

Special Additives for Non-Polymer Applications

BÆRLOCHER



Additives worldwide for your success



Additives play a crucial role in determining processing properties as well as product quality and character. The Baerlocher Group of Companies is one of the leading suppliers of metal soap based additives for diverse applications and industries and looks back on a history of over 190 years. The family-owned group employs more than 1,150 employees in its production sites and joint ventures which are strategically located around the globe in all key markets for plastics processing.

www.baerlocher.com

Baerlocher is your global partner for all polymer and non-polymer processing agents. With consistent leading edge technology for sustainable additive solutions, we can service locally from world class sites in many deliverable, user friendly forms.

One class of versatile, renewable additives are metal soaps – metal salts of fatty acids derived from natural and renewable sources. Metal soaps have a variety of properties that can be tailored through different metal centers, fatty acid chains and morphology to suit diverse application areas. Vulcanization aids, release agents, thickeners and many more – metal soaps are an integral additive in all areas. We at Baerlocher are looking forward to support you in optimizing your production processes.

Baerlocher supplies sustainable and innovative solutions for plastics and rubber in the construction and lubricant industry, as well as many other markets.

Special Additives for Non-Polymer Applications



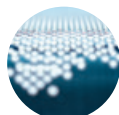
Technical service

Page 4



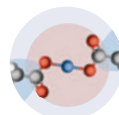
Global network

Page 6



Special Performance Additives

Page 8



Metal soaps

Page 10



Product forms

Page 12



Lubrication Effect

Page 14



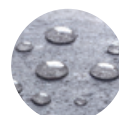
Rheology Modifier

Page 16



Sulphur Affinity

Page 18



Hydrophobic Effect

Page 20



Product Recommendations

Page 20

Baerlocher is not only known as a leading producer of high-quality metal soaps for diverse application areas like processing aids, lubrication additives, hydrophobic agents, thickening agents and vulcanization aids.

Its focus is on offering a wide range of innovative additives that meet the highest requirements in terms of customers' efficiency, sustainability, and performance.

With its global reach and long experience in various industries, Baerlocher individually develops tailor-made solutions supported by state-of-the-art laboratories combined with local highly experienced technical service personnel to support its customer's needs. Experience and knowledge are the key factors of our service.

Technical service creates value

Additives and worldwide service

Baerlocher's technical service takes care of the customers' needs and transfers our research results to the various markets. Furthermore, we individually develop tailor-made solutions with our customers, combining experience and knowledge. Our technicians' toolbox helps support many related industries such as producers of machinery, tooling and raw materials and is backed by well-equipped application laboratories. Experience and knowledge is shared throughout our technical service groups worldwide.



Improving processability and usability



Analysis of product request

After getting in contact with us, our technical specialists worldwide will analyze your additive product request based on your application and needs. At the same time, initial requirements for the specification of the additive are formulated.



Developing the optimal solution

Based on our high level of experience in a variety of applications, a first selection of additives can be suggested to solve your technical challenge and provide additional value. Our portfolio offers a wide range of high-performance additives which act as a starting point for every tailor-made solution.



Tailor-made additives

We work hand in hand with the customer if specific additives need to be optimised, adjusted or developed from scratch to find the best solution for the application. In our state-of-the-art equipped laboratory, we carry out standardised product tests in selected areas of application.



From a profound idea up to high scale production readiness

Every product development process will run through various scale up stages until it concludes in a fully commercially available product. From the first steps in the lab stage with our product development specialists to the final step, this always includes real production environment. Finally, our quality control laboratory ensures the final evaluation of the product.



Worldwide availability

It is important to us to be present where and whenever you need us. All Baerlocher production sites work closely together to ensure optimal production processes and transfer of technical knowledge. That is why almost every additive is available worldwide.



Increase in quality and productivity

As a result of consistent improvement of product development, as well as manufacturing processes, you will recognize an improved quality of your final products which go often alongside with higher productivity.

Baerlocher service quality

- Global network of experts
- Trusted advisors to the industry
- Local solution provider
- Own research & development
- Consistent and assured supply

Baerlocher's global network

We speak your language

Over 1,000 employees worldwide make sure that we are close to our customers and sustainably support their growth. For Baerlocher, being a global company, it is essential to be local in both presence and thought. We remain close to the markets, due to our employees who continue to make Baerlocher a reliable and trusted advisor.

Baerlocher operates a global network of production plants. Each and every one of these facilities fulfills the very highest technical and safety standards. This allows us to provide our teams the resources they need to deliver consistently excellent quality for our customers. In addition, we are deeply committed to promoting best practices, and to the principle of continuous improvement.



Headquarter

Baerlocher's headquarter is located in the area of Germany's metropolis Munich. As a family-owned company, Baerlocher is aware of its social responsibility, welcoming and developing talents from all over the world regardless of their religion and cultural background.



Baerlocher worldwide

Production sites in Germany, United Kingdom, Italy, Turkey, the United States, China, Malaysia, India, Brazil and joint ventures in Italy, San Marino, Korea, Peru and Argentina as well as a worldwide sales network make the Baerlocher group of companies a strong partner. Future-oriented, we are continuously investing in research and development. Our innovative power results from the creativity of our in-house scientists and technical experts, as well as our global inhouse research and development facilities and application laboratories.



