# Anti-friction coatings

BECHEM
LUBRICATION
TECHNOLOGY

# A bright idea

**This is how the BECHEM product programme presents its anti-friction coatings. Our three special anti-friction coatings. Berucoat AF, Berucoat AK and Berucoat FX offer a lot of advantages and individual application possibilities for all industries, especially for bulk material and commodities, metals, elastomers, plastics and leather applications.**

**Of course, these three new BECHEM product series excel by highest quality and the well known high performance of all special solutions offered by BECHEM.**

**BECHEM anti-friction coatings – a smooth solution**

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 by 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 the various methods being well-known in the industry for drying and hardening processes.

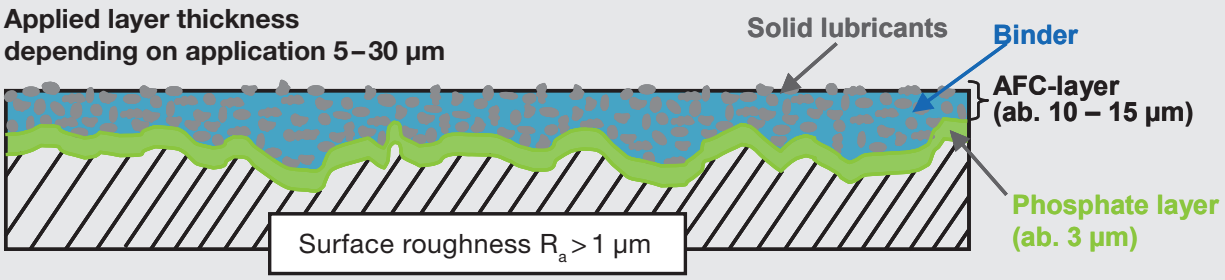
**Thoroughly tested**

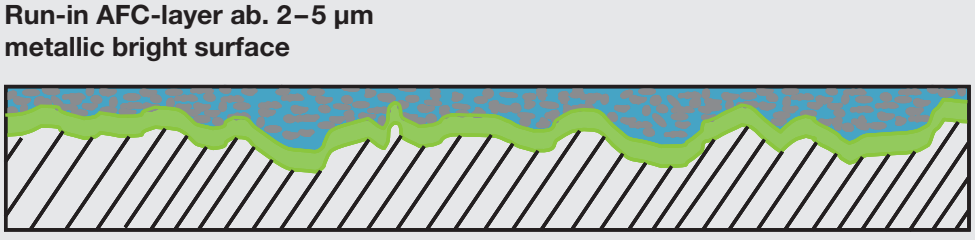
No matter whether friction and wear or anti-squeaking properties have to be determined, we dispose of the most modern test equipment for all fields of application. This offers you the security that the most adequate AF coating for your requirements will be chosen.

# The 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 is situated in a range 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 aging
- 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

## Layer scheme of anti-friction coatings



# Applications

The anti-friction coatings made by BECHEM have especially been tailored to the high customers' requirements as well as the technological challenges. This is only possible if latest technologies - with regard to the raw materials as well as the test methods - are the basis for the product development. BECHEM has accepted the challenge to check all possible formulations when developing a new product, to look for innovations and also to break new grounds, to question the well established methods.

This also includes the permanent optimisation and upgrading of practical performance tests of our products tailored to the specific fields of application. Our anti-friction coatings are as individual as the customers' requirements and markets. One of our main challenges is to find a solution to customer specific problems, and to meet these challenges means a maximum of cooperation on a partnership basis.

| Product | Applications | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Seals | | | Sealing lips | Locking systems/ locking cylinders | Springs | Cam shaft | Gearing | Spindles in small gears | Plain bearing | O-Rings |
| | Auto-motive | Door, window and boot seals | Flocked seals | | | | | | | | |
| **Berucoat AF 130** | | | | | • | • | • | • | | • | |
| **Berucoat AF 291** | | | | | • | • | • | • | | • | |
| **Berucoat AF 320** | | | | | • | • | | | • | • | |
| **Berucoat AF 438** | | | | | | | • | • | | • | |
| **Berucoat AF 481** | | | | | • | • | • | • | | • | |
| **Berucoat AF 732** | | | | | • | • | • | | | • | |
| **Berucoat AK 376** | | | | | | • | | | • | | |
| **Berucoat AK 978*** | | | | | | | | | | | |
| **Berucoat FX 172** | • | • | | | | | | | | | |
| **Berucoat FX 270** | • | | | | | | | | | | • |
| **Berucoat FX 670** | • | | | | | | | | | | • |
| **Berucoat FX 671** | • | • | | • | | | | | | | • |
| **Berucoat FX 876** | • | | • | • | | | | | | | • |
| **Berucoat MC 216** | | | | | | • | • | • | • | • | |

