Anti-friction coatings
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 knowledge and do not represent any product specification.
BECHEM anti-friction coatings – a smooth solution

Berceo AF, Berucot AK and Berucot 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

MoS$_2$, PTFE, Graphite

Binding agents

org. resin/ inorg. binder

Solvents

benzine, ester, water, etc.

Additives

wetting agent, defoamer, corrosion inhibitors

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

Applied layer thickness depending on application 5 – 30 µm

Run-in AFC-layer ab. 2 – 5 µm, metallic bright surface

Solid lubricants

Binder

AFC-layer (ab. 10 – 15 µm)

Phosphate layer (ab. 3 µm)

Surface roughness $R_a > 1 \mu m$
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.

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.

Properties

<table>
<thead>
<tr>
<th>Properties</th>
<th>Dry lubricants</th>
<th>Liquid lubricants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacuum application</td>
<td>Very good</td>
<td>Almost impossible</td>
</tr>
<tr>
<td>Low temperature range</td>
<td>Good</td>
<td>Unfavourable</td>
</tr>
<tr>
<td>High temperature range</td>
<td>Very good</td>
<td>Not suitable</td>
</tr>
<tr>
<td>Low speeds</td>
<td>Low influence</td>
<td>Bad</td>
</tr>
<tr>
<td>High speeds</td>
<td>Limited</td>
<td>Good, hydrodynamic</td>
</tr>
<tr>
<td>Flammability</td>
<td>None</td>
<td>Generally High</td>
</tr>
<tr>
<td>Ionising radiation</td>
<td>Good</td>
<td>Bad</td>
</tr>
<tr>
<td>Environmental risks</td>
<td>Very low</td>
<td>Difficult to dispose</td>
</tr>
<tr>
<td>Contamination</td>
<td>Low</td>
<td>Creeping</td>
</tr>
</tbody>
</table>

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.

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.

Spraying

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

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.

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.

BECHEM offers custom consultation in selecting the most efficient application method that best fits the application.
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, MoS₂, PTFE or combinations of solid lubricants for optimal anti-friction properties.

### APPLICATIONS

- Dipping
- Screen printing
- Spray barrels
- Brushing
- Electric spraying
- Steel
- 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
- Radiation
- Chemicals
- Surface pressure
- Avoids stick-slip
- Locking systems
- Springs
- Cam shaft
- Gearing
- Spindles in small gears
- Plain bearing
- Telescopic cranes
- Plastic, leather, tissue
- Spindles in small gears
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- Telescopic cranes
- Plastic, leather, tissue

### MATERIAL COMBINATIONS

### COMPATIBILITY

### PROPERTIES

### APPLICATIONS

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>Applications</th>
<th>Material Combinations</th>
<th>Compatibility</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berucoat AF 130</td>
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<tr>
<td>Berucoat AF 191-2</td>
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<td>Berucoat AF 230</td>
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<tr>
<td>Berucoat AF 291</td>
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<tr>
<td>Berucoat AF 320 E</td>
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<tr>
<td>Berucoat AF 330 E</td>
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<tr>
<td>Berucoat AF 339</td>
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<td>Berucoat AF 379</td>
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<td>Berucoat AF 438</td>
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<td>Berucoat AF 470</td>
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<td>Berucoat AF 481</td>
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<td>Berucoat AF 534</td>
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<tr>
<td>Berucoat AF 732</td>
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<tr>
<td>Berucoat AF 932</td>
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</tbody>
</table>

**Also suitable under influence of**

- Vacuum
- 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 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

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>APPLICATIONS</th>
<th>MATERIAL COMBINATIONS</th>
<th>COMPATIBILITY</th>
<th>PROPERTIES</th>
<th>APPLICATIONS</th>
</tr>
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<tbody>
<tr>
<td>Berucoat AK 376</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Berucoat AK 376 BK</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Berucoat AK 978</td>
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</tbody>
</table>

### Berucoat FX

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>APPLICATIONS</th>
<th>MATERIAL COMBINATIONS</th>
<th>COMPATIBILITY</th>
<th>PROPERTIES</th>
<th>APPLICATIONS</th>
</tr>
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<tbody>
<tr>
<td>Berucoat FX 270</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Berucoat FX 676</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Berucoat FX 876</td>
<td>•</td>
<td>•</td>
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</table>
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.

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.

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.