Application and Property Overview

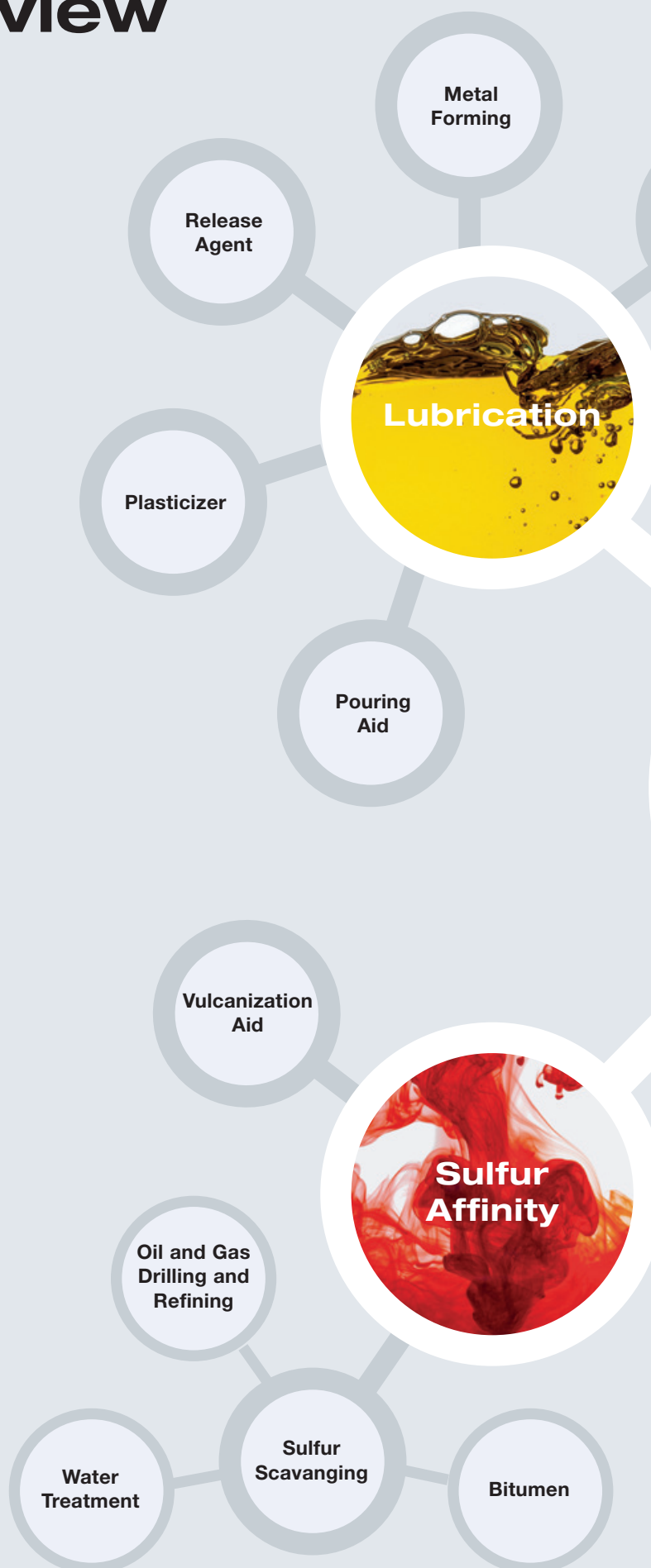
Baerlocher's SPA Non-Polymer Portfolio

Baerlocher's Special Additives sales offer includes oleochemical products, metal soaps and complex additive systems. Through our backward-integrated production, we offer neat metal soaps as well as stearic acid, hydrogenated triglyceride and glycerin of various grades. Oleochemicals are an integral part of bio-economy using renewable resources. We also offer our products as VEG versions – in this case our fatty acid supply is plant-based. These Baerlocher products are also available with RSPO certification.

We provide special solutions to our different customers and adapt to your needs – e.g. as a multi-additive one-pack solution (with or without fillers) or novel hybrid metal soap material. Our services also include toll-manufacturing capabilities.

Advantages of Baerlocher Products

- Sustainable due to renewable resourcing
- Customer-specific solutions
- Improving processing
- Increasing efficiency
- Optimizing performance





