



Special Additives for 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 additives for the plastics industry and looks back on a history of over 190 years. The family-owned group employs more than 1000 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 processing with consistent leading edge technology for sustainable additive solutions serviced locally from world class production sites in many deliverable user friendly forms.

Metal soaps, integral as the raw materials for Calcium-based PVC stabilizer and fundamental as acid scavengers for the production of polyolefins, serve as the backbone of our special additive portfolio. Combining Baerlocher's proprietary resin stabilizer technology with lubricants and additional functional additives, Baerlocher supplies sustainable solutions for plastics and rubber as well as innovative solutions for the construction and lubricant industries.

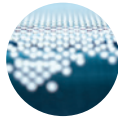


Special Additives for Polymer Applications



Technical service

Page 4



Product forms

Page 6



Global network

Page 8



Metal soaps

Page 10



Acid scavenger

Page 12



Processing aids

Page 14



Polymer stabilization

Page 16



Additives for recycling

Page 18

Baerlocher is known as a leading producer of additives developed for the processing of and to determine the properties of a variety of different polymers. The company provides solutions for polymer production up to converting. It's focus is on offering a wide range of innovative additives that meet the highest requirements in terms of efficiency, sustainability and performance.

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

Baerlocher products

BAEROPAN **BAEROCID**
BAEROSTAB **BAEROCIN**
BAEROPOL **CEASIT**
BAEROLUB **ZINCUM**
BAEROPHOB

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



On-site analysis

An expert from our worldwide technical service team comes to your plant and analyses the local requirements. Depending on the formulation in use, raw materials, machinery, tooling system and the needs for the final product the specification for a new additive recipe is set.



Worldwide team expertise

Our data base offers a wide portfolio of high performance additive blends which act as a starting point for every tailor-made solution. The international cooperation of our experts and networks within the industry ensures a high level of technical knowledge.



Additive blend development

In our application lab with state-of-the-art equipment, we mimic the processes of our customers, fine-tuning the additive system until it fits to the specification. A new solution is created and a first sample is sent out for tests on site.



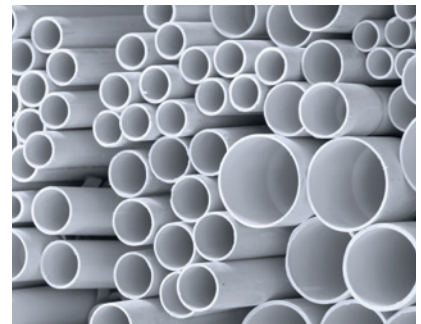
Production fine-tuning and extended trials

An interesting moment occurs when the new solution has to show how it works in a real production environment. Our technical service manager will be present and has a critical view on the performance. If needed, some further modifications (e.g. adding lubricants) can be done on site.



Scale-up

The new solution is scaled-up in your plant. At this stage, the additive has to run on different machines all over the shop floor, making many final products which have to pass the quality control. We accompany the process and support your quality control with additional tests in our analytical laboratory.



Increase in quality and productivity

As a result of product development and a closely monitored introduction, you will see in many cases improved quality of your final product and a higher productivity. Many of our customers confirm that, when using our additive blends, their scrap rates declined and downtimes reduced significantly.

