Flexible Polymers _ Wire & Cable Grades

Lucofin® 7410HFFR and Lucofin® 7440HFFR

LUCOBIT
THERMOPLASTIC POLYOLEFINS

LUCOBIT HFFR Wire & Cable compounds based on ethylene butyl acrylate

_ General

Halogen Free Flame Retardant (HFFR) compounds are a relatively new class of materials substituting more and more PVC compounds in cable applications. This trend follows consumer demands as well as legislative pressure.

HFFR Compounds have the following characteristics:
- Low smoke generation
- Non-corrosive gases
- Very good dielectric properties
- Recyclability

Especially if security of people and protection of values are of concern the use of HFFR compounds is requested. Hospitals, energy stations, chemical and off-shore industry –as shown on the cover page- are just some target markets.

LUCOBIT developed HFFR grades based on ethylene butyl acrylate (EBA) and aluminium tri hydrate (ATH) –Lucofin 7410 HFFR- as well as based on ethylene butyl acrylate (EBA) and Magnesium di hydrate (MDH) –Lucofin 7440HFFR. With these grades LUCOBIT offers technical solutions where standard HFFR grades fail.

The unique structure of the ethylene butyl acrylate (EBA) moiety –as shown in figure 1- is resulting in a variety of technical advantages of EBA/ATH or EBA/MDH compounds as compared to compounds based on other ethylene esters, especially ethylene vinyl acetate.

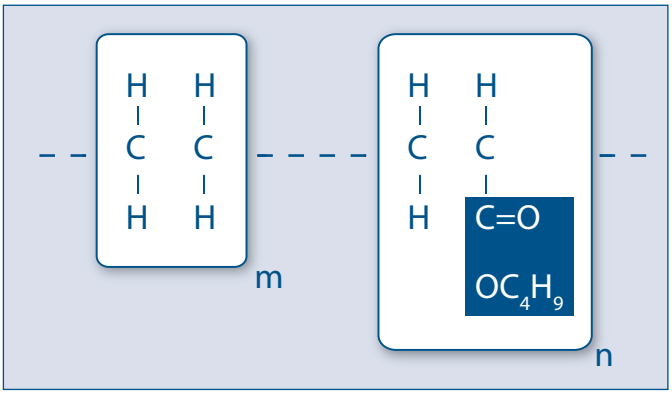


Figure 1: Molecular structure of ethylene butyl acrylate (EBA)

_ Water absorption as well as electrical and mechanical properties before/after water storage

Lucofin 7410HFFR and Lucofin 7440HFFR have a very low water absorption in the range of 0,5 mg/cm², whereas standard HFFR grades based on EVA have a water absorption well above 1,5 mg/cm² as shown in figure 2.

Consequently, the electrical properties, such as volume resistivity –as shown in figure 3- and mechanical properties, such as elongation at break –as shown in figure 4- of Lucofin 7410HFFR and Lucofin 7440HFFR exhibit a much less drop in these properties after water storage as compared to EVA based compounds. This is important for all cables –both jacketing and insulation- which are potentially exposed to moist conditions, such as buried cables, cables on ships and outdoor cables.

Ever since there is a pending demand from cable associations to set the maximum value of water absorption at 1 mg/cm², cable manufacturers are increasing looking for compounds which allow to pass this tough requirement. Lucofin 7410HFFR and Lucofin 7440HFFR do fulfill this requirement.