Metal soaps: introduction

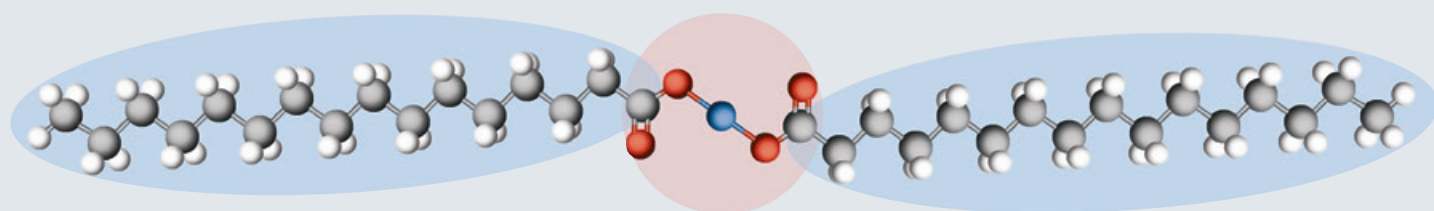
Metal soaps are chemical substances comprised of long-chain fatty acids and metal ions of different valences. The most important metal soaps, in terms of number of applications and quantities produced, are the stearates of calcium, zinc, magnesium and aluminum. These commercially most important metal soaps are produced from commercial fatty acids derived from oil (vegetable e.g. palm oil or coconut fat, animal e.g. tallow) with the predominance of those being sourced containing mostly stearic acid (C18), palmitic acids (C16), myristic acid (C14) and lauric acid (C12).

The general properties of metal soaps correlate strongly to the chemical composition of the soap. Due to the lipophilic fatty acid chain and an usually hydrophilic metal ion center the metal soaps act as versatile surfactant with applications in a diversity of industries and processes.

General properties

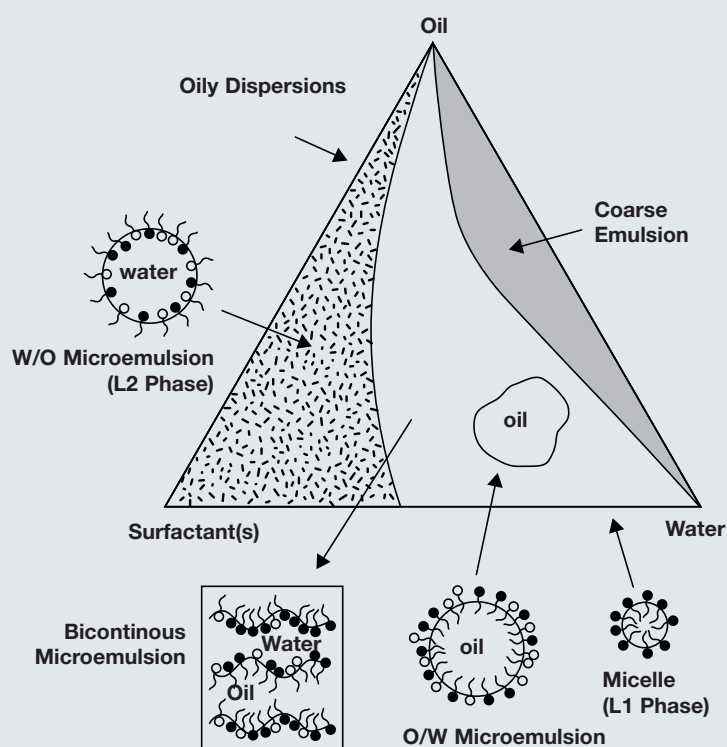
- Lubricating
- Releasing
- Separating
- Hydrophobic
- Gelling capacity
- Stabilizing effect
- Foam inhibition
- Dispersing additive

Polar metal center – hydrophilic



Non-polar fatty acid chain – lipophilic

Non-polar fatty acid chain – lipophilic



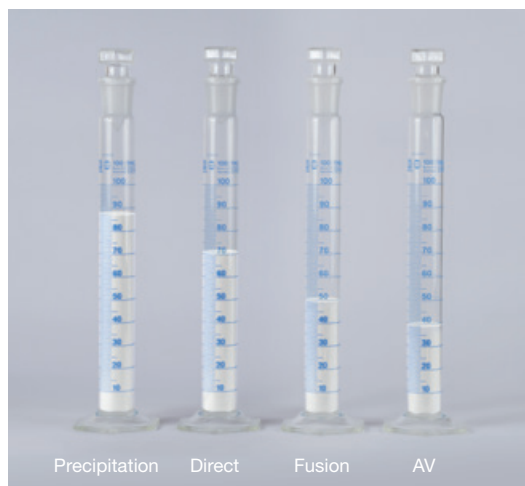
Qualitative phase diagram of the ternary system Water-Surfactant-Oil

Depending on the desired properties of the metal soap and its application, variations on the composition of the metal soap can be made. The metal ions, for example, are the key factor for solubility properties – sodium and potassium salts are soluble, calcium and zinc salts are insoluble in water.

The fatty carbon chains can further affect the miscibility but are responsible for other properties too. The chain length, additional functional groups and saturated/unsaturated chains, direct the property profile of the metal salts further in the desired direction.

As described in the picture on the left, metal soaps form different types of structures depending on the media and production method. The liquid crystalline structures heavily influence the performance of the desired metal salt.