Baerlocher service quality

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

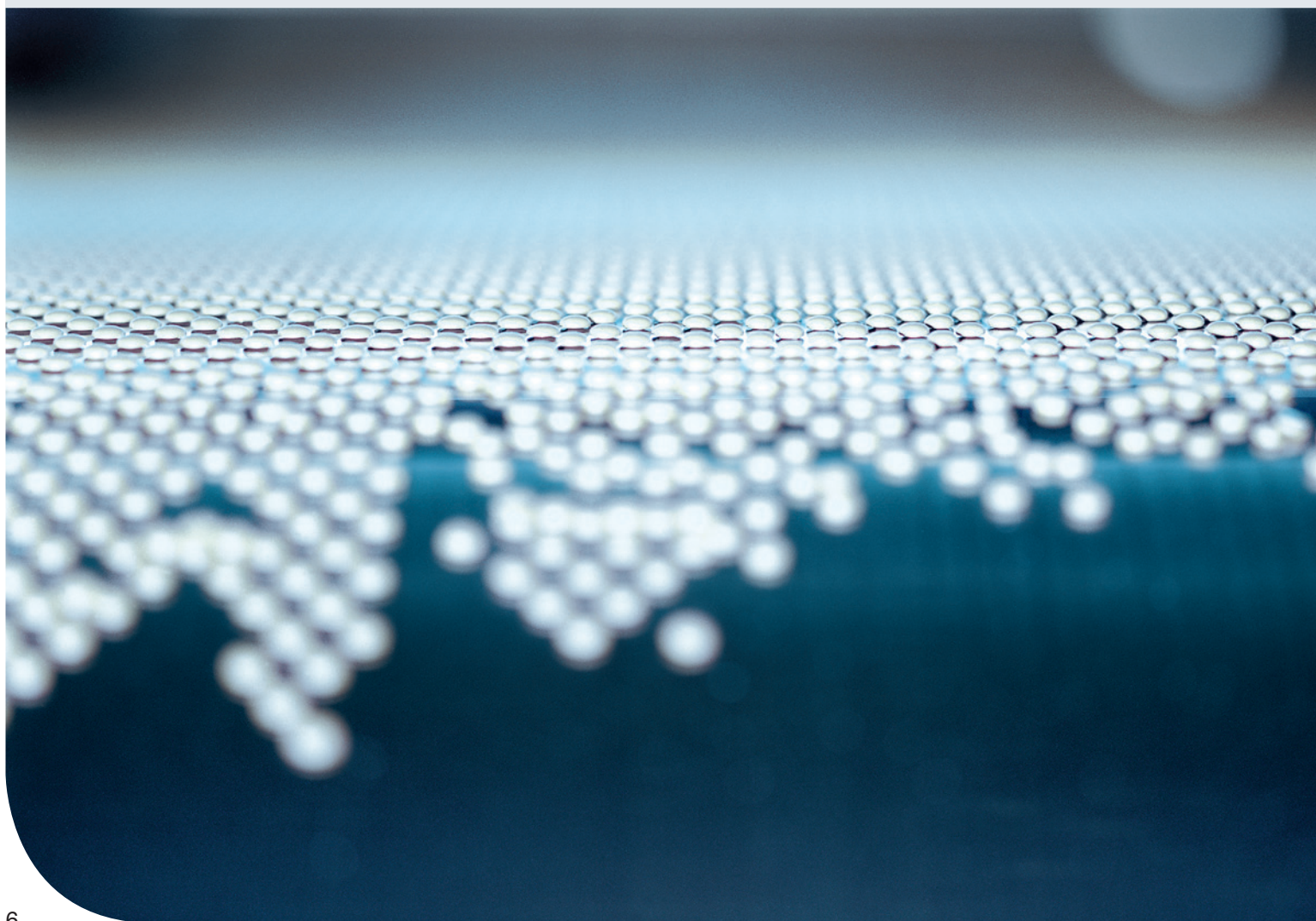
Forms for all functions

Product forms for high processing & production quality

All of Baerlocher's products comply with and even exceed the current status of directives like REACH in the European Union or other regional regulations. Based on the close partnership with the 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 (AV and R) products, prills (SP), flakes (SMS) and pastilles (TX) that ensure dust-free handling combined with excellent dispersability.



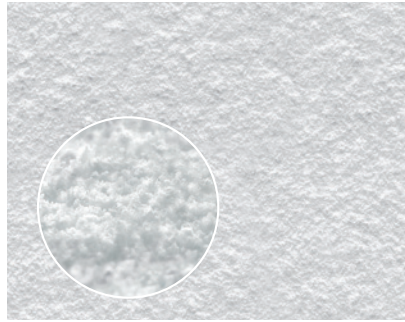
Product forms



R granules

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

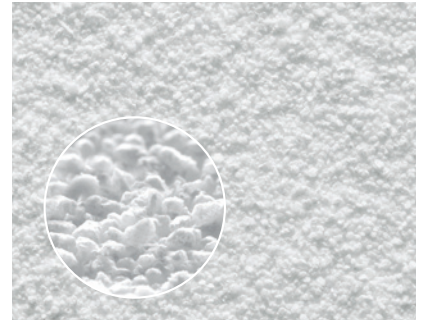
- free-flowing
- robust handling characteristics
- high feeding accuracy
- good dispersability
- suitable to be stored in silo
- low dust



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.

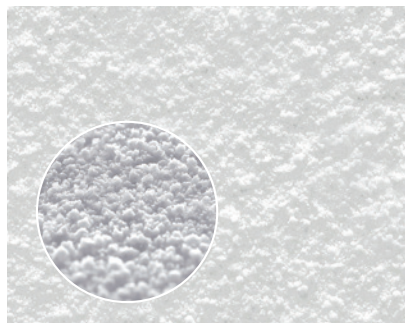
- free-flowing
- very low dust
- good dispersability in polymers
- easy to handle, accurate dosing
- high bulk density
- granular fractions selected to customer needs



SMS/TX melt products

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

- dust-free
- suitable to be stored in silo
- 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

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.



