Lightweight, Insulating Building Materials

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Inner-leaf Walls
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Lecaterm® blocks
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Foundations
LECA® consists of small, strong, lightweight and thermally insulating particles of burnt clay. LECA is manufactured worldwide, from natural materials. LECA products may therefore vary individually from country to country, but the manufacturing methods and the benefits are the same everywhere.
An environment-friendly, natural product made from plastic clay, LECA is indestructible, frost-resistant, non-combustible and impervious to dry-rot, wet-rot and insect attack.

LECA is an extremely lightweight, strong and thermally insulating material. These are valuable properties when establishing solid-based floors, applying structural fill, growing plants, and insulating basements, terraces and roofs. The size of the LECA particles determines which property is predominant and how the product is utilised in practice. LECA is therefore available in different sizes for different purposes.

Danish LECA and LECA·light are also available in coated form for solid-based floors. The coating, which is wholly non-toxic, imparts water-repelling properties and ensures that moisture absorption from the soil does not extend beyond the base layer of LECA or LECA·light.

LECA is the prime constituent in many building materials, including industrially-made wall blocks and structural components. LECA can also usefully be employed in structural concrete and lightweight mortar.

**LECA coated and LECA·light coated are Danish special product which combines thermal-insulation properties with non-capillary characteristics.**

1. LECA can be blown direct to the point of application through flexible hoses. The capacity is typically more than 1 m³ of LECA per minute.

2. LECA can be delivered in bulk by lorries carrying up to 103 m³ at a time.

3. LECA is also supplied in big-bags and 100 litre and 50 litre sacks.
Blocks

Danish LECA blocks provide effective protection against thermal bridge and are suitable for foundations, floors and walls. The blocks are easy to work with and provide excellent key for subsequent render or mortar application.

LECA is used for making solid blocks of lightweight concrete, hollow blocks and Lecaterm blocks.

LECA solid blocks are suitable for inner-leaf walls, foundations, basement walls, partitions and outer walls. Specially-made LECA floor blocks for solid-based floors are also available.

Special feature blocks like the hollow block and the grooved block are used for specific applications. The hollow block is especially useful as top of foundation under cavity walls.

The grooved block gives the possibility to make reinforced basement walls. Lecaterm blocks are made of LECA lightweight concrete and foam plastic. Lecaterm is a complete building system consisting of straight blocks and corner blocks. Lecaterm blocks are used for outer walls and foundations.

Elements

LECA lightweight aggregate concrete is used for wall panels and for floor and roof slabs.

LECA wall panels and floor slabs form parts of a building system. The elements are specially fabricated for the individual project and are therefore compatible with almost any construction method. The wall panels are available in densities of 900-1800 kg/m³, according to requirements for strength, sound insulation and surface. LECA floor and roof slabs are available as thermally insulating sandwich elements or sound-insulating, solid floor slabs.
Solid-based Floors
Danish LECA is exceptionally well suited for solid-based floors.
LECA has thermally insulating, water-repelling and non-capillary properties and provides simple, lightweight floor constructions at competitive prices.

Coated LECA
LECA coated and LECA light coated can be deposited in bulk and used for solid-based floors. There is no wastage as the nodules adapt themselves completely along foundations and around drains.

LECA Floor Blocks
Solid-based floors can be constructed entirely of LECA floor blocks. The blocks have thermally insulating and non-capillary properties and can be surface-strengthened with a grout wash of cement or sand. The blocks are then ready for the next stage of the floor construction.

LECA Lightweight Concrete
LECA lightweight concrete 1:8 can be used for filling purposes and in areas where form stability is also essential.

Slope Construction on Roofs
LECA makes it easy to construct slopes on flat roofs and carry out roof insulation at the same time.

General Procedure
Deposit the LECA and level to the required gradient.
Apply welded LECA netting to stabilise the surface.
Roll the surface and lay sheets of mineral wool for added insulation.
Finish by installing underpaper and roofing.

LECA can also be used to fill cavities in an existing roof surface prior to renovation. This avoids soft areas in the new roof.

Form-stable Finish
In areas of the roof destined for later structural penetration the LECA can be mixed with cement and water.
Light Fill

LECA can be used as lightweight fill in cases where there is a need to ensure stability, prevent settlement and compensate for heavy loads.

Stability
LECA light fill provides increased stability for embankments built on clay inclines, for sheet-pile harbour walls and for coastal road construction. LECA can be used to prevent land slides or piling failure at noise-abatement ramparts along roads or buildings with pile footings.