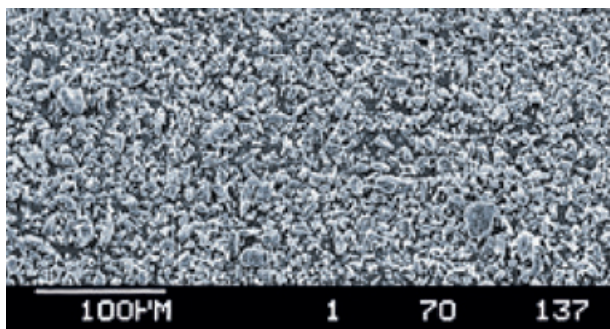
Differences in bulk densities
resulting from different
manufacturing processes by
comparing the volume of
similar mass



The Baerlocher group uses four different methods for the production of metal stearates, with each method imparting its own specific properties to the final product:

Precipitation

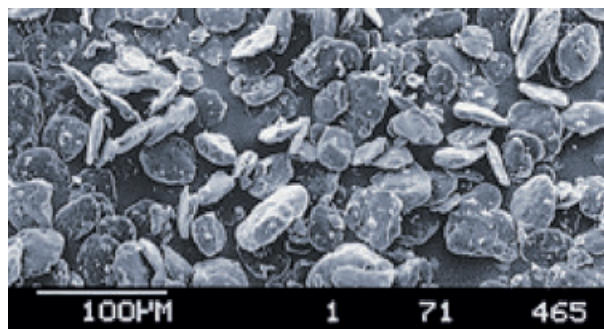
The fatty acid is first saponified in relatively large volume of heated water. Particle size, surface area and particle morphology or shape are influenced by the concentration of reactants and precipitation rates. In general, the higher the dilution of the saponified fatty acid, the smaller the particles and the larger the surface will be. These properties determine the bulk (apparent) density, which is typically low for precipitated metal soaps. This precipitation process typically produces very light, fine powders with a large surface area and a more platelet morphology. These types of metal soaps are used in applications requiring fine particle size and high surface area for the best lubrication and release properties and where special emphasis is placed on good hydrophobic properties.



Particle size by Precipitation process

Direct reaction

The reaction between fatty acid and metal oxide, hydroxide or carbonate takes place at an elevated temperature in a large excess of water. Particle size, and thus particle surface and bulk density, are influenced by the relation of fatty acid to water. The higher the dilution, the smaller the particles and the larger the surface will be. The metal soaps produced by direct reaction are also relatively fine powders with a high degree of purity, being free of water-soluble salts. Direct reaction in water generally produces a more rounded, agglomerated particle, with higher bulk density than precipitated soaps.



Particle size by Direct reaction

AV process

Baerlocher's AV process is a combination of the direct reaction and fusion processes. Metal oxides or hydroxides are heated according to a patented method with a fatty acid and a small quantity of water in a pressurised reactor. The AV process allows the very efficient production of a variety of stoichiometries, including very pure products. AV technology is generally used to produce metal soaps in free-flowing granule or powder forms.

Fusion process

During the fusion process, metal oxides or hydroxides and fatty acid are heated under pressure with continual stirring. A variety of physical forms can be produced from this process, depending on the melting range of the final product. For relatively low or sharp melting metal soaps, all forms (pastilles, prills, flakes and powder) are generally feasible. A very high degree of purity is achievable with the fusion process.