*Free of N-methyl-2-pyrrolidone (NMP)

| Taps with water contact | Tele-scopic cranes | Plastic, leather, tissue |
|---|---|---|
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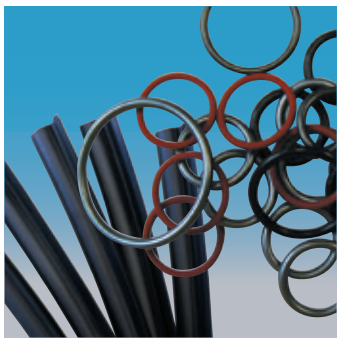
**Berucoat AF – reduces friction, allows extreme pressure**

Our series Berucoat AF contains friction reducing and extreme pressure anti-friction coatings with excellent corrosion protection and is preferably used on 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 antifriction properties.

**Berucoat AK – invisible and noise damping**

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 care for long-lasting and effective acoustic comfort.



**Berucoat FX – flexible and resistant to abrasion**

Our Berucoat FX types offer excellent anti-friction properties with a maximum of 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 MC – Innovative microcapsule technology**

For these new anti-friction coating products an innovative microcapsule technology is used. Ball type containers, which are visible by microscope only, are filled with a special lubricant and embedded in a varnish layer. They release the lubricant at the friction or lubrication point only when a certain load is achieved. From this moment an extremely powerful lubricating film between the friction partners is formed which guarantees outstanding lifetime.

# Characteristics

Anti-friction coatings have proven as dry coating films in various applications as reliable construction element. In view of the increasing automation possibilities in production and assembly the anti-friction coatings are of growing importance in the different industries. Today the anti-friction coatings are applied as support for the running-in process of extremely loaded machine elements, as assembly aid, or for maintenance-free for-life lubrication. The multiple applications often also require tailor-made solutions, a special strength of BECHEM and their team of developers.

| Product | Characteristics or properties | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Anti-squeak | Longlife lubrication | Corrosion protection | Also suitable under influence of | | | | Avoids stick-slip |
| | | | | Vacuum | Radiation | Chemicals | Surface pressure | |
| **Berucoat AF 130** | | • | • | • | | • | • | • |
| **Berucoat AF 291** | | • | • | • | | • | • | • |
| **Berucoat AF 320** | | • | • | • | | • | • | • |
| **Berucoat AF 438** | | • | | • | • | | • | • |
| **Berucoat AF 481** | | • | • | • | | • | • | • |
| **Berucoat AF 732** | | • | • | • | | • | • | • |
| **Berucoat AK 376** | • | | • | | | | | • |
| **Berucoat AK 978*** | • | • | | | | | | • |
| **Berucoat FX 172** | • | • | | | | • | | • |
| **Berucoat FX 270** | | • | | | | | | • |
| **Berucoat FX 670** | | • | | | | | | • |
| **Berucoat FX 671** | • | • | | | | • | | • |
| **Berucoat FX 876** | • | • | | | | | | • |
| **Berucoat MC 216** | | • | | | | | • | • |

*Free of N-methyl-2-pyrrolidone (NMP)

| 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 | in general high |
| **Ionising radiation** | good | bad |
| **Environmental risks** | very low | difficult to dispose |
| **Contamination** | low | creeping |

**Functionality Berucoat MC 216 anti-friction coating with microcapsule technology**

- touch dry
- consistent friction value
- up to three times higher lifetime
- lubrication on demand

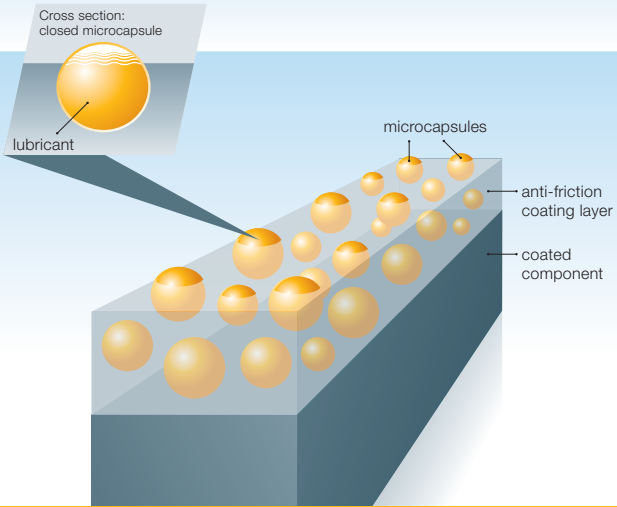
# Material combinations

The selection of the suitable anti-friction coating starts with the analysis of the material to be coated and the material of the friction partner. Thus the BECHEM products in their conception are as different as the materials and material partners themselves. No matter whether metal, plastics, elastomers, leather or wood are rubbing against the same or completely different material partner – for almost all material pairings we have the right solution.