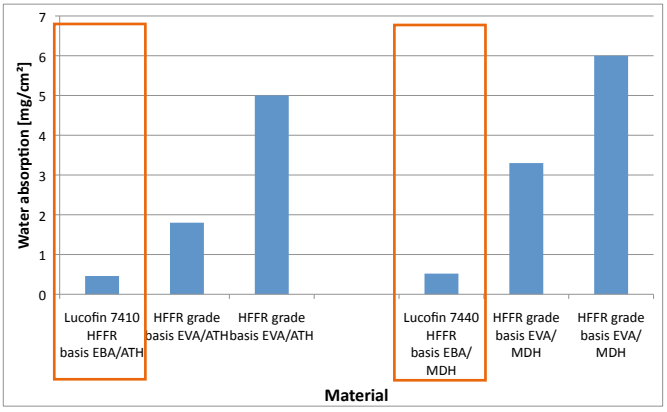
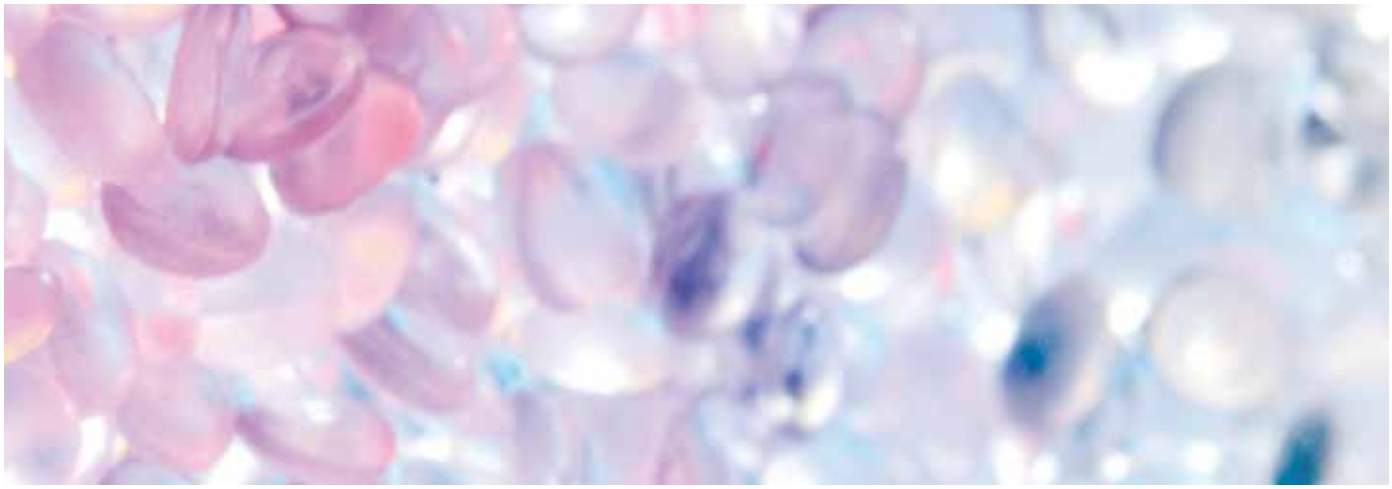


Figure 2: Water absorption of various HFFR grades



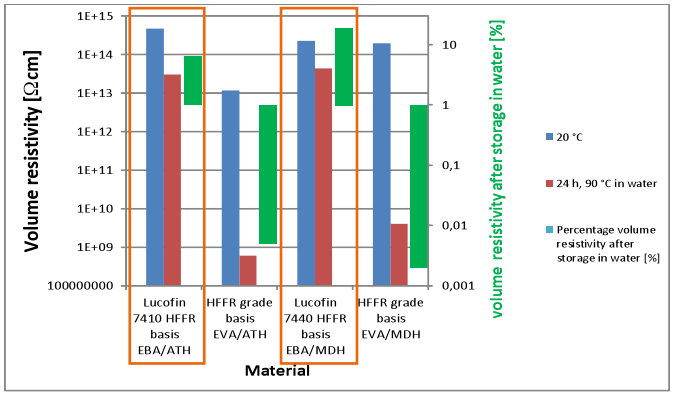


Figure 3: Volume resistivity of some HFFR grades and percentage volume resistivity before/after storage in water