### Technical data

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>Binder Type</th>
<th>Solvent</th>
<th>Service Temperature Range °C</th>
<th>Application</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berucoat AF 130</td>
<td>Organic binder</td>
<td>MoS₂</td>
<td>-70 to +250</td>
<td>Black</td>
<td>Low annealing temperature of 130 °C, good media resistance</td>
</tr>
<tr>
<td>Berucoat AF 191-2</td>
<td>Organic binder</td>
<td>Solid lubricants</td>
<td>-40 to +250</td>
<td>Dark-grey</td>
<td>Excellent load-carrying properties</td>
</tr>
<tr>
<td>Berucoat AF 290</td>
<td>Organic binder</td>
<td>Solid lubricants</td>
<td>-70 to +250</td>
<td>Grey</td>
<td>Very good in combination with greases</td>
</tr>
<tr>
<td>Berucoat AF 291</td>
<td>Organic binder</td>
<td>Graphite</td>
<td>-40 to +250</td>
<td>Black</td>
<td>Outstanding media resistance, especially in combination with motor oils</td>
</tr>
<tr>
<td>Berucoat AF 320 E</td>
<td>Organic binder</td>
<td>PTFE</td>
<td>-70 to +250</td>
<td>Black semi gloss</td>
<td>Low annealing temperature of 120 °C, ideal for plastic coatings</td>
</tr>
<tr>
<td>Berucoat AF 330 E</td>
<td>Organic binder</td>
<td>PTFE</td>
<td>-70 to +250</td>
<td>Black silky gloss</td>
<td>Low annealing temperature of 120 °C, ideal for plastic coatings, silk gloss</td>
</tr>
<tr>
<td>Berucoat AF 339</td>
<td>Organic binder</td>
<td>PTFE</td>
<td>-70 to +250</td>
<td>–</td>
<td>Two-component lacquer, prevents stick-slip</td>
</tr>
<tr>
<td>Berucoat AF 379</td>
<td>Organic binder</td>
<td>PTFE</td>
<td>-70 to +250</td>
<td>White</td>
<td>Water-based stove enamel, optimal for package slipping</td>
</tr>
<tr>
<td>Berucoat AF 438</td>
<td>Inorganic binder</td>
<td>MoS₂/graphite</td>
<td>-180 to +450</td>
<td>Black-grey</td>
<td>Transfer layer structure, excellent temperature resistance, high load bearing capacity with low friction values</td>
</tr>
<tr>
<td>Berucoat AF 470</td>
<td>Organic binder</td>
<td>MoS₂/graphite</td>
<td>-40 to +450</td>
<td>Dark-grey</td>
<td>Water-based anti-friction coating Berucoat AF 438</td>
</tr>
<tr>
<td>Berucoat AF 481</td>
<td>Organic binder</td>
<td>MoS₂/graphite</td>
<td>-40 to +250</td>
<td>Grey</td>
<td>Excellent wear protection, outstanding media resistance</td>
</tr>
<tr>
<td>Berucoat AF 534</td>
<td>Organic binder</td>
<td>MoS₂/graphite/PTFE</td>
<td>-70 to +250</td>
<td>Black-grey</td>
<td>Hard multi-function anti-friction coating with solid lubricants</td>
</tr>
<tr>
<td>Berucoat AF 538</td>
<td>Organic binder</td>
<td>MoS₂/PTFE</td>
<td>-70 to +250</td>
<td>Black-grey</td>
<td>Multi-function anti-friction coating with solid lubricants, excellent corrosion protection</td>
</tr>
<tr>
<td>Berucoat AF 932</td>
<td>Organic binder</td>
<td>–</td>
<td>-40 to +200</td>
<td>Yellow</td>
<td>Excellent corrosion protection, very good in combination with greases</td>
</tr>
<tr>
<td>Berucoat AK 376</td>
<td>Organic binder</td>
<td>PTFE</td>
<td>-40 to +120</td>
<td>Whitish</td>
<td>White, noise dampening PTFE anti-friction coating</td>
</tr>
<tr>
<td>Berucoat AK 376 BK</td>
<td>Organic binder</td>
<td>PTFE</td>
<td>-40 to +120</td>
<td>Black</td>
<td>Black, noise dampening PTFE anti-friction coating</td>
</tr>
<tr>
<td>Berucoat AK 978</td>
<td>Organic binder</td>
<td>Combination solid lubricants</td>
<td>-40 to +80</td>
<td>Grey-white</td>
<td>Transparent, noise dampening anti-friction coating for interior applications</td>
</tr>
<tr>
<td>Berucoat FX 270</td>
<td>Organic binder</td>
<td>Graphite</td>
<td>-40 to +300</td>
<td>Black-grey</td>
<td>Powerful anti-friction coating for elastomers</td>
</tr>
<tr>
<td>Berucoat FX 670</td>
<td>Organic binder</td>
<td>PTFE/graphite</td>
<td>-40 to +250</td>
<td>Black-grey</td>
<td>Powerful anti-friction coating for elastomers, prevents stick-slip</td>
</tr>
<tr>
<td>Berucoat FX 876</td>
<td>Organic binder</td>
<td>Combination solid lubricants</td>
<td>-40 to +80</td>
<td>White</td>
<td>Assembly aid for elastomers</td>
</tr>
</tbody>
</table>

*Value marked in grey indicates short term maximum temperature*
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
- Color 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.

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.

**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.

**Result of the mechanical force:** Burst microcapsules can be seen at the edge of the notch, which have released the lubricant they contained.
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 m²/kg
- Bonded lubricant coatings can be revarnished
- No hydrogen embrittlement
- Improved assembly of machine elements
- Minimisation of maintenance costs

We thank Brose Fahrzeugteile GmbH & Co., Coburg (p. 7), Kiesow Dr. Brinkmann GmbH & Co. KG, Detmold (p. 8), Rudolf Hillebrand GmbH & Co. KG, Wickede (p. 9), Voss GmbH, Simmerath (p. 9), De Martin GmbH Surface Technology, Neustadt an der Aisch (p. 17) for the image material provided.

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

Award for Berufuid – a joint project with Fraunhofer Institute IWF 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.
Lubrication solutions for industry