Settlement Prevention
LECA light fill can prevent the settlement which may occur when roads and embankments built on soft ground are subject to increased loading. Houses which normally require pile footings can be erected on a cushion of LECA light fill.

Load Compensation
Roads, buildings and open spaces constructed on compressible deposits or sloping ground can be consolidated with LECA light fill.

Roof Gardens

LECA is ideal for drainage purposes and slope construction in roof gardens.

Bulk LECA can be used in roof gardens for drainage purposes and for constructing and eliminating slopes. With its combination of effective drainage and low density, LECA is the perfect material for creating roof gardens on existing buildings. Spread a bed of LECA on top of the roof membrane and any insulation, then cover the nodules with a fibre cloth to serve as a base for the garden proper. The garden can be constructed using gravel and paving or soil/Lecamix for plants.
Outer Walls, Inner-leaf Walls and Partitions

LECA blocks enable fast, easy building.
LECA blocks provide strong, robust walls and ensure a healthy indoor climate.

Lightweight concrete blocks of LECA are used for construction of outer walls, inner-leaf walls and partitions.
LECA blocks are inorganic and impervious to dry-rot, wet-rot and insect attack.
They are also frost-resistant even under extreme temperature conditions. In addition, they have excellent thermal-retention properties, which contributes to a pleasant indoor climate.

Shaping
The blocks are simple to shape using a carbide-toothed cutting saw, small jobs being carried out with a masonry hammer or axe.
Division of the blocks is easiest to perform using a standard block cutter. Chasing and drilling operations in the finished LECA wall are readily accomplished with a concrete power tool.

Surface Treatment
LECA is eminently suitable for rendering and plastering by both manual and mechanical means.

Dimensions
For inner-leaf walls and partitions Danish LECA blocks are manufactured in 100 mm, 150 mm and 190 mm thicknesses.
The 100 mm and 150 mm sizes are normally used for cavity walls and curtain walls. The length and height dimensions of LECA blocks are 490 mm x 190 mm.

Strength
Danish LECA blocks are supplied in block class 3.0 MPa with a density of 600 kg/m³.

Beams
Wall beams are made of LECA concrete with a density of 1400 kg/m³. Wall beams are manufactured in the same width and height dimensions as LECA blocks and in lengths up to 3.49 m.

Bricks
For masonry infill, partitions and repairs use LECA class 4 bricks which have a density of 700 kg/m³.
LECA® Blocks

Lecaterm® Blocks

Each Lecaterm block is a section of fully-insulated outer wall

Lecaterm blocks are part of a complete building system which includes thermal insulation strips, joint reinforcement and stainless-steel wall ties. The finished Lecaterm blocks are produced in three versions. The length is 490 mm and the height is 190 mm. The width is 330 mm, 350 mm and 390 mm respectively.

Basement Walls

LECA provides warm, dry basements. As well as a substantial weight-saving compared with conventionally-cast basement walls

By virtue of their high strength, excellent thermal-insulation properties, frost resistance and minimal moisture absorption, LECA blocks are the ideal solution for basement outer walls. A special grooved LECA block provides possibility to place reinforcement in the bed joints. Below ground level, basement walls built of LECA blocks must be grounded, asphalted and coated with cement mortar. Basement walls must always be equipped with perimeter drains. Wall drainage can be established with 50 mm or 75 mm LECA drainage blocks or using bulk LECA.

Foundations

Danish LECA blocks provide effective termination of cold conduction in foundations

Capping the head of outer-wall foundations with two rows of LECA blocks, provides effective floor protection at the cold-critical point adjacent to the concrete slab. LECA blocks can also be used to cap internal foundations, thus terminating the moisture and cold conduction which otherwise originates from the foundation concrete.

Standard-size LECA bricks (100 x 55 x 230 mm) can be used for transition purposes at foundations.

For foundations subjected to heavy loads, LECA class 5.0 MPa high-strength blocks can be used. For foundation subject to 1½-store houses LECA class 2.0 MPa lightweight blocks can be used.

Where extra foundation insulation is required, use Lecaterm-blocks. For application below cavity walls, use LECA hollow blocks. These are available in widths of 290 mm and 330 mm.
LECA Floor Slabs

Effective sound insulation between apartments.
Self-supporting up to 6.4 m. Simple site erection

LECA Sandwich Elements
LECA sandwich elements are composed of alternate layers of LECA high-strength concrete and LECA thermally insulating, lightweight concrete. Openings may be constructed to half the width of the element without compromising the load-bearing capacity. Where necessary, for example around openings and near abutments, the elements should be grouted solid with LECA concrete.