Headquarters

Baerlocher's headquarters are 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 and Joint Ventures in Germany, United Kingdom, Italy, San Marino, Turkey, the United States, China, Malaysia, Korea, India, Brazil, 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.



Metal soaps: introduction

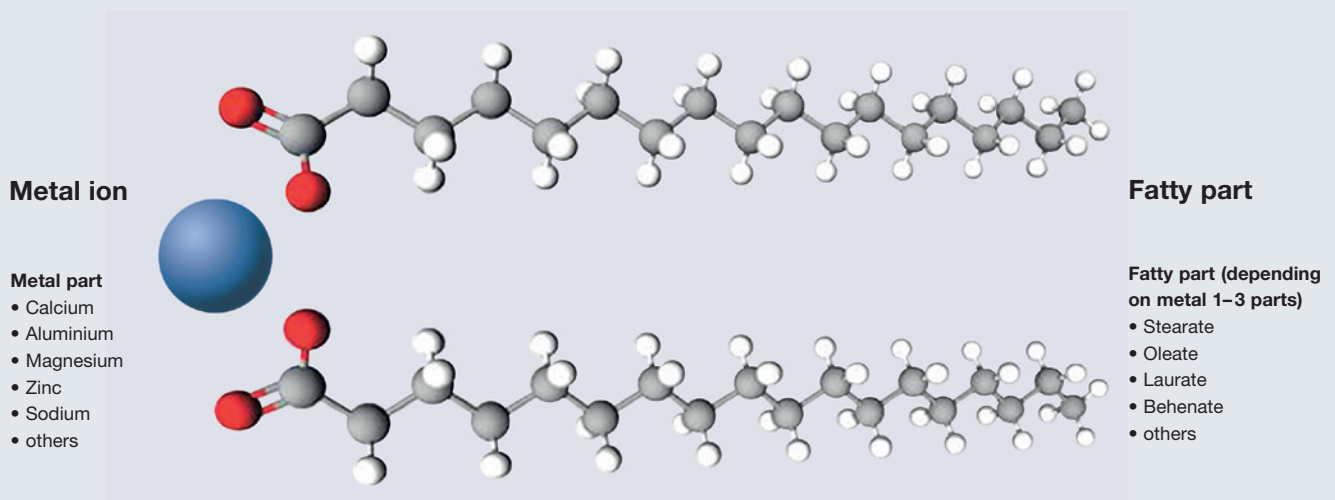
Metal soaps are chemical substances of long-chain fatty acids with metals of different valencies; some metal soaps are not soluble in water, whereas other soaps, i.e. substances of long-chain fatty acids with alkaline metals or ammonia are partly soluble in water. The most important metal soaps, in terms of number of applications and quantities produced, are the stearates of calcium, zinc, magnesium and aluminium.

Stearates of greatest commercial importance are produced from commercial fatty acids derived from natural sources, with the predominance of those being sources containing mostly stearic acid and palmitic acids. Due to the OH-group present in the fatty acid molecule, 12-hydroxystearates are usually more soluble in polar solvents and their melting point is higher than the metal salts of mixtures of predominantly stearic and palmitic acids. Due to the shorter chain length of

the fatty acid, the properties of laurates are greatly influenced by the respective metal base. The basic properties of metal soaps such as water repellence and gelation are maintained, whilst lubricating and separating properties are already significantly reduced. As a consequence of the double bond present in the fatty acid, oleates have a lower melting point than the corresponding stearates. Their solubility in water is usually slightly improved but the double bond can undergo oxidation processes.

General properties

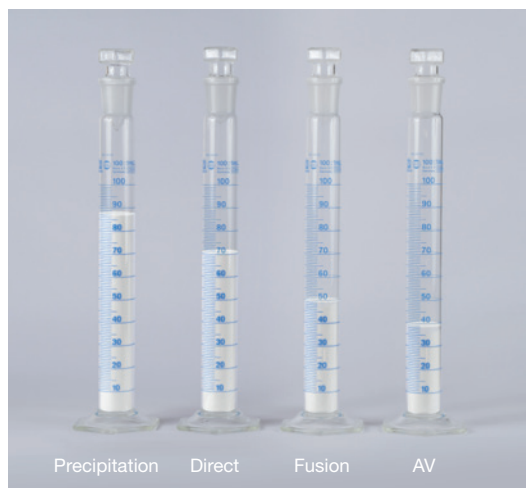
- lubricating
- release
- separating
- water repellence
- gelling capacity
- stabilising effect
- foam inhibition
- dispersing additive



