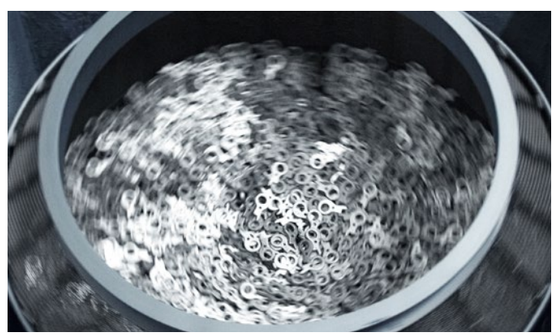
Spray barrel

If components weigh less than 5 g, the spray barrel method can be used. Spraying the parts in a rotating barrel prevents the coated components from sticking.

Spray barrel

Immersion centrifuge

This method is an inexpensive alternative to spraying when certain that the components cannot stick due to their geometry. Components from 20 - 100 mm weighing up to max. 150 g can be coated in an immersion centrifuge.



Immersion centrifuge

Berucoat AF – reduces friction, allows extreme pressure

The Berucoat AF series contains friction reducing and extreme pressure anti-friction coatings with excellent corrosion protection and is the preferred choice for metallic surfaces. BECHEM offers air-drying as well as heat curing systems for a service temperature range up to 450 °C. They contain graphite, MoS_2, PTFE or combinations of solid lubricants for optimal anti-friction properties.

PRODUCT	APPLICATIONS							MATERIAL COMBINATIONS								COMPATIBILITY				PROPERTIES						APPLICATIONS							
	Spray application	Dipping	Immersion spinners	Spray barrels	Screen printing	Brushing	Electric spraying	Steel/steel	Steel/plastic	Plastic/plastic	Steel/paper	Metal/plastic	Metal/metal	with elastomers	with polymers	with (non-ferrous) metals	Longlife lubrication	Corrosion protection	Vacuum	Also suitable under influence of Radiation	Chemicals	Surface pressure	Avoids stick-slip	Locking systems	Springs	Cam shaft	Gearing	Spindles in small gears	Plain bearing	Telescopic cranes	Plastic, leather, tissue
Berucoat AF 130	•		•	•		•		•				•	•			•	•	•	•		•	•	•	•	•	•	•	•	•		
Berucoat AF 191-2					•			•				•	•			•	•	•	•		•	•	•		•	•	•	•	•		
Berucoat AF 230	•		•	•				•				•	•			•	•	•	•		•	•	•	•		•		•	•		•
Berucoat AF 291					•			•				•	•			•	•	•	•		•	•	•	•	•	•	•		•		
Berucoat AF 320 E	•		•	•		•	•	•	•	•		•	•		•	•	•	•	•		•	•	•	•	•			•	•		•
Berucoat AF 330 E	•		•	•		•	•	•	•	•		•	•		•	•	•	•	•		•	•	•	•	•			•	•		•
Berucoat AF 339	•								•	•		•	•			•	•		•		•	•	•			•		•	•	•	•
Berucoat AF 379	•	•	•	•				•	•		•	•	•			•	•	•	•		•	•	•		•			•			•
Berucoat AF 438	•		•	•		•		•				•	•			•	•		•	•		•	•			•	•		•		
Berucoat AF 470	•		•	•				•				•	•				•	•	•		•	•	•			•	•		•		
Berucoat AF 481	•	•	•					•				•	•			•	•	•	•		•	•	•		•	•	•		•		
Berucoat AF 534	•		•	•		•		•				•	•			•	•	•	•		•	•	•		•	•			•		
Berucoat AF 732	•		•	•		•		•				•	•			•	•	•	•		•	•	•		•	•			•		
Berucoat AF 932	•		•	•				•	•			•	•			•		•	•		•			•					•		

Berucoat AK – invisible and noise dampening

Berucoat AK are so-called anti-squeaking coatings for coating of plastics, leather or foils. Our transparent and nearly invisible qualities based on solids, synthetic wax or nano-technologies provide long-lasting and effective noise dampening.

Berucoat FX – flexible and resistant to abrasion

The Berucoat FX series features excellent anti-friction properties with a maximum separating effect, adherence, durability and abrasion. They are especially suitable for application on flexible elastomer materials like profile seals or o-rings. Besides systems containing solids we use modern nano-technologies in order to meet the continuously increasing demands.