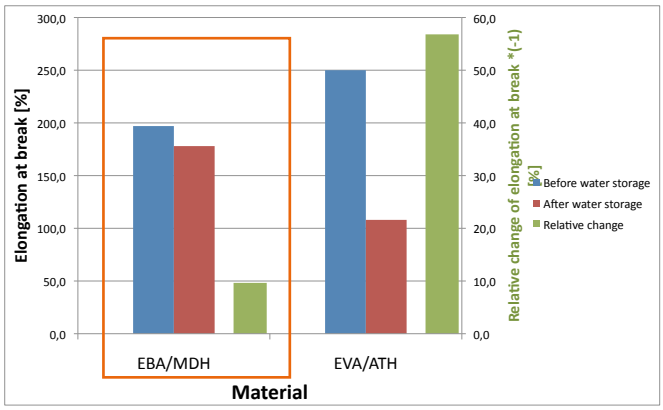


Figure 4: Elongation at break of some HFFR compounds before/after water storage and relative change

_ Low temperatures properties

Butyl acrylate has one of the lowest glass transition temperatures (Tg) of any polar ethylene copolymer. The Tg of butyl acrylate at -56 °C is far below the Tg of vinyl acetate at +28 °C. (figure 5). Therefore, EBA based HFFR compounds -Lucofin 7410HFFR and Lucofin 7440HFFR- maintain their flexibility at lower temperatures as compared to EVA based HFFR compounds (see Dynamical Mechanical analysis in figure 6). This is crucial for all cables in cold areas –either during usage or during installation-, especially in regions with harsh winters or for refrigerated rooms.

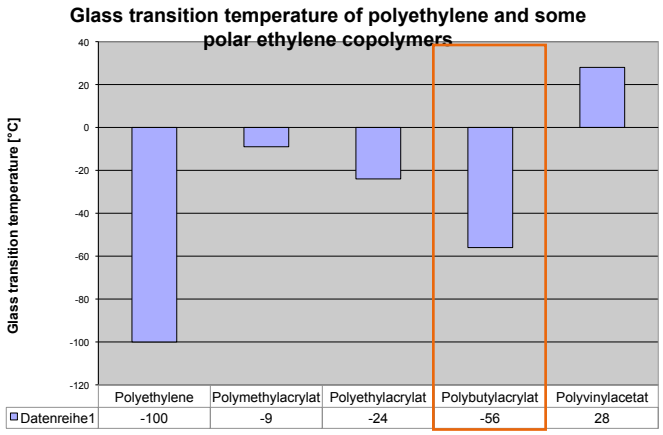


Figure 5: Glass transition temperature of polyethylene and some polar ethylene copolymers

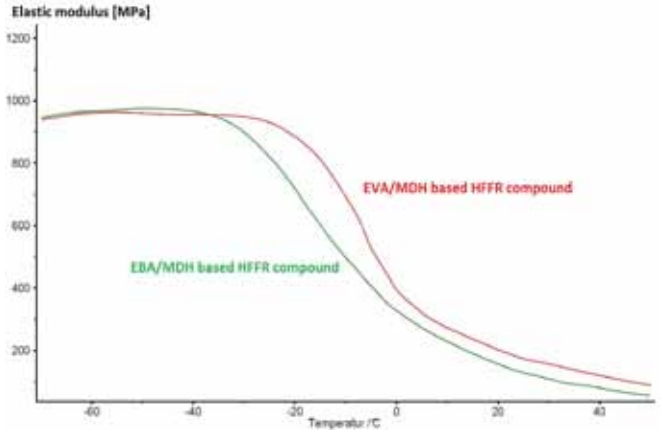


Figure 6: Dynamical Mechanical analysis (DMA) of HFFR compounds based on EVA/MDH and EBA/MDH

Products – that makes you successful.

_ Ageing properties

The thermal properties during end usage of EBA are better than the corresponding properties of EVA. Figure 7 shows, that the vicat softening and the melting point are higher for EBA with 16 % butyl acrylate as compared to EVA with a comparable vinyl acetate content.