Contrary to most other lubricants and release agents, metal soaps are characterised by their relatively high melting point (>120 °C). Therefore, metal soaps in the form of a fine dry powder can act as a dry lubricant (like graphite) when used in this solid powder form. In most cases, the hydrophobic nature of metal soaps is highly desirable. Lubrication and release properties, as well as water repellency, are characteristics of all metal soaps. The special effects of these properties are determined by the cation, the chain length of the fatty acid and certain other properties of the respective

metal soap (e.g. the water of crystallisation content). The gelling properties of the aluminium stearates are particularly effective, however, satisfactory gelation depends on the type of stearate (mono-, di- or tribasic stearate), its polarity and the viscosity and solvent properties of the liquid component. Calcium stearate, magnesium stearate and zinc stearate have stabilizing and processing aid effects in a wide range of thermoplastics. Aluminium and magnesium stearates are used as foam inhibitors for various suspensions.

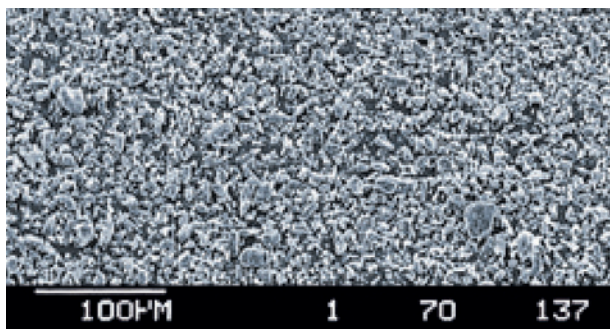
Differences in bulk densities by manufacturing process



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

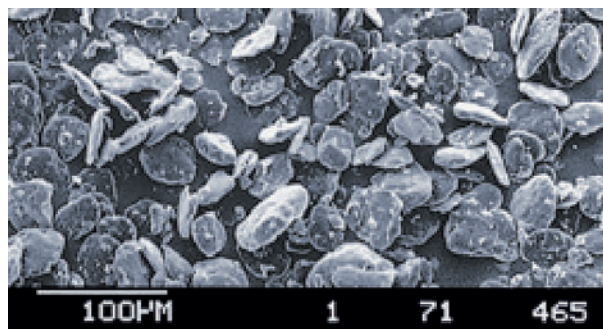
The fatty acid is first saponified in relatively large volume of heated water. Particle size, surface area and particle morphology or shape are influenced by the concentration of reactants and precipitation rates. In general, the higher the dilution of the saponified fatty acid, the smaller the particles and the larger the surface will be. These properties determine the bulk (apparent) density, which is typically low for precipitated metal stearates. The desired water-insoluble metal soap is subsequently produced by adding a metal salt solution. 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.

Acid scavenger

Acid scavengers play a fundamental role in the polymer industry. They are used to deactivate catalyst residues, primarily chlorides, and thus protect the polymer from unwanted reactions.

When a polyolefin is processed to its semi or final finished form, shear, heat and oxygen work to degrade the polymer chain. This process is catalyzed by the presence of acidic species. While typical oxidation can be handled by antioxidants, dedicated acid scavengers need to be present in parallel. Without the acid scavenger, the antioxidants would not be able to ensure the long term and processing stability which they would otherwise provide.

Acids are formed not only by catalyst residues – for example, flame retardants, fillers and pigments can also contribute. Acid scavengers also help protect processing equipment from corrosion induced by such raw materials.

Zinc and calcium stearate act as acid scavengers according to a very simple mechanism. The two soaps can also act in synergy, as calcium stearate may react with the zinc chloride to regenerate zinc stearate.

The acid scavenging activity of an additive can be evaluated by very simple means, for example, by subjecting a steel plate to molten polymer and then keeping it in a humid environment for 24 hours.

Left: Polymer granules made from well-stabilized reactor powder

Right: The same reactor powder granulated without acid scavenger



The visual performance of PP & PE-films, as well as clarified PP grades, relies on a minimum of particulate metal oxide remaining from the saponification process, which is used to synthesize calcium and zinc stearates. The presence of such solids is identified by melt filtration and the amount identified is quantified by the Filtration Index (FI). Baerlocher offers high purity acid scavengers with extremely low Filtration Index.