LECA Sound Insulation Slabs
LECA sound insulation slabs are self-supporting, homogeneous elements made of LECA concrete and loadbearing reinforcement. They are especially intended for floors in apartment blocks.

LECA Acoustic Roof Slabs
LECA acoustic roof slabs may be sandwich elements or sound insulation slabs provided with a 20 mm layer of LECA acoustic concrete on the underside. The acoustic concrete creates a rustic, fabric-like ceiling.

LECA Wall Panels

A building system for shell constructions in which the individual components are specially fabricated to order. Compatible with almost any construction method

LECA wall panels can be used for inner-leaf walls, panel walls, partition walls, sound insulation and basement walls. The panels are made in lengths up to 6 m, thicknesses of 10-24 cm, and storey heights up to 2.70 m, as standard.

The panels, which incorporate shrinkage reinforcement, are supplied to order in densities from 900-1800kg/m³.

Pre-installed Components
LECA wall panels can be delivered pre-installed with electrical boxes, conduits and polystyrene blocks, which greatly facilitates on-site assembly. Large-size installation openings can also be provided at the factory, smaller pipeways being easily constructed on site.
Cleaning filter
Inexpensive, environment-friendly treatment of household sewage in areas not connected to sewer systems

A bed of LECA can be used as a cleaning filter in conjunction with both new and existing sewage installations. Outflows from kitchen, bath and WC are passed to a septic tank from which the sewage flows to the cleaning filter.

A cleaning filter is highly effective; controlled experiments have quantified the expected breakdown of sewage wastes as

- $\text{Bi}_5$ = 90%
- Suspended materials = 70%
- Ammonia/ammonium = 45%
- Total nitrogen = 30%
- Total phosphorous = 30%

where $\text{Bi}_5$ = biological oxygen consumption over a five-day period, i.e. the amount of oxygen used by the microorganisms to break down the organic substances in the course of five days.

In the experiments the pH-value of the filtered sewage averaged a constant 7.8.

Floating Layer in Liquid Manure Storage Tanks
Eliminates odour problems quickly, simply and effectively.
Risk of frost damage is also reduced

Blowing from a road tanker with blowing device, it takes one hour to cover the contents of a liquid manure storage tank with a layer of LECA 7-10 cm thick - and to put an effective stop to odour problems. And if a few grains are eventually discharged from the tank along with the contents, all well and good - LECA has soil-improving properties.

Lightweight Mortar
Special-produced mortar for construction and rendering of masonry

The U-value of complete masonry structures built with LECA lightweight mortar is superior to that provided by conventional mortar. LECA lightweight mortar also weighs less than conventional mortar, which has benefits for transportation and application. LECA lightweight mortar can be manufactured locally, which means that compressive strength, density and insulation value can be adjusted to the requirements of the individual factories. Dansk Leca A/S supplies LECA direct from dry storage for production of lightweight mortar.
Lecamix®

More vigorous plant growth.
Longer-lived plants for the customer.
Protection against root formation due to overwatering.
Improved structural stability and air change in planting soil

Lecamix is a mixture of LECA and peat moss which improves growth conditions for plants by creating a lighter, more porous soil structure. Lecamix is easy to produce and normally consists of 25% LECA and 75% peat moss. The peat moss used need not be of any one specific type.

Trials have shown that adding more than 25% LECA does not enhance results further, and that the best LECA size is 2-4 mm.

Lecamix is marketed ready-mixed under the name ‘Lecamuld’.

Hydroculture

Excellent plant growth combined with effective hygiene protection

Plants are efficient air purifiers and create a healthy environment. LECA is useful in hydrocultural applications where minimum attention and maximum hygiene protection are priority requirements. LECA is chemically neutral and ensures air penetration to plant roots. At the same time, fungal spores, bacteria and insect pests are avoided.

Structural Concrete

The aggregate used in concrete structures can often be substituted by LECA. This is a cost-effective solution which enables the overall weight of the construction to be reduced

LECA structural concrete is particularly useful where it is required to minimise the weight of the overall construction. Lightweight structural concrete is required under European standards to have a density of less than 2000 kg/m³.

Using Danish LECA as the aggregate, structural concrete can be fabricated in strengths of up to 45 MPa. Depending on the strength the density can be varied between 1200 and 2000 kg/m³.