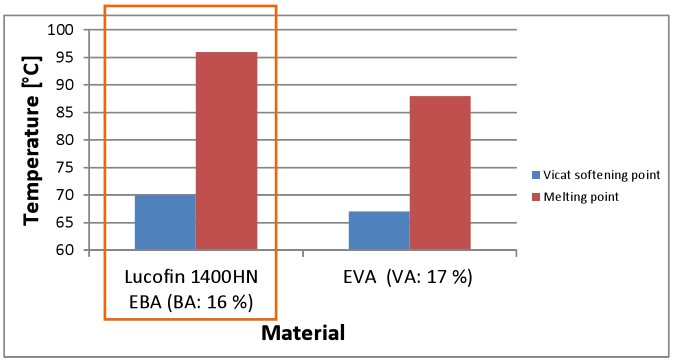


Figure 7: Vicat temperature and melting point of EBA and EVA of comparable comonomer content

Hence, the drop of elongation at break with increasing storage temperature is much less severe for an EBA based HFFR compound in comparison with an EVA based HFFR compound (see figure 8).

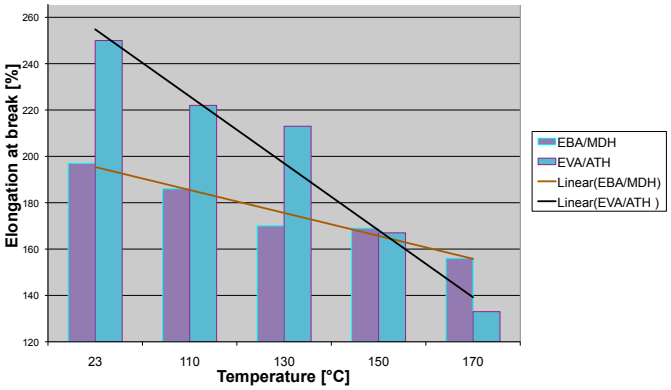


Figure 8: Elongation at break of HFFR compounds based on EBA/MDH and EVA/ATH as a function of storage temperature

_ Production output

EVA cannot be processed at temperatures higher than 210 °C due to a thermal decomposition process yielding corrosive acetic acid which not only may harm the processing equipment but also the final cable. Opposed to that, EBA is stable to be processed up to 280 °C (figure 9). MDH thermally decomposes at temperatures >300 °C, ATH at around 180 °C.

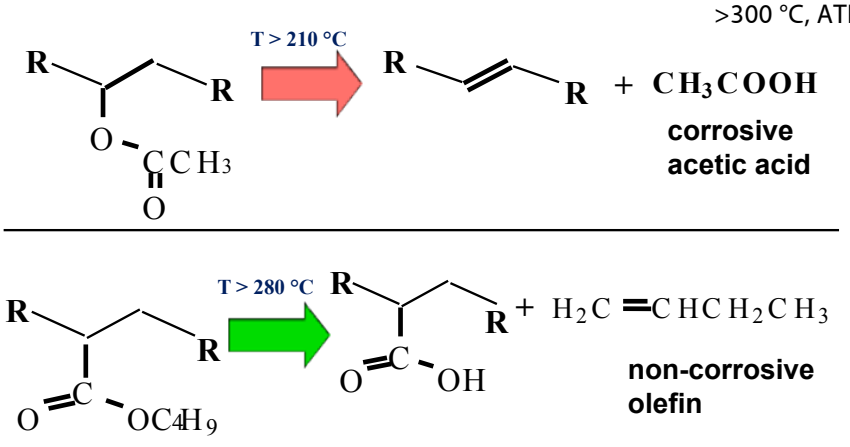
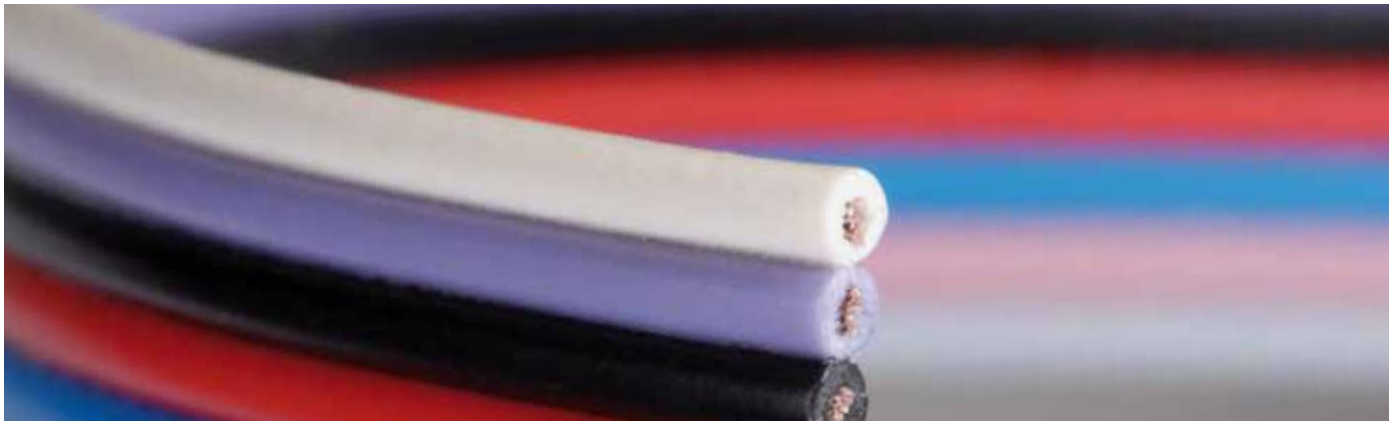