Advantages

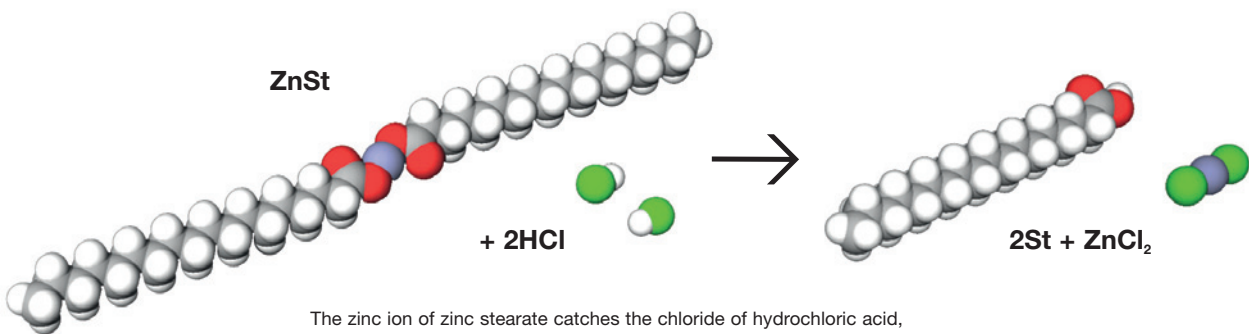
- Low dusting forms
- Vegetable and RSPO grades
- One product – one specification worldwide
- Wide polymer license recognition
- High-end film and fiber grades
- Global regulatory compliance



Magnification of PE film surface showing the effect of 1000 ppm of a low FI Calcium stearate from Baerlocher.



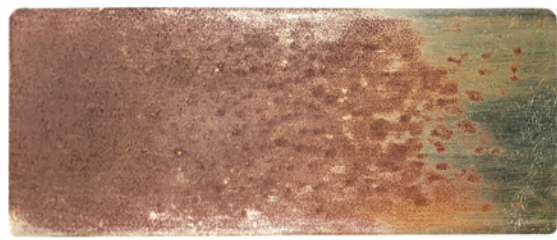
Magnification PE film surface showing the effect of 1000 ppm of a standard calcium stearate.



The zinc ion of zinc stearate catches the chloride of hydrochloric acid, forming a stable zinc chloride. The stearic acid is left in the polymer system.



No corrosion as protected by acid scavenger



Corrosion by acids due to insufficient or missing acid scavenger

Baerlocher Products

Product	Description	Special feature	Typical applications	Product forms
CEASIT	Calcium stearate	Low filtration index	PP, PE, POM, PA	Powder, low dust granules
ZINCUM	Zinc stearate	Minimized discoloration	PE, ABS, PS	Powder, low dust prills and dust free pastilles
BAEROPOL RST 92D	Proprietary blend	Stabilizer synergist	PP, PE	Low dust prills and dust free pastilles

Processing aids

Processing aid is a general term for something that has a positive influence on one or more of the process steps necessary to transform a polymer into a final article. Baerlocher offers a wide range of products fulfilling the definition of a processing aid, by providing lubrication, mold release and dispersion characteristics. Apart from supplying individual metal soaps and other oleochemicals, Baerlocher also offers multifunctional combination products within its BAEROLUB range of products. These can be tailored to fit customer specific requirements.

Mold release agents are especially important for injection molding, but also thermoset applications such as bulk molding and sheet molding. Metal soaps impregnate the mold surface and permit an easy release.

Dispersion aids can improve the wetting of dispersed materials, such as minerals, wood fibres, flame retardants or pigments, and facilitate a better mixing. The

use of such additives might allow increased loading levels, improved color strength or higher mechanical properties thanks to a lower presence of agglomerates.

The lubrication effect relates to the adhesion of the polymer melt to metal surfaces of the processing equipment, where it reduces friction. As compatibility (e.g. polarity) between processing aid and polymer affects the mechanism, it is often distinguished between internal and external function, although sometimes both effects are present at the same time.

Advantages

- Beside powder, low dusting forms and one-packs are available
- Multiple functionality
- Customized combination products
- Global regulatory compliance



Lubricants

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 polymer relative to the lubricant can aid the right choice of chemistry. Another important parameter for predicting the effect of it is the melting range.

Important characteristics of processing aids:

Chemical	Polarity	Melting range
Fatty acids	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">Low</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">High</div> </div>	54° C – 60° C
Zinc stearate		118° C – 122° C
Armide wax		140° C – 150° C
Calcium stearate		150° C – 160° C
Glycerol ester		56° C – 62° C

Mold release

Metal soaps often fulfil multiple purposes in a polymer formulation. Providing mold release, whether in a thermoset or thermoplastic application, is often one of the more important ones. Metal soaps can be used alone or in combination with other mold release agents, such as BAEROLUB L-AS, to provide synergism and cost advantages.