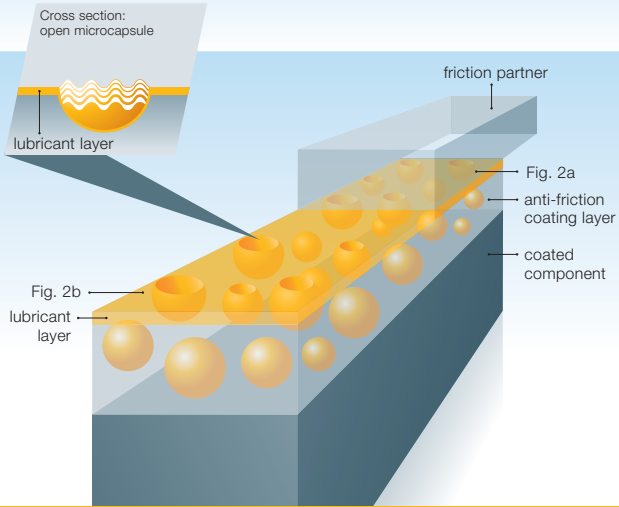
| Product | Material combinations | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Steel/ steel | Steel/ plastic | Elastomer/ glass | Elastomer/ auto body sheet | Metal/ elastomer | Plastic/ elastomer | Plastic/ plastic | Metal/ plastic | Metal/ metal |
| **Berucoat AF 130** | • | | | | | | | • | • |
| **Berucoat AF 291** | • | | | | | | | • | • |
| **Berucoat AF 320** | • | • | | | | | • | • | • |
| **Berucoat AF 438** | • | • | | | | | | • | • |
| **Berucoat AF 481** | • | | | | | | | • | • |
| **Berucoat AF 732** | • | • | | | | | | • | • |
| **Berucoat AK 376** | • | • | | | | | • | | |
| **Berucoat AK 978*** | | • | | | | • | • | | |
| **Berucoat FX 172** | | | • | • | | | | | |
| **Berucoat FX 270** | | | • | | | | | | |
| **Berucoat FX 670** | | | • | | | | | | |
| **Berucoat FX 671** | | | • | • | | • | | | |
| **Berucoat FX 876** | | | | • | • | • | | | |
| **Berucoat MC 216** | • | • | | | | | • | • | • |

*Free of N-methyl-2-pyrrolidone (NMP)

**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** the contact [Fig. 2a] and **after** the contact [Fig. 2b] with a friction partner



# Applications

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

This is why our technical service is not limited to the recommendation of the suitable AF coating, but also includes the selection of the most economic and best method of application.

**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 especially tailored to the AF coating and the construction part. Depending on the requirements with regard to adhesion and lifetime of the AF coating it is sometimes sufficient to carefully remove grease residues, dust, dirt or rust.

For pre-treatment of metal materials especially phosphating and sand blasting are very suitable. Both processes produce a rough or porous surface and thus a mechanical fastening of the AF coating, resulting in a considerably improved adhesion.

In case of plastic materials a roughening of the surface can lead to better adhesion. By means of various physical processes, such as plasma treatment, corona treatment or flame impingement polar chemical groups are produced on the material surface which allow excellent adhesion of the AF coating.

| Product | Applications | | | | |
|---|---|---|---|---|---|
| | Dipping | Brushing | Dip centrifuging | Spray application | Print |
| **Berucoat AF 130** | • | • | • | • | |
| **Berucoat AF 291** | | | | • | • |
| **Berucoat AF 320** | • | • | • | • | |
| **Berucoat AF 438** | • | • | • | • | |
| **Berucoat AF 481** | • | • | • | • | |
| **Berucoat AF 732** | • | • | • | • | |
| **Berucoat AK 376** | • | • | • | • | |
| **Berucoat AK 978*** | • | • | | • | |
| **Berucoat FX 172** | • | | | • | |
| **Berucoat FX 270** | • | | | • | |
| **Berucoat FX 670** | • | | | • | |
| **Berucoat FX 671** | • | | | • | |
| **Berucoat FX 876** | • | • | | • | |
| **Berucoat MC 216** | • | • | • | • | |

*Free of N-methyl-2-pyrrolidone (NMP)

# Compatibility

Besides the required sliding properties on the different materials the compatibility with the material to be coated is of importance. Already during the development of the anti-friction coatings BECHEM therefore took care that the AF coatings are compatible with the materials intended for the application and that there will be no undesired chemical reactions between the AF coating and the material.