Figure 9: Thermal decomposition of EVA and EBA at different temperatures yielding corrosive and non-corrosive by-products, respectively



As a result, EBA/MDH based compounds –Lucofin 7440 HFFR- can be processed up to +- 220 °C whereas ATH based compounds -7410 Lucofin HFFR and standard EVA/ATH compounds- can be processed only up to 160 °C – 170 °C. Depending on the design of the extrusion line Lucofin 7440 HFFR enables an increase of production output of at least 30 % due to its significantly elevated processing temperature (see figure 10).

This is essential because in many cable designs the highly filled HFFR compounds represent the bottle neck limiting line speed. Lucofin 7440HFFR offers an attractive solution to overcome this issue.

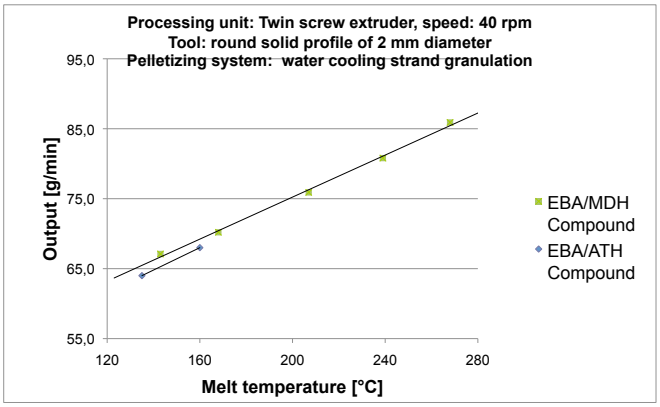


Figure 10: Output of HFFR compounds based on EBA/ATH Compound and EBA/MDH as a function of melt temperature

_ Processing stability

Many HFFR grades based on EVA/ATH are prone to processing instabilities, such as surging, whereas EBA based compounds are very stable in that respect. Figure 11 shows the rheology curve for Lucofin 7410HFFR, Lucofin 7440HFFR and for a standard EVA/ATH compound.

The often observed surging of EVA/ATH compounds -to be seen at ca. 5.00 e2 bar in figure 11- may result in fluctuations of layer thickness during cable production and the eventual need for more material to compensate for these fluctuations. Opposed to that, EBA based compounds -Lucofin 7410HFFR and Lucofin 7440HFFR- can be processed very smoothly and offer the potential for using less material due to only minor fluctuations in cable thickness.

