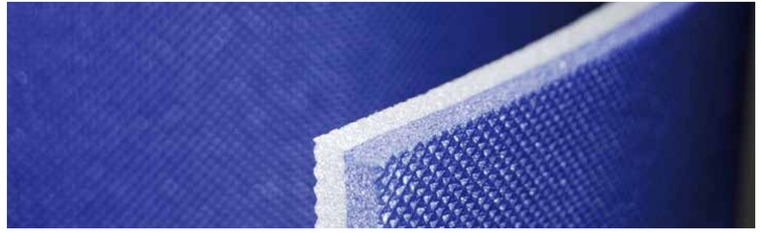
LOW TEMPERATURE PROPERTIES OF POLYETHYLENE FOAMS



LDPE foams are semi-rigid. In order to impart more softness and resiliency to LDPE foams polar copolymers in the range between 10 % - 50 % are often added as part of the formulation. Suitable polar copolymers are poly butyl acrylat, poly methyl acrylat, poly ethyl acrylat and poly vinyl acetat. In order to be fit for use in their specific applications and markets, such as automotive, building and aerospace, excellent low temperature properties are often very important.

Polymers change their properties from rigid to more rubbery at the glass transition temperature. A low glass transition temperature of a polymer is therefore important to retain soft and flexible properties at low temperatures.

Left-hand figure compares the glass transition temperatures of some common polar copolymers. It can be seen that poly butyl acrylat has the lowest glass transition temperature. Consequently ethylen butyl acrylat (EBA) is the copolymer of choice for low temperature applications.

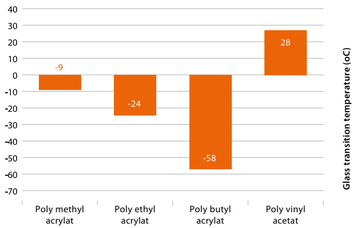
Right-hand figure shows the elastic modulus of ethylen butyl acrylat (EBA) and ethylen vinyl acetat (EVA) as a function of temperature. The increase of modulus being equivalent with loosing flexibility, takes place for EBA at temperatures roughly -20 °C lower compared to EVA.

Therefore, ethylen butyl acrylat (EBA) in blend with LDPE is an excellent starting material to produce soft and resilient foams keeping these properties even at very low temperatures.

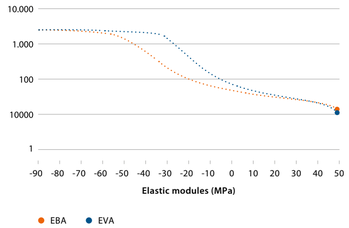
Applications for EBA / LDPE foams include–among many others–pipe insulation, expansion joints, gaskets and camping mats.

All Lucofin® grades as offered by LUCOBIT AG are based on ethylen butyl acrylat (EBA) making them perfectly suited to be used in all polyolefin foams, especially in those foams where superior low temperatures properties are a must.

Glass transition temperature of various polar copolymers

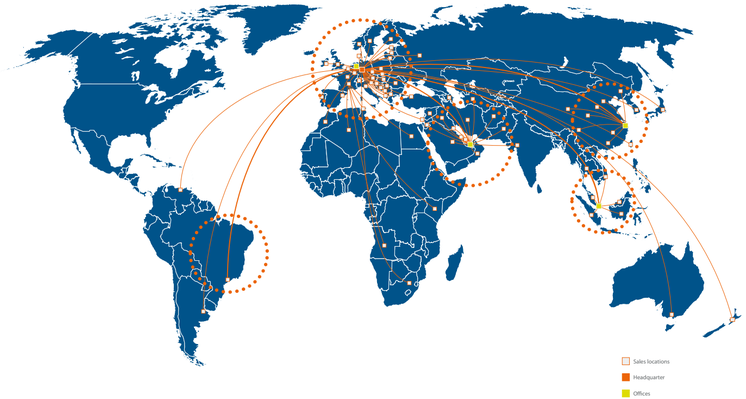


EBA / EVA Dynamical Mechanical Analysis



LUCOBIT
THERMOPLASTIC POLYOLEFINS

LOCATIONS



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LUCOBIT
THERMOPLASTIC POLYOLEFINS

FLEXIBLE POLYMERS

FOAM

... we make better polymers

LUCOBIT RESINS AND THEIR USE IN IN FOAM APPLICATIONS

GENERAL

Polyolefin foams are a relatively recent development in comparison with other foams such as polyurethane and poly-styrene. The main processes were introduced in the 1960s, with significant commercial operation production beginning in the 1970s.

Polyolefins are tough, flexible and resistant to chemicals. Foams made from polyolefins inherit these properties. Most polyolefin foams have a closed-cell structure which makes the foams suitable for applications where buoyancy is important as well as providing resiliency for packing applications. In addition, polyolefin foams are used in building and construction, automobiles, insulation, sports and leisure, and agriculture.
Polyolefins used in foaming applications include polyethylene, polypropylene and copolymers, such as ethylene butyl acrylate.

