



Anti-Friction-Coatings

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 MoS₂, 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.



Anti-squeak test rig

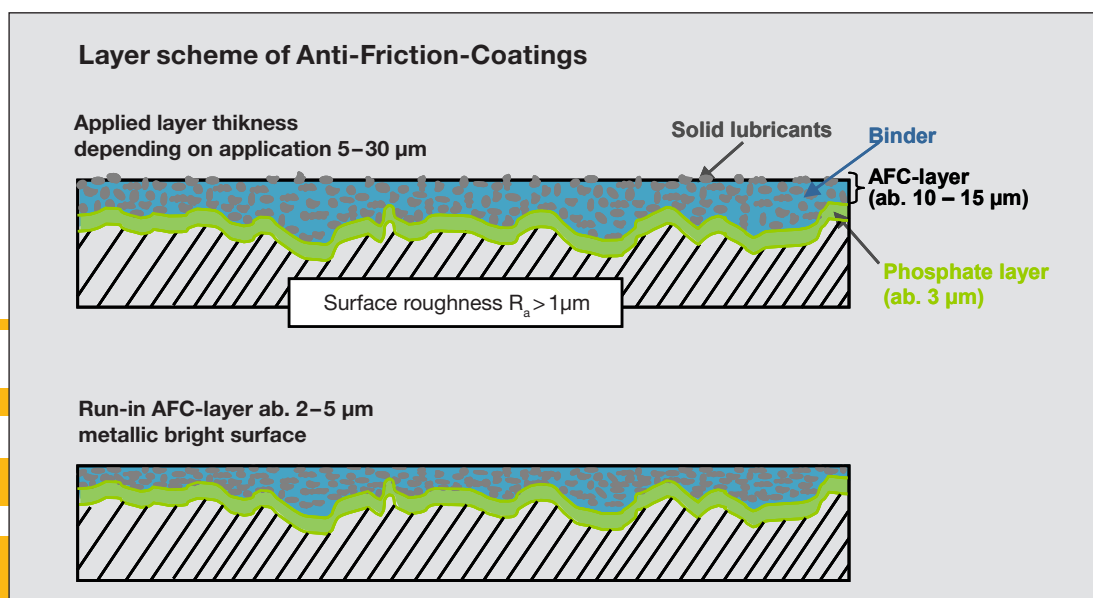


Vibrational wear test rig



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 $+650\text{ °C}$
- 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 ($5\text{--}30\ \mu\text{m}$)
- Coverage rate amounts to an average of $15\ \text{m}^2/\text{kg}$
- Bonded lubricant coatings can be revarnished
- No hydrogen embrittlement
- Improved assembly of machine elements
- Minimisation of maintenance costs



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
	Automotive	Door, window and boot seals	Flocked seals								
BERUCOAT AF 130					■	■	■	■		■	
BERUCOAT AF 291					■	■	■	■		■	
BERUCOAT AF 320					■	■			■	■	
BERUCOAT AF 438							■	■		■	
BERUCOAT AF 732					■	■	■			■	
BERUCOAT AK 376						■			■		
BERUCOAT AK 978*											
BERUCOAT FX 170	■	■		■							■
BERUCOAT FX 172	■	■									
BERUCOAT FX 270	■										■
BERUCOAT FX 670	■										■
BERUCOAT FX 671	■	■		■							■
BERUCOAT FX 871			■	■							■
BERUCOAT MC 216						■	■	■	■	■	

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



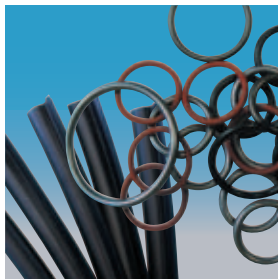
BERUCOAT AF – reduces friction, allows extreme pressure

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, MoS₂, PTFE or combinations of solid lubricants for optimal antifriction properties.



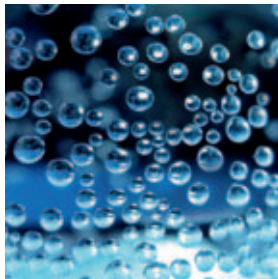
BERUCOAT AK – invisible and noise damping

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.