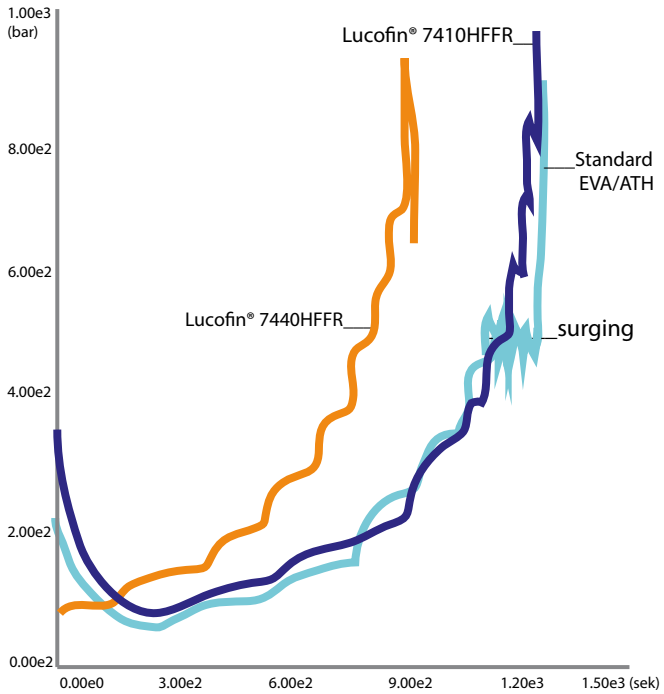


Figure 11: rheology curve for Lucofin 7410HFFR, Lucofin 7440HFFR and for a standard EVA/ATH compound

Summary and conclusion.

In summary, it can be concluded that EBA based Lucofin 7410HFFR and Lucofin 7440HFFR have the following advantages as compared to traditional HFFR grades based on EVA/ATH:

+Very low water absorption and only little drop of electrical and mechanical properties after water storage: suitable for cables in wet areas

+Excellent low temperatures flexibility: suitable for cables in cold areas

+Good ageing properties: suitable for cables in hot areas

+Increased production output for Lucofin 7440HFFR: suitable for high line speed cables

+Superior processing stability avoiding issues like surging during cable extrusion and resulting in very few fluctuations of layer thickness therefore offering the potential for using less material

Solutions in flexible polyolefins.

_ Competence and diversity

LUCOBIT AG develops, produces and sells top quality materials for the plastics processing industry. Our focal area of business is in high-quality speciality plastics based on flexible polyolefins which are used in waterproofing, asphalt and in numerous other segments of flexible polymers. LUCOBIT products are supplied to compounding companies all over the world.

Competence, experience and the specialist knowledge from 40 years of product history are the reasons behind LUCOBIT AG's success as a first class point of reference on the national and international markets. As a flexible and group-independent company, we are present and active in all significant plastics markets around the world – supported by a far-reaching sales networks which offers our customers a direct contact partner wherever they need one. Wherever they can be found, LUCOBIT AG products and services stand for consistently high quality standards, top rate workability and diverse opportunities for use.

_ Thinking and acting

Constant innovation and the willingness to venture into new terrain – this approach is an integral part of the way we think and act. In this way, we not only secure our own future, but also that of our customers. The LUCOBIT materials research is also always using the latest knowledge and methods to further optimize our products. The responsible use of our natural resources is of equal importance to us. Development and production of lasting products and a distinctive environmental awareness are deeply rooted within our company. An ecological approach is top priority for us.