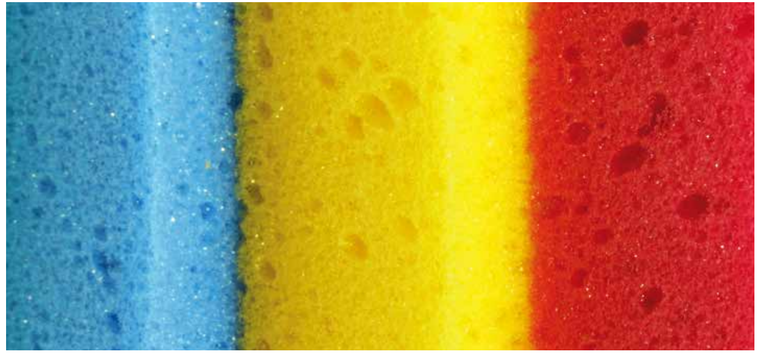
Manufacturing technologies for polyolefin foams are classified depending on type of blowing agent, degree of crosslinking and type of equipment.

The following table shows the LUCOBIT products and their main properties fit for use in foam applications:

SOUND PROTECTION (ALSO AU) • INSULATION TUBES (TPO + EPDM BASED) • CONSTRUCTION FOAMS • FLEXIBLE FOAMS (E.G. SPORT MATS)

PRODUCT	MATERIAL	COLOR	SHORE A	MFR[1] 190°C / 2.16 KG
Lucofin® 1400HN	EBA (16 % BA)	natural	90	1.4
Lucofin® 1400MN	EBA (17 % BA)	natural	88	7
Lucofin® 1494M	MAh grafted EBA (17 % BA)	natural	92	5
Lucopren® EP 1500H-90[2]	PP | EPM	natural	30[3]	0.6
Lucopren® EP 1500M-90[2]	PP | EPM	natural	30[3]	8

[1] average [2] MFR 230 °C / 2.16 kg [3] SHORE D

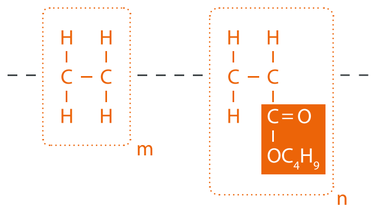


LUCOBIT PRODUCTS

Foams, foams, foams: crosslinked or non-crosslinked, extruded or moulded, physically blown or chemically blown, batch or continous process. LUCOBIT products are good for any foam providing:

- Low compression set
- Exceptional cushioning characteristics
- Means of controlling cell size
- Excellent low temperature behaviour

The majority of LUCOBIT products is based on ethylene butyl acrylate copolymer (EBA). The repeat unit of EBA copolymers is shown in the figure. This structure explains many of its unique properties as explained on the next page.



CASE STUDY

CUSTOMER

Major producer of crosslinked polyethylene foam.

PREVIOUS SITUATION

LDPE and EVA based foam.

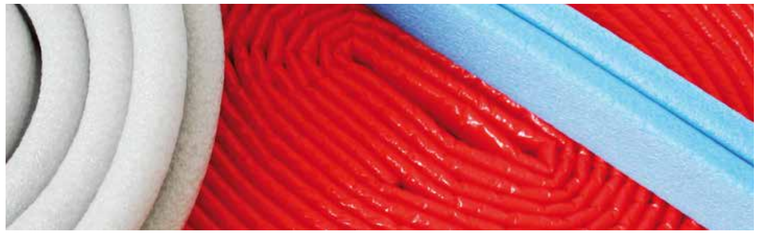
SOLUTON NOW

LDPE and Lucofin® 1400HN.

BENEFITS TO THE CUSTOMER

- Cushioning comfort improved by 10 % due to more effective energy absorption
- Cell size reduction combined with improved thermal insulation
- Reduction of compression creep by 5 % resulting in better long term properties

PRODUCTS – THAT MAKE YOU SUCCESSFUL



ADVANTAGES OF LUCOBIT PRODUCTS COMPARED TO PLASTOMERS AND EVA

The stream of truth flows through its channels of mistakes. The speciality plastics based on flexible polyolefins which are marketed and sold by LUCOBIT AG under the trade name Lucofin® types are doubtless products that you have long known to be quality materials. Particularly with a view to our grafted and non-grafted EBA grades, our distribution partners repeatedly tell us that there is a certain information gap as far as cost-effectiveness is concerned. What may at first glance appear to be more expensive compared with other polymer systems does in fact almost always, on closer inspection, prove to be the cheapest solution overall and in the long term.

It is essential here not to interpret the performance of a product solely in terms of the price per unit of quantity. You only obtain an objective result if you examine all technical aspects. In terms of our EBA grades competing on both a commercial and technical basis with EVA, plastomers, but also EBA products from other manufacturers, the Lucofin® materials are proving time and time again to be the optimum solution for an increasingly large number of our customers' end applications.

A sustainable assessment must take account not just of the simple formula of „dosage x price" but also the value attached to the technical advantages afforded from the use of Lucofin® EBA. The following table illustrates the key properties and the resulting advantages of Lucofin® 1400HN and 1400MN. If all of these factors impacting on cost effectiveness are assessed in an objective and unbiased way, it is ultimately apparent that Lucofin® EBA materials usually constitute the better solution.