Taps with water contact	Telescopic cranes	Plastic, leather, tissue
		■
		■
		■
■		
		■

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 732		■	■	■		■	■	■
BERUCOAT AK 376	■		■					■
BERUCOAT AK 978*	■	■						■
BERUCOAT FX 170	■	■				■		■
BERUCOAT FX 172	■	■				■		■
BERUCOAT FX 270		■						■
BERUCOAT FX 670		■						■
BERUCOAT FX 671	■	■				■		■
BERUCOAT FX 871	■	■						■
BERUCOAT MC 216		■					■	■

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

Dry lubricants vs. liquid lubricants		
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

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 732	■	■						■	■
BERUCOAT AK 376	■	■					■		
BERUCOAT AK 978*		■				■	■		
BERUCOAT FX 170			■	■		■			
BERUCOAT FX 172			■	■					
BERUCOAT FX 270			■						
BERUCOAT FX 670			■						
BERUCOAT FX 671			■	■		■			
BERUCOAT FX 871					■	■			
BERUCOAT MC 216	■	■					■	■	■

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Characteristics or Properties /
Material combinations

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-Coatings.

Product	Applications				
	Dipping	Brushing	Dip centrifuging	Spray application	Print
BERUCOAT AF 130	■	■	■	■	
BERUCOAT AF 291				■	■
BERUCOAT AF 320	■	■	■	■	
BERUCOAT AF 438	■	■	■	■	
BERUCOAT AF 732	■	■	■	■	
BERUCOAT AK 376	■	■	■	■	
BERUCOAT AK 978*	■	■		■	
BERUCOAT FX 170	■			■	
BERUCOAT FX 172	■			■	
BERUCOAT FX 270	■			■	
BERUCOAT FX 670	■			■	
BERUCOAT FX 671	■			■	
BERUCOAT FX 871	■			■	
BERUCOAT MC 216	■	■	■	■	

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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 732			■
BERUCOAT AK 376	■	■	■
BERUCOAT AK 978*	■	■	■
BERUCOAT FX 170	■		
BERUCOAT FX 172	■		
BERUCOAT FX 270	■		
BERUCOAT FX 670	■		
BERUCOAT FX 671	■		
BERUCOAT FX 871	■	■	■
BERUCOAT MC 216	■	■	■

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

Technical Data

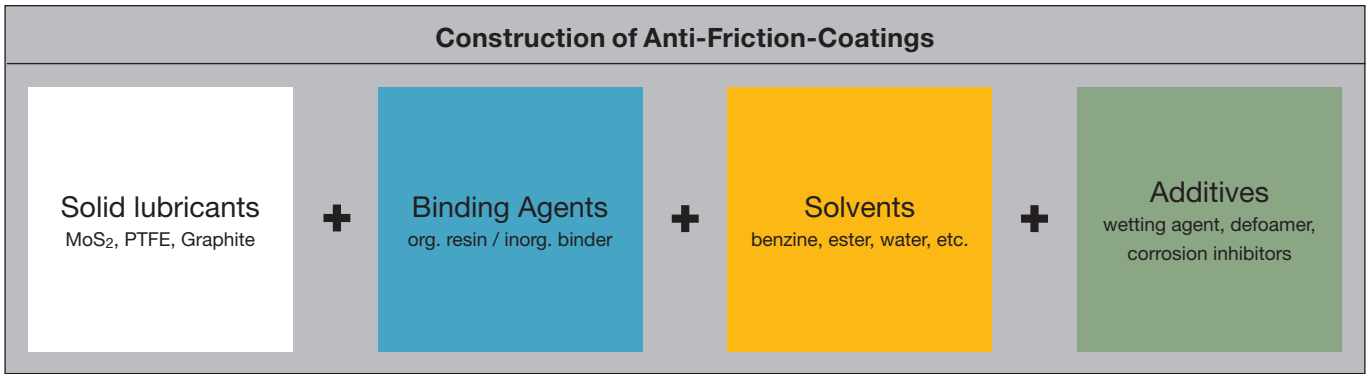
Anti-Friction-Coatings are dispersions of selected solid lubrications in solutions of organic or inorganic binding agents in solvents or water. After application and hardening the Anti-Friction-Coatings form a solid bond of binding agent and solid lubricants. During the tribologic process the solid lubricants 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
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	ester	-40 °C	+250 °C	black	
BERUCOAT AF 438	Anorganischer Binder	MoS ₂ /Graphite	ester/benzine	-180 °C	+450 °C	black-grey	■
BERUCOAT AF 732	organic binder	MoS ₂ /PTFE	ester	-70 °C	+250 °C	matt-black	
BERUCOAT AK 376	organic binder	PTFE	water	-40 °C	+120 °C	whitely	■
BERUCOAT AK 978*	organic binder	combination solid lubricants	water	-40 °C	+80 °C	transparent	■
BERUCOAT FX 170	organic binder	org. Polymer	water	-40 °C	+140 °C	black	
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 871	organic binder	Wax	water	-40 °C	+120 °C	whitely 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 hardening	
■	heat curing: 30 min at +200 °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. hard- ness is achieved approx. 24 hours after application
	air drying: 20 min at room temperature 5 min at +40 °C, max. hard- ness is achieved approx. 24 hours after application
■	
	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 tempera- ture range	-180 °C to +450 °C (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 fret- ting, 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
AFC SOLVENT E	BERUCOAT AF 732
AFC SOLVENT M	BERUCOAT AF 130 BERUCOAT AF 320
AFC SOLVENT P	BERUCOAT AF 291