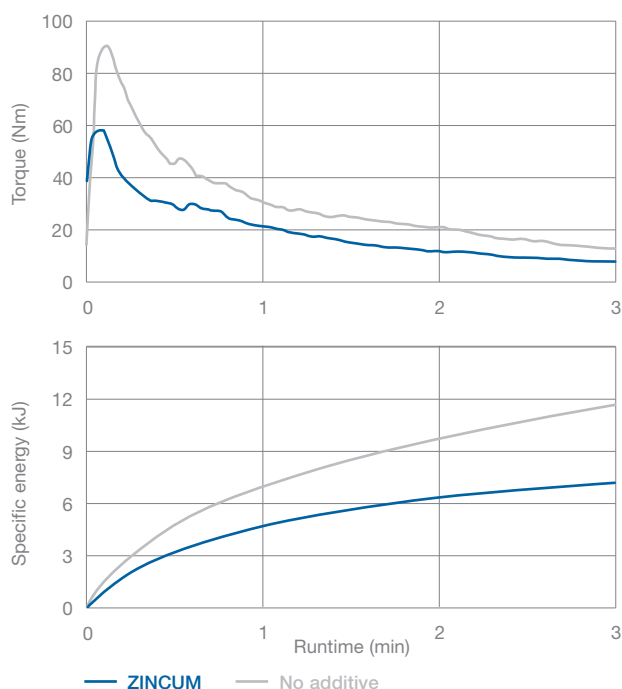
Baerlocher Products

Product	Description	Mold release	Dispersion aid	Further use
CEASIT	Calcium stearate	e.g. SMC, BMC, PE, PP, PA	Mineral filled PP & PE	Anti blocking agent
ZINCUM	Zinc stearate	e.g. SMC, BMC, PE, PP, ABS, PS	Mineral filled PP & PE Pigments and masterbatch	Anti blocking agent EPS
Sodium stearate	Sodium stearate	e.g. PA, PBT, PET-C		Improved nucleation of PA6
Magnesium stearate	Magnesium stearate	e.g. PP, ABS	Mineral filled PP Pigment dispersion in ABS	
Alugel	Aluminium stearate	e.g. PA		
BAEROLUB L-AS	Amide wax	e.g. PP, ABS, PA, POM, PBT		

Dispersion aid

Highly filled polyolefin compounds, for packaging or sound insulation pipes often take advantage of the dispersive properties of metal soaps. Another important application is pigment masterbatches. Using metal soaps directly in the compounding process can sometimes provide a cost-efficient alternative to using pretreated minerals.

Rheometer data for 30% CaCO₃ filled PP



Additives for polymer stabilization

Oxidation reactions of organic material, such as polymers, severely affects their characteristics e.g. mechanical properties and color. Oxidation takes place in every stage of the life cycle, more significantly by processing but also during service life. Various additives are added to polymers to slow down the oxidation. By attacking the free radicals formed in the oxidation cycle, these additives contribute to long-term or processing stability to various degrees. Critical to processing stability are the so called secondary antioxidants, which also protect the more long-term acting primary antioxidants, mainly by hydroperoxide decomposition. The presence of an acid scavenger is essential for the function of the antioxidants.

Baerlocher's own resin stabilization technology BAEROPOL RST acts as co-stabilizer to secondary

antioxidants but can also be used as stand-alone secondary antioxidant. In addition, it is a very powerful acid scavenger. BAEROPOL RST can be easily combined with other additives e.g. antioxidants to form additive packages for all polyolefins. It also can be used to formulate customized blends for various end applications in polymer production, processing or even recycling.

Advantages

- Dust free and easy to dose
- Partial or total replacement of phosphites
- Improved color compared to classical phosphites
- Reduced blooming and gel counts
- Hydrolytically stable
- Global food contact approvals



Additives for stabilization are key to ensure processability, mechanical characters and long-term stability, and are a must to have for all converters to fulfil market requirements. Baerlocher's product platform RST helps finding synergistic combinations of typical primary and secondary antioxidants and provide customer specific solutions.

Phosphite replacement

Traditional phosphites, especially when used at high loadings, can present technical challenges such as plate-out and chemical compatibility issues in the final product. High end phosphites are often too expensive to be considered as an alternative. The RST platform offers the possibility to formulate around such problems, while maintaining cost efficiency.

