Baerlocher Additives for PVC

Lead Stabilizers

we add character to plastics
Plastics open new avenues for the future. Additives essentially determine properties and quality of the end product. For more than 50 years, Baerlocher, a global leader in supplying additives has been successfully providing support to the plastics industry by developing and manufacturing high-quality plastics additives.

www.baerlocher.com
Fourteen production sites in Germany, Great Britain, Italy, France, the United States, Malaysia, India, China, Korea, Brazil, Peru and Argentina as well as a sales network covering more than 40 countries make the Baerlocher group of companies a strong partner. This global presence and more than 1200 employees worldwide make sure that we are always close to the customer. Future-oriented, we are continuously investing in research and development. A large number of in-house research scientists and technical experts ensure our considerable creative potential and innovative power. Baerlocher has R+D facilities in Germany (München-Unterschleissheim), France (Marseille), Italy (Lodi) and the United States (Dover, Cincinnati) and India (Dewas).

Environmentally sound production processes as well as the safety and protection of people and environment are key corporate goals. As a globally active group of companies we are aware of our responsibility, regardless of time or place. We are committed to the principles of “Responsible Care”: Our quality management is certified to ISO 9001 and our environmental management system to ISO 14001, encouraging our employees to work together in a responsible way. This policy will not least benefit our customers.
The starting material for all Baerlocher lead products is high purity lead metal.

Baerlocher PVC Additives

- high-performance
- tailor-made
- quality-controlled
- future-orientated
- cost-efficient

Contents

5 Properties and applications
8 Overview
10 Production
12 Special notes
14 Properties
History
“Like tin and iron, lead is among the longest-known metals, and was made mention of already in the Old Testament”, the famous chemist Dr J. Jakob Berzelius, a professor at the Royal Swedish Academy of Sciences, wrote in his chemistry textbook in 1824.
Lead is easy to mine and both pure lead and lead alloys have favourable mechanical properties. In addition, lead can be formed into many different compounds and has therefore always been extensively used across a wide range of applications.
For example, it is a well-known fact that lead compounds are used as pigments, such as minium, white lead and patent yellow or lead chromates in a variety of shades from yellow to fiery red.

Lead and PVC
Lead compounds were among the first materials to be used as Stabilizers to prevent the decomposition of PVC. A Union Carbide patent from 1934 describes the use of lead oxide as a heat stabilizer for vinyl resin enamels. Only compounds derived from bivalent lead are relevant in practice, with basic primary lead stabilizers and lead soaps being the most commonly used PVC Stabilizers.

Applications
Typical applications of lead Stabilizers include recyclable PVC profiles, pipes and cables with a long service life.
**Stabilizer systems**

Primary lead Stabilizers are generally used in conjunction with lead soaps, calcium soaps, lubricants and antioxidants.

**Benefits:**
- Excellent long-term heat stability
- Pigmenting effect of basic primary lead Stabilizers beneficial in light coloured applications
- Low solubility in water, no leaking into the environment
- No odour during processing and in the final product
- No detrimental effects on the Vicat softening temperature of rigid PVC

**Disadvantages:**
- Lead compounds in biologically available form are chronically toxic (as explained in the notes on precautions in handling lead products).
- Discolouration in contact with sulphur-containing compounds (sulphur staining)

**Principle of action**

Basic lead compounds are excellent HCl scavengers and are able to bind substantial amounts of hydrogen chloride during the decomposition of PVC. The resulting lead chloride is very stable, insoluble in water and does not encourage the decomposition of PVC.
Lead Commodities

Baerlocher offers a wide range of lead commodities, allowing customers to create their own formulation or modify existing recipes. The products are available in various modifications already containing lubricants, additional metal soaps, plasticizers or antioxidants besides the respective lead commodity.

Our customers can further choose from a variety of product forms: regular or low-dusting powder as well as low-dusting or non-dusting granules, pellets or flakes.