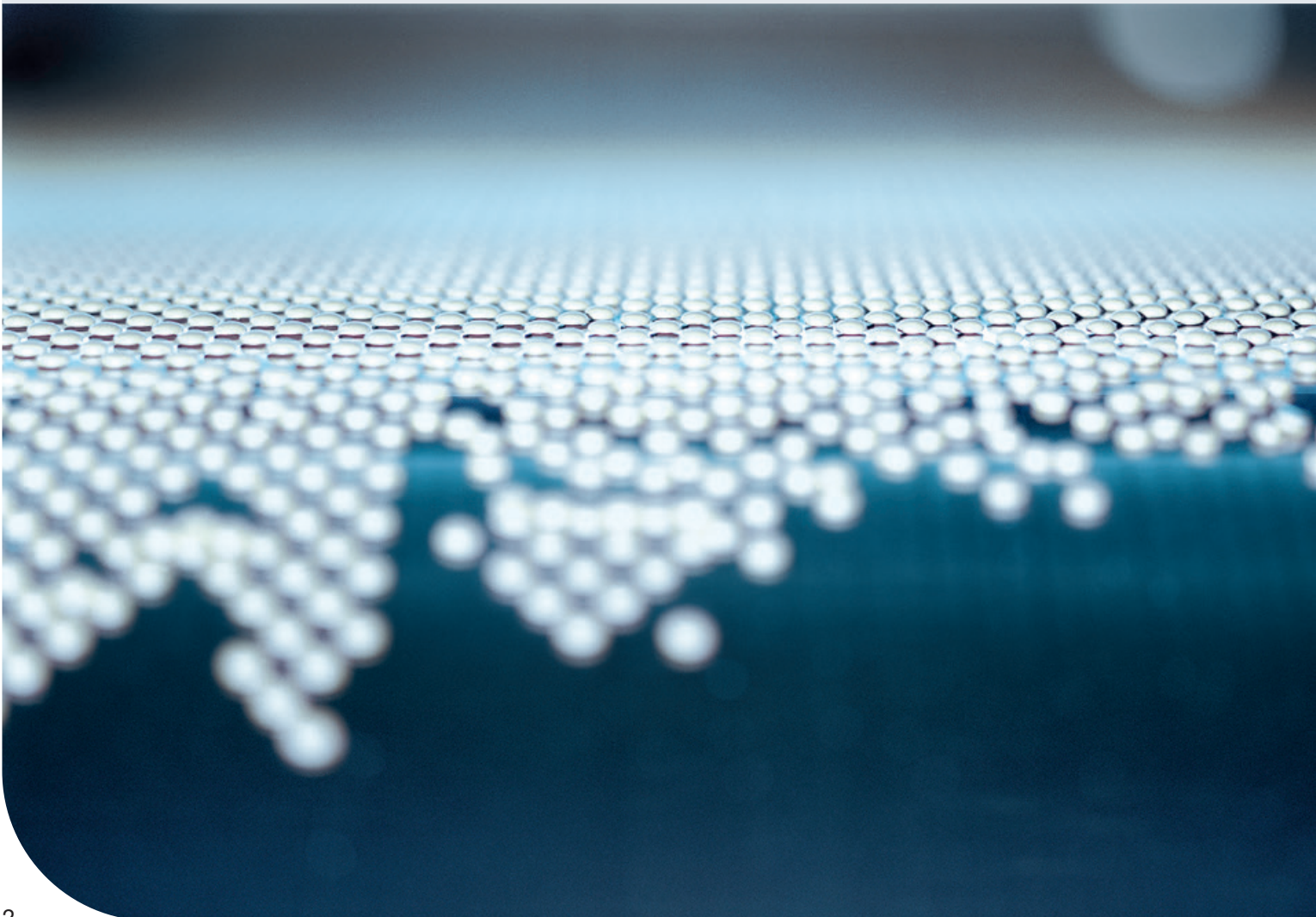
Forms for all functions

Product forms for high processing & production quality

All of Baerlocher's products comply with or even exceed the current status of directives like REACH in the European Union or other regional regulations. Based on the close partnership with our customers all products can be tailored to meet individual requirements.

Incorporation solutions for additives via innovative product forms and one-packs are beneficial to the industry. Our aim is to increase our customers' efficiency and improve working conditions in their operations.

Innovative products, product forms and packaging ensure safe handling during transport, storage and production at our customers' facilities. Main focus lies on granular products (AV and R), prills (SP), flakes (SMS) and pastilles (TX) that ensure dust-reduced handling combined with excellent dispersibility. Besides, Baerlocher offers a variety of powder grades.



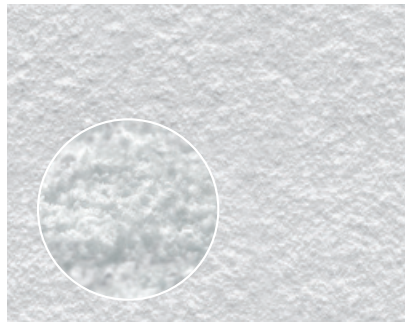
Product forms



R granules

A variety of additives is mixed and compacted to form Baerlocher's R granules.

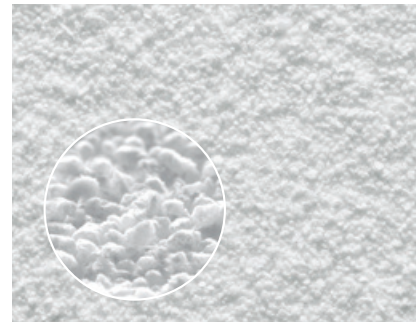
- free-flowing
- robust handling characteristics
- high feeding accuracy
- good dispersability
- suitable to be stored in silo
- low dust



MC/SW powder

Single components and customer specific additive blends in powder forms, ranging from micronized to free flowing coarse powders.

- small particles, high active surface area
- good dispersability in final applications
- good compatibility with powder blends
- medium bulk density



AV granules

A broad range of high quality stearates is produced by Baerlocher's proprietary AV technology.

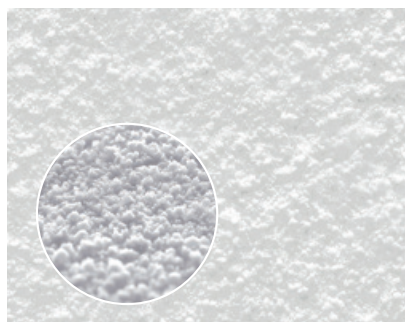
- free-flowing
- very low dust
- good dispersability in polymers
- easy to handle, accurate dosing
- high bulk density
- granular fractions adjusted to customer needs



SMS/TX melt products

Originating from specific melt processes, Baerlocher offers zinc stearates and multi component stabilizers as pastilles (TX) and flakes (SMS).

- low dusting
- free-flowing
- durable, high abrasion resistance
- improved industrial hygiene



SP sprayed prills

Highest purity zinc stearates and a range of Baerlocher's lubricants are offered as sprayed prills.

- very low dusting
- absolutely free-flowing granules, compatible with powder blends
- very high bulk density
- high feeding accuracy



Liquids

Various families of stabilizers and other additives are available in liquid form.