Berucoat AK

	APPLICATIONS				MATERIAL COMBINATIONS				COMPATIBILITY			PROPERTIES				APPLICATIONS
PRODUCT	Spray application	Dipping	Immersion spinners	Brushing	Steel/steel	Steel/plastic	Plastic/plastic	with elastomers	with polymers	with (non-ferrous) metals	Anti-squeak	Longlife lubrication	Corrosion protection	Avoids stick-slip	Spindles in small gears	Plastic, leather, tissue
Berucoat AK 376	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•
Berucoat AK 376 BK	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•
Berucoat AK 978	•	•		•		•	•	•	•	•	•	•	•	•		•

Berucoat FX

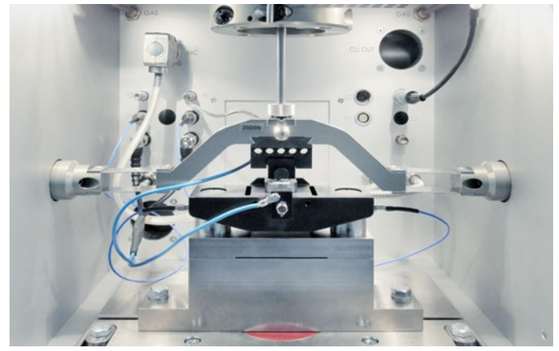
	APPLICATIONS			MATERIAL COMBINATIONS				COMPATIBILITY			PROPERTIES			APPLICATIONS			
PRODUCT	Spray application	Dipping	Elastomer/glass	Elastomer/ auto body sheet	Metal/elastomer	Plastic/elastomer	with elastomers	with polymers	with (non-ferrous) metals	Anti-squeak	Longlife lubrication	Avoids stick-slip	Seals	Flocked seals	Sealing lips	O-Rings	Taps with water contact
Berucoat FX 270	•	•	•				•				•	•	•			•	
Berucoat FX 670	•	•	•				•				•	•	•			•	
Berucoat FX 876	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•

Technical data

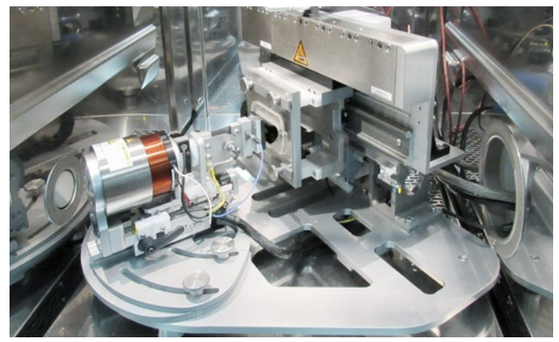
	PRODUCT	Basic	Solid lubricant	Solvent	Service temperature range [°C][1]		Colour	Air hardening	Heat hardening	Description
Berucoat AF series	**Berucoat AF 130**	Organic binder	MoS_2	Organic solvent	-70	+250	Black		•	Low annealing temperature of 130 °C, good media resistance
	Berucoat AF 191-2	Organic binder	Solid lubricants	Organic solvent	-40	+250	Dark-grey		•	Excellent load-carrying properties
	Berucoat AF 230	Organic binder	Solid lubricants	Organic solvent	-70	+250	Grey		•	Very good in combination with greases
	Berucoat AF 291	Organic binder	Graphite	Organic solvent	-40	+250 +350	Black		•	Outstanding media resistance, especially in combination with motor oils
	Berucoat AF 320 E	Organic binder	PTFE	Organic solvent	-70	+250	Black semi gloss		•	Low annealing temperature of 120 °C, ideal for plastic coatings
	Berucoat AF 330 E	Organic binder	PTFE	Organic solvent	-70	+250	Black silky gloss		•	Low annealing temperature of 120 °C, ideal for plastic coatings, silk gloss
	Berucoat AF 339	Organic binder	PTFE	Organic solvent	-70	+250	–	•		Two-component lacquer, prevents stick-slip
	Berucoat AF 379	Organic binder	PTFE	Water	-40	+180	White		•	Water-based stove enamel, optimal for package slipping
	Berucoat AF 438	Inorganic binder	MoS_2/graphite	Organic solvent	-180	+450	Black-grey	•		Transfer layer structure, excellent temperature resistance, high load bearing capacity with low friction values
	Berucoat AF 470	Organic binder	MoS_2/graphite	Water	-40	+450	Dark-grey	•		Water-based anti-friction coating Berucoat AF 438
	Berucoat AF 481	Organic binder	MoS_2/graphite	Organic solvent	-40	+250 +450	Grey		•	Excellent wear protection, outstanding media resistance
	Berucoat AF 534	Organic binder	MoS_2/graphite/PTFE	Ester/alcohol	-70	+250	Black-grey		•	Hard multi-function anti-friction coating with solid lubricants
	Berucoat AF 732	Organic binder	MoS_2/PTFE	Organic solvent	-70	+250	Black-grey		•	Multi-function anti-friction coating with solid lubricants, excellent corrosion protection
	Berucoat AF 932	Organic binder	–	Organic solvent	-40	+200	Yellow		•	Excellent corrosion protection, very good in combination with greases
Berucoat AK series	**Berucoat AK 376**	Organic binder	PTFE	Water	-40	+120	Whitish	•		White, noise dampening PTFE anti-friction coating
	Berucoat AK 376 BK	Organic binder	PTFE	Water	-40	+120	Black	•		Black, noise dampening PTFE anti-friction coating
	Berucoat AK 978	Organic binder	Combination solid lubricants	Water	-40	+80	Grey-white	•		Transparent, noise dampening anti-friction coating for interior applications
Berucoat FX series	**Berucoat FX 270**	Organic binder	Graphite	Water	-40	+300	Black-grey	•		Powerful anti-friction coating for elastomers
	Berucoat FX 670	Organic binder	PTFE/graphite	Water	-40	+250	Black-grey	•		Powerful anti-friction coating for elastomers, prevents stick-slip
	Berucoat FX 876	Organic binder	Combination solid lubricants	Water	-40	+80	White	•		Assembly aid for elastomers