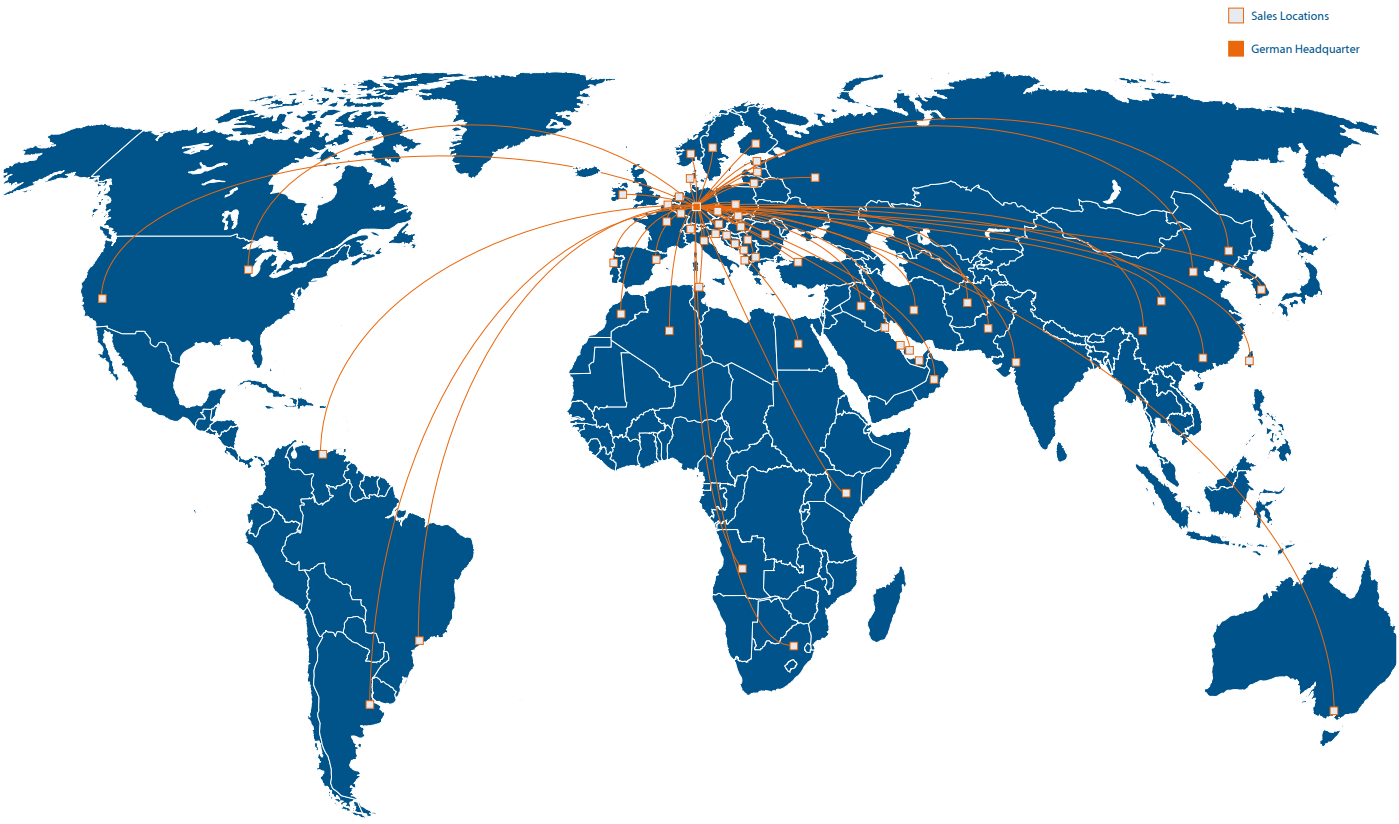
The compliance with international standards is a matter of course. LUCOBIT AG is ISO-certified according to the standards DIN EN 9001 (quality management) and DIN EN 14001 (environment management).

_ Services and solutions

The focal point of our daily work is the task to satisfy our customers and to offer them tailor-made solutions which suit their specific requirements. Customer-oriented service therefore has top priority at LUCOBIT AG. This is reflected in our business processes and organisational structures. Short decision-making processes and reaction times are as much a part of this as binding agreements and the targeted implementation of agreed arrangements. High qualification demands on our employees are a guarantee for the observation of these principles. Our work is characterised by our reliability, readiness for action and flexibility.

Uncompromising quality and first class services are our trademarks. We offer our customers comprehensive consultancy services and support ranging from product development and the calibration of specialty plastics for their specific production facilities to the optimisation of production processes and concepts for transport and logistics. Your task is our challenge. Together with you, we want to use perspectives in markets of the future and help these grow.

Locations.



Note
The information provided in this document is based on our product tests and present technical knowledge. It does not release purchasers from the responsibility of carrying out their receiving inspections. Neither does it imply any binding assurance of suitability of our products for a particular purpose. As LUCOBIT cannot anticipate or control the many different conditions under which this product may be processed and used this information does not relieve processors from their own tests and investigations. Any proprietary rights as well as existing legislation shall be observed.

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