<table>
<thead>
<tr>
<th>Chemical basis</th>
<th>Product name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tribasic lead sulphate</td>
<td>Baerostab V 220 MC</td>
</tr>
<tr>
<td>Tetrabasic lead sulphate</td>
<td>Baerostab V 420 MC</td>
</tr>
<tr>
<td>Dibasic lead phthalate</td>
<td>Baerostab Pebetal</td>
</tr>
<tr>
<td>Dibasic lead stearate</td>
<td>Baerostab Pb 51 S</td>
</tr>
<tr>
<td>Neutral lead stearate</td>
<td>Baerostab Pb 28 f</td>
</tr>
<tr>
<td>Dibasic lead phosphite</td>
<td>Baerostab Pebefos FP</td>
</tr>
<tr>
<td>Dibasic lead phosphite/sulfite</td>
<td>Baerostab Pebefos</td>
</tr>
</tbody>
</table>
The starting material for all Baerlocher lead products is high-purity lead metal of 99.985 % purity, DIN 1719. The DIN standard defines the composition and maximum allowable content of foreign metals. Lead metal has a density of 11.336 g/cm³ and a melting point of 327.4 °C. It is oxidised by way of the Barton process to produce yellow lead oxide. Lead forms various compounds with oxygen (PbO, Pb₂O₃, PbO₂). Trilead tetroxide (Pb₃O₄), or minium, for example, is commonly used in corrosion-resistant paints. For the production of lead commodities suitable for plastics processing bivalent lead oxide which exists in two modifications is needed:

a) a stable type, red lead oxide, also referred to as massicot, resulting from the oxidation of lead metal at temperatures below 488 °C.

b) a more reactive type, yellow lead oxide, also referred to as litharge, produced by oxidation at temperatures above 488 °C.

The yellow modification transforms to the more stable red type when exposed to moisture. Only the yellow modification can be used for making lead commodities. Therefore the internal production of lead oxide is an important prerequisite for the production of high-quality products.

**Lead commodities are produced by reacting yellow PbO with acids.**

<table>
<thead>
<tr>
<th>PbO</th>
<th>acid</th>
<th>product</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ sulfuric acid</td>
<td>tribasic lead sulphate or tetrabasic lead sulphate</td>
<td></td>
</tr>
<tr>
<td>+ phthalic anhydride</td>
<td>dibasic lead phthalate</td>
<td></td>
</tr>
<tr>
<td>+ stearic acid</td>
<td>dibasic lead stearate or neutral lead stearate</td>
<td></td>
</tr>
<tr>
<td>+ phosphoric acid</td>
<td>dibasic lead phosphite</td>
<td></td>
</tr>
<tr>
<td>+ phosphoric acid sulfuric acid</td>
<td>dibasic lead phosphite/sulphite</td>
<td></td>
</tr>
</tbody>
</table>

The resulting lead commodities are mixed with additives to obtain diverse products or, in the case of low-dusting grades, mixed with other additives and then granulated. Non-dusting product forms are produced by a melt process.
Production scheme for Baerlocher lead products:

- Lead metal
- Oxygen

  - Yellow lead oxide
  - Acids

  - Lead commodities
  - Additives

  - Lead stabilizer one-packs
    - Baeropan
**Precautions when handling lead compounds**

Lead commodities are classified as dangerous to humans and aquatic organisms. The necessary precautions when handling lead products are described in detail in Baerlocher’s safety data sheets and in the relevant statutory rules and regulations.

1. **Safety at work**

   Based on the Council Directive 89/391/EEC (as amended) the European Union und the Member States have issued many regulations and guidance documents to support companies in health and safety at work, when handling dangerous substances i.e. lead compounds. They are containing important information on:

   a) Application areas
   b) Prohibited applications
   c) Concentration limits at the workplace
   d) Protective measures for employees
   e) Operating instructions

   An overview can be found on the website of the European Agency for Safety and Health at work ([osha.europa.eu](http://osha.europa.eu)). Important information on national level can be found e.g.

2. **Storage**

   Lead containing products are affected by the Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances (Seveso II Directive), which recently has been updated by the Seveso III Directive. It has to be implemented in the Member States by 1 June 2015. Specific requirements have to be observed in case the quantities stored or handled exceed certain limits.