- high dosage accuracy
- easy storage in tanks
- easy homogenisation in polymers and with other ingredients
- quick and safe flow through pumps

Lubrication

Due to the chemical structure of metal soaps, consisting of a polar center and a non-polar hydrocarbon chain, they can form different liquid crystal phases at elevated temperatures or in solvents. These properties influence the surface tension leading to different wetting or dispersion behaviors therefore allowing the modification of surfaces and interfaces.

This heavily influences processability of many compounds and can be generally outlined as lubrication. Lubrication typically is categorized internal and external lubrication, where internal lubricants function inside the material and external lubricants work between materials and surfaces. In each field metal soaps can

be applied. Depending on the compound used, type of processing and the chosen metal soap the lubrication can be tuned to the desired effects.

Using metal soap-based lubricants offers the following advantages.

Advantages

- Faster and improved processing
- Less wear on equipment
- Higher output
- Increased efficiency
- Better surface quality



Metal forming

In metal forming processes like wire or tube drawing, lubrication is needed to increase lifetime and prevent wear-down of tools and machine parts. Due to their hydrocarbon chain, Baerlocher metal soaps provide a slipping effect between the manufacturing tool and metal good. Depending on the chain length and metal center, different soaps are more beneficial than others for different metals, e.g. zinc soaps like Baerlocher's ZINKBEHENAT are best used for some aluminum based products.

As mentioned before the product form is a key property for various applications and Baerlocher offers a wide range of solutions. Usually, powdered metal soaps are preferred in this application field. However, Baerlocher can provide metal soaps in different product forms such as dust-free pastilles or free flowing granules.

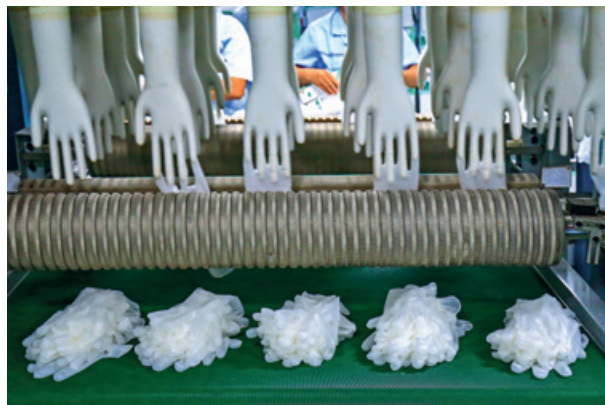


Plasticizer

Many times, oleochemicals such as metal soaps carry traits of both internal and external lubrication characters. As this is also affected by the system in which the lubricant is employed, considering the polarity of the medium relative to the lubricant helps to determine the right choice of chemistry for the desired plastizing effect. Considering the production parameters of rubber manufacturing, there might be different choices. Alkaline and alkaline earth soaps provide different characteristics in melting point and therefore can be adapted to a variety of processes to provide lubrication in various temperature ranges. An internal lubricant will reduce the bulk viscosity and therefore minimize agglomeration of other additives. So, for example, our CEASIT series is used to control the viscosity of butyl rubber and helps to incorporate fillers.

Release agents

Baerlocher's release agents are applied whenever two materials of high affinity to each other need to be detached after or during a production process at moderate temperatures without any contaminants or residue on the respective surface. Physically the metal soaps have higher affinity to the interface between the material and the surface of the mold – which can be metal, ceramic, wood etc. In this process Baerlocher products guarantee a contamination free release in many applications like rubber glove manufacturing. Widely used in rubber processing are anti-tack powders or liquids that impede sticking of the raw rubber slabs. For these applications Baerlocher offers a variety of grades based on zinc, calcium or magnesium like ZINCUM 5, CEASIT SW/PA or MAGNESIUMSTEARAT SW1632. Our products can be used in powder-form or used to formulate a liquid suspension. Furthermore, metal soaps are used as a deforming aid in the production of pharmaceutical tablets.



As environmental and health issues play a role for the final decision of metal soap, BAERLOCHER offers a wide range of metal soaps considering the individual requirements of our customers.

Important characteristics of processing aids:

Chemical	Polarity	Melting range
Fatty acids	High Low	54° C – 60° C
Zinc stearate		118° C – 122° C
Calcium stearate		150° C – 160° C
Magnesium stearate		140° C – 150° C
Sodium stearate		200° C – 240° C

Rheology Modifier

Thickening is achieved by a solid three-dimensional network spanning the volume of a liquid medium and trapping it through surface tension effects. Metal soap-based thickening or gelling can be achieved through physical or chemical effects. Depending on the application the properties can be controlled ranging from soft and weak or hard and tough. Metal soaps are commonly used as thickening or gelling agents in a variety of applications. Depending on the medium that needs to be thickened, different structures are formed (see chart on p. 10) which are responsible for the thickening or gelling effect. The underlying mechanism is derived from the amphiphilic structure of the metal soap with a hydrophilic and hydrophobic part of the molecule building agglomerates in the medium that further form micelle-based structures or networks.

Different media and applications in the media require different metal soaps. The most prominent representative for oil-based solutions are lithium and calcium soaps and aluminum or alkali soaps in organic media.