RST product family

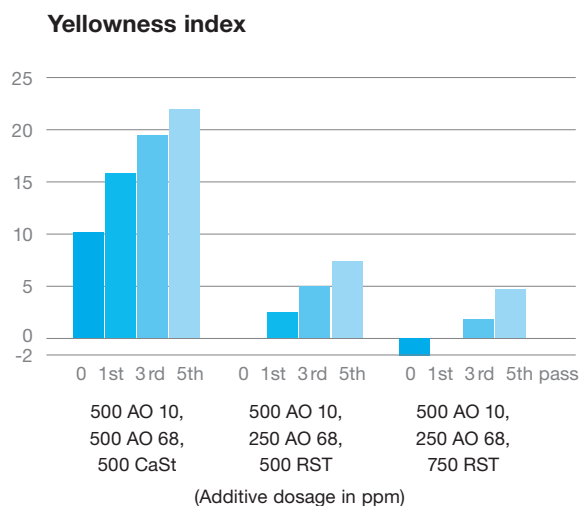
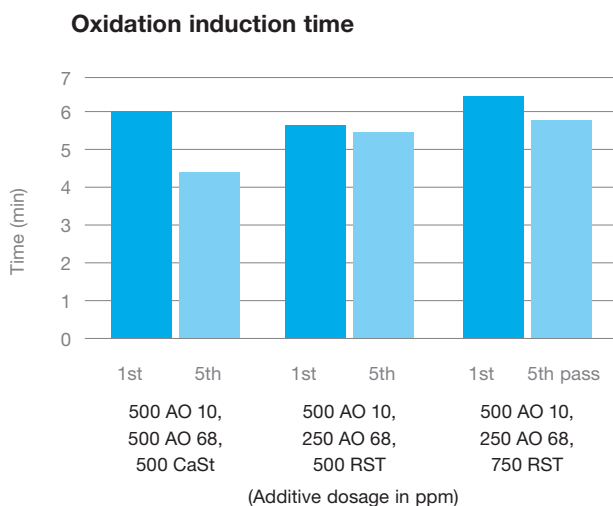
RST 92D is made from oleochemical raw materials widely recognized as safe in food contact applications. As part of a base stabilization package, it can help reduce the content of "Non Intentionally Added Substances (NIAS)", when partly substituting traditional stabilizers. Others prefer the product form options of RST, enabling a safer and healthier working environment, while also having free-flow properties that ensure uninterrupted feeding.

Reduced yellowing index

Relative to many traditional stabilization systems Baeropol RST 92D is particularly effective in suppressing yellowing during processing.

Data from a multiple extrusion trial showing how key properties are affected when RST 92D is allowed to substitute certain components of a typical base stabilization package.

Trial performed in unstabilized PP homopolymer MFI 10



Baerlocher products

Product	Description	Typical applications	Polymers
BAEROPOL RST 92D	Proprietary blend	Base stabilization co-additive	PP, PE
BAEROPOL one-packs	Blends of additives (e.g. antioxidants, UV stabilizer)	Compounding, recycling and extrusion	PP, PE

Additives for recycling

The discussions about the circular economy of polymers have shown that recycling is one of the most important topics in the polymer industry.

Baerlocher is dedicated to offering services which help converters of recycled material convert their plastic waste into new end products by advising additive solutions to ease their processes. At the same time the recycled material can reach a higher quality level by adding Baerlocher additives.

Additives play a determining factor in processing properties and product quality. Baerlocher one-pack solutions form a proven concept to enable the recycling industry to fulfil the industrial standards of the end applications, for instance film, pipe and even automotive applications.

Baerlocher additive solutions can be combined with various other additives e.g. UV stabilizers, metal deactivators and others.

Increasing the value of recyclates and expanding the number of applications where recyclates can be used is the recipe for growth that recycling companies are looking for. However, plastics made from recyclates need to meet the requirements of converters. Baerlocher additive packages help fulfil these requirements.

Advantages

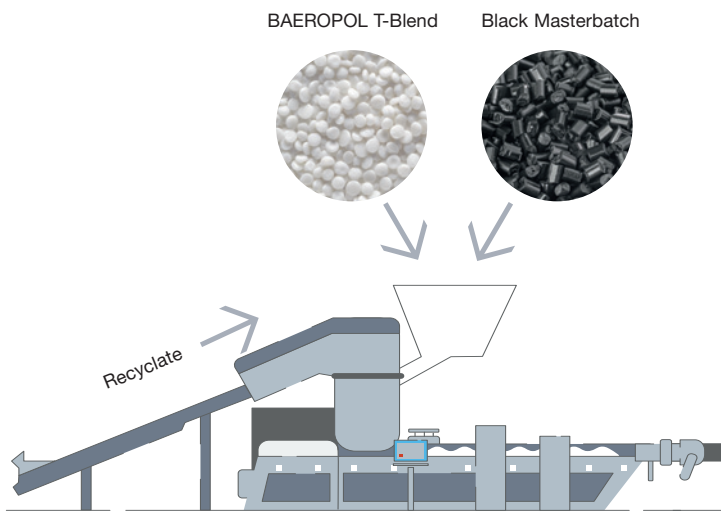
- Dust free and easy to dose
- 100 % active substance
- Stabilization of melt flow
- Color retention for translucent film
- Reduction of gels and bubble breaks
- Consistent shot size to minimize rejected parts



Simple handling

Standardized stabilizer one-packs known as BAEROPOL T-Blends offer solutions for many recycling challenges. The BAEROPOL T-Blend product range is delivered in low or no dust product forms, which ensure easy handling, dosing and dry blending.