   Important information about storage on national level can be found e.g.
   Storage of dangerous substances (United Kingdom) ([http://www.hse.gov.uk/pubns/books/l135.htm](http://www.hse.gov.uk/pubns/books/l135.htm))

3. **Labelling**

   Baerlocher lead commodities must be labeled in accordance with EC Directives 67/548/EWG, 1999/45/EU and Regulation EC 1272/2008 (as amended). In case the materials are re-packed, the new packaging must also be labeled in accordance with the above EC Directives and Regulations.

4. **Water pollution**

   Baerlocher lead commodities are classified as toxic (WGK2) to aquatic organisms. The relevant national regulations regarding the handling of substances toxic to aquatic organisms must be observed.
5. Waste disposal
On European level the revised EU Waste Framework Directive lays down measures to protect the environment and human health by preventing or reducing the adverse impacts of the generation and management of waste. According to Germany's Closed-Loop Recycling Act, all waste must either be recycled or disposed of properly. Residual material and empty packaging have to be disposed of in accordance with the instructions given in our safety data sheets. The correct labelling of waste is described in TRGS 201.

6. Exhaust air
The concentration limit for lead in air emissions is 0.5 mg/m3, according to the German Technical Regulations on Airborne Emissions (TA Luft). You can contact Baerlocher's technical department for advice on dust filter equipment. The relevant national regulations in other countries must be observed.

7. Explosion hazard protection
Baerlocher lead stearates and modifications in powder may form explosive dust concentrations in air and are therefore subject to specific regulations concerning emergency and improving the safety and health of workforce. Regulations regarding explosion hazard protection are contained in the VDI Guidelines 2263 and 3673 and in the VDE standards DIN VDE 0165 and 0170/0171.
Properties of Baerlocher lead commodities

<table>
<thead>
<tr>
<th>Baerostab</th>
<th>V 220 MC</th>
<th>V 420 MC</th>
<th>Pebetal</th>
<th>Pb 51 S</th>
<th>Pb 28 f</th>
<th>Pebefos FP</th>
<th>Pebefos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical basis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total ash (%)</td>
<td>V 039</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HV 039</td>
<td>96.0 – 98.0</td>
<td>97.0 – 99.0</td>
<td>78.5 – 80.5</td>
<td>54.5 – 56.5</td>
<td>28.5 – 30.5</td>
<td>97.9 – 99.9</td>
<td>97.9 – 99.9</td>
</tr>
<tr>
<td>Lead content (%)</td>
<td>HV 042</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HV 042</td>
<td>81.0 – 83.0</td>
<td>82.0 – 84.0</td>
<td>74.0 – 76.0</td>
<td>50.0 – 52.0</td>
<td>27.0 – 29.0</td>
<td>81.0 – 83.0</td>
<td>81.0 – 83.0</td>
</tr>
<tr>
<td>Moisture content</td>
<td>HV 063</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HV 063</td>
<td>max. 0.2</td>
<td>max. 0.2</td>
<td>max. 0.2</td>
<td>max. 0.2</td>
<td>max. 0.2</td>
<td>max. 0.8</td>
<td>max. 0.8</td>
</tr>
<tr>
<td>Sieve residue (%)</td>
<td>HV 021</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HV 021</td>
<td>max. 0.2</td>
<td>max. 0.2</td>
<td>max. 0.2</td>
<td>max. 0.2</td>
<td>0</td>
<td>max. 0.2</td>
<td>max. 0.2</td>
</tr>
<tr>
<td>Tamped density (g/l)</td>
<td>HV 091</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FFA (%)</td>
<td>HV 067</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free fatty acid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HV 067</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>max. 0.1</td>
<td>max. 1.0</td>
</tr>
<tr>
<td>Density (g/cm³)*</td>
<td>DIN 53 193</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIN 53 193</td>
<td>6.6</td>
<td>7.2</td>
<td>4.5</td>
<td>2.0</td>
<td>1.4</td>
<td>7.0</td>
<td>6.1</td>
</tr>
</tbody>
</table>

*The values are given for information purposes only.
we add character to plastics
Disclaimer

Although the information and recommendations contained in this document (hereinafter “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 to which Information refers.

Neither Baerlocher nor any of its employees or agents shall be liable or responsible for any patent or intellectual property rights infringement or for any loss or expenses resulting from any such infringement, or any claims or suits related thereto.

Reach out for the Future: www.baerlocher.com