[1] Value marked in grey indicates short term maximum temperature

Anti-friction coatings are dispersions of selected solid lubrications in solutions of organic or inorganic binding agents in solvents or water. After application and hardening, the anti-friction coatings form a solid bond between binding agent and solid lubricants. During the tribologic process the solid lubricants will be transmitted onto the counter part, whereby a so-called transfer film is formed, which leads to reduction of shear forces and thus to reduced friction values. Today, a variety of different binding agents and solid lubricants with a wide range of properties are available – also on nano-technology basis. This offers BECHEM the possibility to develop new, improved and trend-setting systems.



Virtually every application can be rendered and simulated on the translatory oscillation test rig. Movement patterns, friction speeds, surface pressures and temperatures can be varied.



One key test bench for the Berucoat AK series is the stick-slip test bench that identifies potential noise. In combination with a climatic chamber, temperature and humidity effects can also be simulated.

Berucoat MC microcapsule technology

The Berucoat MC series uses the innovative BECHEM microcapsule technology for needs-based anti-friction coating dosing. Sphere-like containers filled with lubricant that can only be seen under a microscope are embedded in a layer of coating, giving off their lubricant to the friction/lubrication point when under a load. A powerful lubricating film forms between the involved friction partners, offering an outstanding service life.

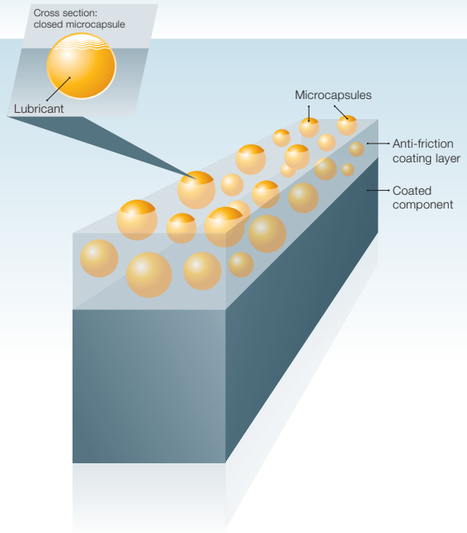
Advantages

- **touch dry**
- **consistent friction value**
- **up to three times higher lifetime**
  (compared to conventional anti-friction coatings)
- **material protection**
- **lubrication on demand**
- **no contamination of the lubrication point**
- **low drying temperature**
- **colour adjustments possible**

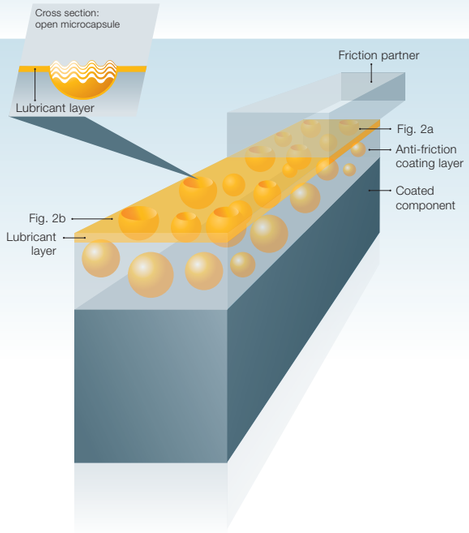
How Berucoat MC works

The schematic representation of the Berucoat MC anti-friction coating shows that the capsules are embedded in the binding system and evenly spread across the coating thickness.