Easy dosing of BAEROPOL T-Blend via side feeder



Bubble breakages and pin holes

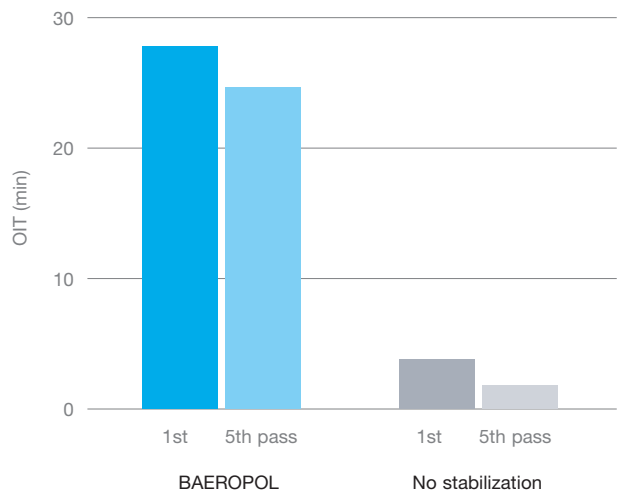
Contaminants from insufficient melt filtering or gels of degraded polyethylene can create pin holes, which can lead to bubble breakages. Introduction of a suitable BAEROPOL T-Blend during the first stage of reprocessing will reduce the number of gels and ensure a more stable production and fewer rejects of finished product.

Re-stabilization

OIT (Oxygen Induction Time) is a typical way to measure the relative amount of stabilization introduced by an additive. The better OIT the better melt processing stability and long-term heat aging performance will be.

Enhancing oxidation induction time by restabilization

OIT value by multipass extrusion of PP recyclate



Typical pin hole in recycled film

Baerlocher products

Product	Description	Typical applications	Polymers
BAEROPOL	Blends of additives as longterm AO, processing aids, UV Stabilizer etc.	Recyclates for various pipe, film and automotive production	PP, PE
BAEROLUB	Blends of additives e.g. waxes, metal soaps	Typical for reduction of friction while extrusion or as a release agent for injection molding processes	PP, PE



www.baerlocher.com

BÆRLOCHER



Baerlocher GmbH
Freisinger Str. 1
85716 Unterschleissheim
Germany
phone: +49/ 89 14 37 30
fax: +49/ 89 14 37 33 12
info@baerlocher.com
www.baerlocher.com

Disclaimer

Notice: Although the information and recommendations contained in this document ("Information") are presented in good faith and believed to be correct at the date of their publication, Baerlocher makes no representations or warranties as to the completeness or accuracy of Information. Information is supplied upon the condition that the persons or entities receiving same will make their own determination as to its suitability for their purposes prior to their use. In no event, will Baerlocher be responsible or liable for any loss of profits, lost goodwill, direct, special, indirect, incidental, or consequential damages of any nature whatsoever, including without limitation lost revenue, resulting from the use of or reliance upon Information or the product to which Information refers. Nothing contained in this disclaimer is to be construed as a recommendation to use any product, process, equipment or formulation in conflict with any patent or intellectual property right, and Baerlocher makes no representation or warranty, express or implied, that the use thereof will not infringe any patent or intellectual property rights. No representations or warranties, either express or implied, of merchantability, fitness for a particular purpose or of any other nature are made hereunder with respect to Information or the product to which Information refers.

September 2019

Photo credits: Thomas L. Fischer (front page, p.2; middle, right, p. 3; top left, top right, p.4, p.5; top left, top middle, p.7, p.8, p.9 middle left, p. 14 bottom left, p. 16 bottom left, p. 24; stockadobe.com: Sven Bähren (p.3 bottom 2nd from left, p.14 top right), happycreator (p.3 bottom 3rd from left, p.16 top right), 831days (p.3 bottom right), waiokar79 (p.5 bottom left), neonspb (p.5 bottom right), AlenKadr (p.14 bottom left), dreamnikon (p.16 top left), shklarov (p.16 bottom right), Ruud Morijn (p.18 top left), markobe (p.18 bottom left), Amikphoto (p.14 top left), all other photos: Baerlocher GmbH and Producers