Advantages

- Easy handling
- Increase of output
- Improvement of performance
- Improvement in processing



Grease

For grease manufacturing typical thickening agents are lithium and calcium based soaps of stearic acid and especially 12-hydroxy stearic acid. The soaps form a sponge like network in the grease derived from inverse micelles where – depending on the metal center – different structures are built. These networks hold, release and reabsorb the lubricating oils during and after stress or workload.

Metal soap based greases are typically made in an in-situ process where the metal soap is synthesized on site in a one-pot reaction in the base oil which is a time and energy extensive process. Ready-made soaps from Baerlocher like LITHIUMSEIFE I, LITHIUM-12-OXY or LITHIUMSEIFE O are utilized in an ex-situ process which guarantees fast and easy processing due to time and energy-savings and are ideal for thickening of sensitive base oils like ester-based oils or natural oils. Furthermore, Baerlocher offers tailor-made metal soap thickeners like lithium-calcium mixed soaps, complex soap mixtures and more.

Sealants

Sealants are multicomponent systems where metal soaps can act as thickeners in specific formulations. The metal soap can aid the thickening process but can also be beneficial for enhancing stability, as a dispersing aid and more which strongly depends on the formulation of the sealant. Whether acrylic resin, butyl rubber or epoxy-based sealants – our metal soaps can optimise rheological properties and aid with curing and stability properties.

Baerlocher Products like NATRIUMSTEARAT SW or our ZINCUM series are applicable.

Pastes and Lacquers

In general metal stearates can be used as additives for paints, pastes and lacquers as dispersing aids, defoamers, and stabilizers, or in the context of thickening more specifically for rheology modification. Depending on the base components different metal soaps can be applied for adjustment of viscosity. As depicted in the chart on p.10 metal soaps form different types of micelles in different media and concentrations. These micelle-types act as viscosity modifiers.

In dependence of the base materials different Baerlocher products can be useful – water based products for example can benefit from our NATRIUMSTEARAT, KALIUMSTEARAT, ALUGEL or MAGNESIUMSTERAT series.



Sulfur Affinity

For most applications metal soaps can be optimized for the desired performance with different fatty acid chains and other metal centers. Yet, some properties are strongly correlated to the metal center – for example lithium in grease manufacturing.

As a transition metal zinc has a specific set of properties that is derived from its reactivity and affinity. In this section we want to take a deeper look into zinc based soaps and their specific properties and applications.

Zinc has a high affinity to sulfur which can be used for rubber curing where sulfur bridges are established in the rubber compound. Zinc soaps act here as an activating component that shortens curing times extensively due to these catalytic effects.

Furthermore, zinc based products can be used where sulfur compounds need to be removed or inactivated.

Advantages

- Better control of reaction processes
- Reduction of bulk viscosity
- Improved processing of components/fillers
- Reduction of side effects like blooming
- Support of energy savings



Vulcanization Aid

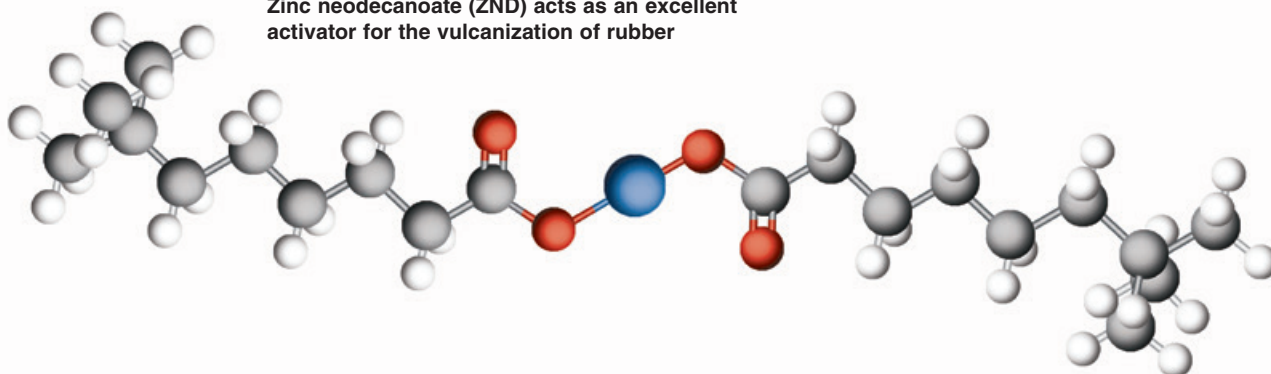
Zinc based additives are well-known vulcanization aids in rubber curing. As a transition metal, zinc provides excellent catalytic behavior and forms an intermediate zinc-sulfur complex which is essential for accelerating the vulcanization reaction.

Baerlocher offers selected zinc carboxylates suitable as activators in natural rubber processing. Besides the well-established ZINCUM product series Baerlocher also offer more specialized products with exceptional catalytic performance – e.g. BAEROSTAB ZND.