PHASE 1: Component coated with **Berucoat MC** anti-friction coating **prior** to contact with a friction partner

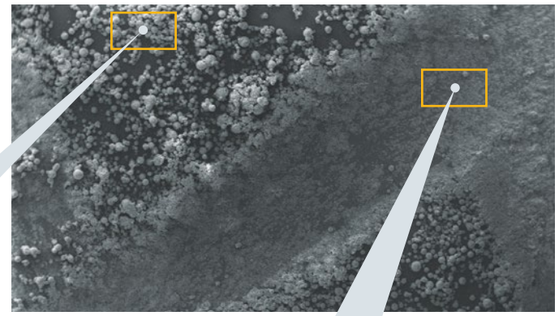


PHASE 2: Component coated with **Berucoat MC** anti-friction coating **during** contact [Fig. 2a] and **after** contact [Fig. 2b] with a friction partner



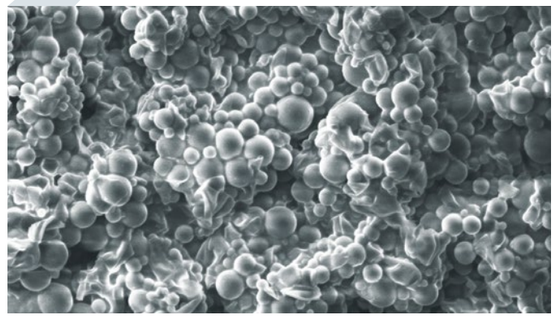
Properties such as friction values and wear can be reduced significantly with the microcapsules of the Berucoat MC technology. The capsules embedded in the anti-friction coating provide additional lubricating support to the existing solid lubricants. Encapsulation provides protection, preventing incompatibilities between the resin binding system and the encapsulated lubricant.

Minimal wear can be detected on the surface after every movement. This is where the microcapsule technology shines: The mechanical effect on the anti-friction coating opens the capsule shell, freeing a dose of the additional lubricant. Due to the continuous friction motion in the tribological opening, it is distributed evenly, ensuring a surface dry to the touch. With additional wear, deeper capsules ensure a consistent supply of lubrication.



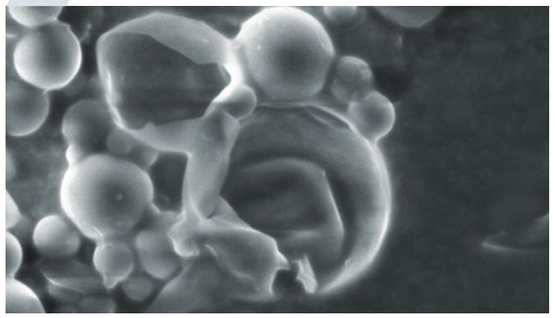
To simulate the capsule method in a Berucoat MC anti-friction coating, the loose agglomerates were subjected to mechanical force, visible in the form of a notch here.

100 µm



Microcapsules dissolved in water were applied to a surface. The air-dried layer features an agglomeration of many microcapsules that are embedded in the Berucoat MC anti-friction coating.

10 µm



Result of the mechanical force: Burst microcapsules can be seen at the edge of the notch, which have released the lubricant they contained.

2 µm

Advantages of anti-friction coatings

- Reduction of friction and wear
- Constant friction values with low variation
- Application under most severe conditions, such as temperature, vacuum and dust
- Depending on the product type, temperature resistance ranges from -200 °C to +650 °C
- In many cases lifetime lubrication without oil and grease
- Support for oil and grease lubrication, thus improved running-in of machine elements and emergency running properties
- Suitable for all materials such as metals, plastics, elastomers and wood
- Excellent corrosion protection
- Long shelf life without influence on ageing
- Mineral oil and chemical resistant coatings possible
- Clean application – no contamination of the friction point and surroundings
- Decorative appearance
- Reduction of vibrational friction wear (contact corrosion)
- Thin layers can be obtained (5 – 30 µm)
- Coverage rate amounts to an average of 15 m^2/kg
- Bonded lubricant coatings can be revarnished
- No hydrogen embrittlement
- Improved assembly of machine elements
- Minimisation of maintenance costs

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De Martin GmbH Surface Technology, Neustadt an der Aisch (p. 17)
for the image material provided.

Awarded

High-quality lubricants are indispensable products that are worth their investment. They have received pretigious awards – by making a decisive contribution to performance, energy efficiency and sustainability of products and processes.

Award for Berufluid – a joint project with Fraunhofer Institute IVV and IWF Braunschweig.

BECHEM wins award for tailored solutions in the premium vehicle sector.

BECHEM as an award-winner is one of the 20 most innovative companies in North Rhine-Westphalia.

BECHEM wins the award for innovative lifetime lubrication of various vehicle components.

BECHEM wins the NRW Efficiency Award for innovative and resource-efficient coating in cold massive forming.