Tomorrow's technologies. Today.

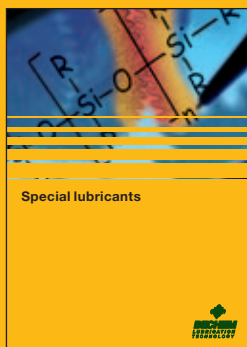
A tradition we are proud of since 1834. This is still today demonstrated by our trademark: the Rhus Flower. After permanent development, BECHEM is today a »Global Player«.

BECHEM special lubricants, industrial lubricants, metal working fluids and solutions for forming technology are based on our extensive experience in the development of special chemistry and on the latest tribologic knowledge. Our know-how with regard to friction, wear and lubrication always takes account of our customers' requirements for economical and ecological optimisation. We feel obliged to tradition and progress.

Besides the headquarter in Hagen, BECHEM has two other production sites in Germany – in Mieste and Kierspe. In addition to that, our worldwide distribution network allows us to develop markets all over the world. With daughter companies in France, India and Switzerland, as well as Joint Ventures in the USA, South Africa, Sweden and China, BECHEM shows its international presence.

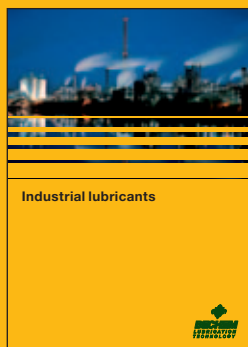
It is our target to supply our customers with high-quality products and to simultaneously meet the corresponding international standards. The quality of our products is guaranteed by our quality management system in accordance with the automotive standard ISO/TS 16949. All our production sites are systematically controlled by internal audits and regular external inspections by the certification association TÜV NORD CERT GmbH. Audits which are regularly carried out by our customers confirm the compliance with our high quality requirements.

Further information material is available either direct from us or at www.bechem.com



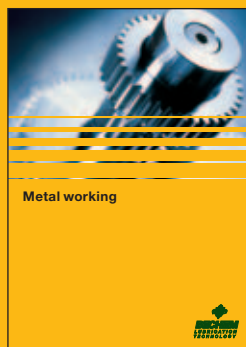
Special lubricants

- Low and high temperature lubricants
- Plastic lubrication
- Electrical contact lubricants
- Food grade lubricants
- Valve lubricants
- Anti-Friction-Coatings



Industrial lubricants

- High performance multipurpose greases
- Heavy duty and high temperature lubricants
- Hydraulic oils
- Gear lubricants
- »Green« lubricants



Metal working

- Coolant lubricants
- Cutting and grinding oils
- Deep drilling oils
- Corrosion protection oils
- Cleaning agents



Forming technology

- Wire drawing lubricants
- Cold forging oils
- Massive forming
- Tube drawing lubricants
- Sheet forming