Sulfur Scavenging

Zinc's affinity to sulfur can also be used for scavenging sulfur cheaply and easily. For example, bitumen contains a variety of sulfur compounds leaving it with a distinct unpleasant odor. Addition of Baerlocher ZINCUM products binds these unwanted compounds in a simple but effective way. Typical example is road construction where improvement of working conditions is of great importance. Bitumen is derived from crude oil containing a variety of sulfur compounds that can be inactivated by addition of Baerlocher's zinc-based products. In addition, our products not only scavenge sulfur compounds but can also provide processing aid when handling bitumen, e.g. water-proofing bitumen membrane for roofing.

Zinc neodecanoate (ZND) acts as an excellent activator for the vulcanization of rubber



Hydrophobic Effect

Whenever people hear the term hydrophobic, they often associate the visual effect of water-repellent lotus flower leaves, water droplets on wax polished car bodies or even self-cleaning properties of high-tech coatings.

Indeed, all mentioned examples do have one basic characteristic in common. It is the physical process of forced separation of a nonpolar surface and water, which maximizes hydrogen bonding between the water molecules and minimizes the contact area between water and nonpolar molecules. A minimal area of contact between water and the substrate results in a high contact angle of the droplet and a well-developed water-repellent effect.

In this context, an analogy can be drawn to additives based on metal soap chemistry due to their behavior towards water. In contrast to the above-mentioned effects, it is more common to speak of a hydrophobic

effect for metal soaps rather than a water-repellent one. This means that the main purpose for the use of metal soaps is not to completely encapsulate a substrate from water penetration but to protect the structure from extreme humidity while still allowing the substrate to remain in atmospheric equilibrium with the environment i.e. breathe.

Advantages

- Good cost/performance ratio
- Very fine particles
- Water-soluble grades which contribute to a good distribution of the hydrophobic effect
- No problems with product recycling
- Metal soaps are partly bio-degradable
- Metal soaps do occur naturally in the environment
- Chloride content < 0,1 % – no corrosion-promoting ingredients



Hydrophobization

Imagine materials in e.g. a building facade, concrete bricks or other substrates which are exposed to changing climate conditions to be completely covered in wax or any other waterproof material. The smallest micro crack would lead to water penetration into the masonry, resulting in immense damage over time.

As this is not feasible, the substrate must instead be able to release the absorbed moisture by drying without losing its hydrophobic properties in the next wetting cycle – a benefit which metal soaps can provide. Very small concentrations can already have a major impact while still allowing for sufficient water vapor diffusion to take place.

Compared to various additives based on different chemistry, a big advantage of metal soaps is that the hydrophobic effect does not show a concentration gradient towards the boundary surface. Instead, hydrophobicity can be induced homogeneously throughout the whole part (mass hydrophobization). This can be achieved since alkali-based metal soaps are water-soluble and can react with ions in the substrate by generating the hydrophobicity within the structure. Non-reactive metal soaps are intrinsically hydrophobic but can easily be dispersed in water by high shear and potentially be used to coat surfaces to ensure an improved protection against humidity. Suitable techniques are limitless!

Possibilities for Application Fields

Application	Reactive Grades	non-reactive Grades	Mixtures
Cementitious Materials	•	•	•
Plaster	•	•	•
Tile Grout	•	•	•
Concrete	•	•	•
Gypsum			•
Facade Painting	•	•	•
Pasty Plaster	•	•	•



Product recommendations

Application	Baerlocher Product	Description
Lubrication		
Metal forming	BAEROLUB LFG ZINKARACHINAT ZINKBEHANAT	Wax-ester, liquid Zinc based metal soaps with long fatty acid chains
Release agent	CEASIT SW/PA MAGNESIUMSTEARAT SW ZINCUM T POWDER	Different metal soaps and product forms for a variety of applications and processes.
Plasticizer/Peptizer	ZINCUM SP, AV, TX, SMS	Zinc based soaps in different product forms depending on individual processes
Thickening		
Grease	LITHIUMSEIFE I LITHIUMSEIFE O LITHIUM-12-HYDROXY-STEARAT	Lithium based stearate and hydroxy stearates
Grease	CALCIUM-12-HYDROXY-STEARAT	Calcium based hydroxy stearate
Paints, Pastes and Laquers	CEASIT SW KALIUMSTEARAT SW NATRIUMSTEARAT SW	Alkaline and alkaline earth soaps
Sulphur Affinity		
Rubber Curing	BAEROSTAB ZND	Zinc-based metal soap, available as powder or liquid
	BAEROLUB FTA	High quality fatty acid mixture
Rubber Curing	ZINCUM T POWDER	Zinc stearate
Sulphur Scavenger	ZINCUM T POWDER BAEROSTAB L 233	Zinc stearate Zinc based metal soap speciality
Hydrophobic Effect		
Hydrophobization	BAEROPHOB CA/2 BAEROPHOB NBL/1 BAEROPHOB MGH BAEROPHOB SW 1840 BAEROPHOB ECO CM/1 BAEROPHOB L 1526	Ca-based and non-reactive Zn-based and non-reactive Mg-based and non-reactive Complex powder Complex powder Alkali-based reactive liquid



Developing solutions for the future together



Contact us now, there is sure
to be a local office near you.

www.baerlocher.com



February 2022

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