| Product | Compatibility | | |
|---|---|---|---|
| | With elastomers | With polymers | With (non-ferrous) metals |
| **Berucoat AF 130** | | | • |
| **Berucoat AF 291** | | | • |
| **Berucoat AF 320** | | • | • |
| **Berucoat AF 438** | | | • |
| **Berucoat AF 481** | | | • |
| **Berucoat AF 732** | | | • |
| **Berucoat AK 376** | • | • | • |
| **Berucoat AK 978*** | • | • | • |
| **Berucoat FX 172** | • | | |
| **Berucoat FX 270** | • | | |
| **Berucoat FX 670** | • | | |
| **Berucoat FX 671** | • | | |
| **Berucoat FX 876** | • | • | • |
| **Berucoat MC 216** | • | • | • |

*Free of N-methyl-2-pyrrolidone (NMP)

**Tensile testing machine** to check tensile strength of elastomers and contact with our lubricants

# Technical Data

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 of binding agent and solid lubricants. During the tribologic process the solid lubricants will be transmitted on 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 also on a nano basis – with most different properties are available. This offers BECHEM the possibility to develop new, improved and trend-setting systems.

| Product | Technical data | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Basic | Solid lubricant | Solvent | **Service temperature range** | | Colour | **Hardening** | |
| | | | | Min. | Max. | | Air hardening | Heat hardening |
| **Berucoat AF 130** | organic binder | $MoS_2$/ nano particles | organic solvent | −70 °C | +250 °C | black | | • |
| **Berucoat AF 291** | organic binder | graphite | organic solvent | −40 °C | +250 °C (+350 °C short term) | black | | • |
| **Berucoat AF 320** | organic binder | PTFE | organic solvent | −70 °C | +250 °C | black | | • |
| **Berucoat AF 438** | inorganic binder | $MoS_2$/graphite | organic solvent | −180 °C | +450 °C | black-grey | • | |
| **Berucoat AF 481** | organic binder | graphite | organic solvent | −40 °C | +250 °C (+450 °C short term) | black | | • |
| **Berucoat AF 732** | organic binder | $MoS_2$/PTFE | organic solvent | −70 °C | +250 °C | black-grey | | • |
| **Berucoat AK 376** | organic binder | PTFE | water | −40 °C | +120 °C | whitish | • | |
| **Berucoat AK 978*** | organic binder | combination solid lubricants | water | −40 °C | +80 °C | transparent | • | |
| **Berucoat FX 172** | organic binder | org. polymer | water | −40 °C | +140 °C | black | | • |
| **Berucoat FX 270** | organic binder | graphite | water | −40 °C | +300 °C | black-grey | • | |
| **Berucoat FX 670** | organic binder | PTFE/graphite | water | −40 °C | +250 °C | black-grey | • | |
| **Berucoat FX 671** | organic binder | PTFE/graphite | water | −40 °C | +180 °C | black | | • |
| **Berucoat FX 876** | organic binder | combination solid lubricants | water | −40 °C | +80 °C | transparent | • | |
| **Berucoat MC 216** | organic binder | combination solid lubricants | water | −40 °C | +80 °C (+120 °C short term) | yellowish | • | |

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## Construction of anti-friction coatings


| General remarks |
|---|
| heat curing: 60 min at +130 °C (object temperature) |
| application by screen printing procedure, heat curing: 15 min at +215 °C |
| low annealing temperature +120 °C in 30 min |
| anti-adhesive properties |
| |
| anti-adhesive properties |
| anti-adhesive properties |
| anti-adhesive properties |
| produces »fibre optics« |
| air drying: 20 min at room temperature 5 min at +40 °C, max. hardness is achieved approx. 24 hours after application |
| air drying: 20 min at room temperature 5 min at +40 °C, max. hardness is achieved approx. 24 hours after application |
| two-component coating |
| |
| air drying: 20 min at +60 °C |

### Solid lubricant

| 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 (vacuum up to 1.100 °C) | –35 °C bis +600 °C | –180 °C bis +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 $MoS_2$ |

### Diluting and cleaning agent

| Product | diluted/ cleaning effect |
|---|---|
| **BECHEM AFC Solvent E** | **Berucoat AF 732** |
| **BECHEM AFC Solvent M** | **Berucoat AF 130**<br>**Berucoat AF 320** |
| **BECHEM AFC Solvent P** | **Berucoat AF 291**<br>**Berucoat AF 481** |

## Lubrication Solutions for Industry

With 180 years of experience, BECHEM is one of the leading manufacturers of premium quality special lubricants and metal working fluids.

Close cooperation with research institutes, industry partners and product users as well as the knowledge, skills and major commitment by our staff are guarantees of new and innovative high performance lubricants, which contribute to the success of our customers at home and abroad.

A powerful network of distributors and several national and international production sites ensure our products are readily available worldwide.

**Tomorrow's technologies. Today.**

BECHEM
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TECHNOLOGY

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