The reinforcement must have the stipulated cover layer. However, this layer must not be thinner than the largest particle size of the LECA plus 5 mm.

Bulk density and particle density are specified dry in accordance with DIN 4226 and based on 90% confidence level. The crushing strength is also specified according to DIN 4226, based on minimum values. The size distribution conforms to Danish Standard DS 405.9. The product acidity is checked regularly and is always neutral or slightly alkaline.

<table>
<thead>
<tr>
<th>Product</th>
<th>Grade mm</th>
<th>Dry bulk density Kg/m³</th>
<th>Dry particle density Kg/m³</th>
<th>Crushing strength MN/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>LECA</td>
<td>0-0.5</td>
<td>600</td>
<td>1150*</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>0.5-2.5</td>
<td>330</td>
<td>630*</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>2-4</td>
<td>275</td>
<td>520</td>
<td>1.16*</td>
</tr>
<tr>
<td></td>
<td>4-10</td>
<td>255</td>
<td>470</td>
<td>1.12</td>
</tr>
<tr>
<td></td>
<td>10-20</td>
<td>215</td>
<td>400</td>
<td>0.78</td>
</tr>
<tr>
<td>LECA·light</td>
<td>4-8</td>
<td>215</td>
<td>400</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>8-22</td>
<td>170</td>
<td>310</td>
<td>0.40</td>
</tr>
</tbody>
</table>

* The values are estimated values.

The values stated are typical values within the declaration limits.

<table>
<thead>
<tr>
<th>LECA grade, mm</th>
<th>LECA</th>
<th>LECA·light</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-0.5</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>0.5-2.5</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>2-4</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>4-10</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>10-20</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>4-8</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>8-22</td>
<td>0.02</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Content of sulphate and chloride conforms to EN 1744-1.
The declared values are expressed in percentage and based on maximum values.

LECA is made of greasy, plastic clay of the montmorillonitic/illitic type. The calcium and magnesium content (in the form of oxides) should be less than 6%.

A high iron content in the form of Fe₂O₃ is desirable.

The expansion of LECA is due to gases generated by oxidation of the organic material contained in the clay, and occurs when the surface of the particles has attained sufficient strength to prevent the gases from escaping from within.
## Product Data

### Size Distribution Curves

The size distribution curves below are constructed in accordance with Danish Standard DS 405.9. The amount passing the mesh is expressed as percentage by weight.

The curves are upper limit, lower limit and typical values.

#### Bulk LECA, 0-0.5 mm

![Size Distribution Curve](image1)

#### Bulk LECA, 0.5-2.5 mm

![Size Distribution Curve](image2)

#### Bulk LECA, 2-4 mm

![Size Distribution Curve](image3)

#### Bulk LECA, 4-10 mm

![Size Distribution Curve](image4)

#### Bulk LECA, 10-20 mm

![Size Distribution Curve](image5)

#### Bulk LECA-light, 4-8 mm

![Size Distribution Curve](image6)

#### Bulk LECA-light, 8-22 mm

![Size Distribution Curve](image7)

### Surface Area

The internal surface area of LECA is readily calculated by the Technical University in Denmark, Department of Buildings and Energy. The external surface area of LECA is calculated based on the typical mean values of the size distribution curves, the typical mean density and the percentage of voids at 45%. All particles are taken to be smooth surfaced spheres. The surface area is expressed in square meters of surface per cubic metre of LECA. Grains smaller than 0.25 mm are not included in the calculation.

### Grade, mm

<table>
<thead>
<tr>
<th>Grade, mm</th>
<th>Typical surface area, m²/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>External</td>
</tr>
<tr>
<td>LECA</td>
<td></td>
</tr>
<tr>
<td>0.5-2.5</td>
<td>2200*</td>
</tr>
<tr>
<td>2-4</td>
<td>1000*</td>
</tr>
<tr>
<td>4-10</td>
<td>550</td>
</tr>
<tr>
<td>10-20</td>
<td>300</td>
</tr>
<tr>
<td>LECA-light</td>
<td></td>
</tr>
<tr>
<td>4-8</td>
<td>600</td>
</tr>
<tr>
<td>8-22</td>
<td>300</td>
</tr>
</tbody>
</table>

* The values are estimated values.
Thermal Conductivity

The thermal conductivity, $\lambda_{10}$, is frequently controlled by Danish Technological Institute according to EN 822, EN 823, EN 12667 and ISO 8302. The declared thermal conductivity, $\lambda_{\text{declared}}$, is calculated on basis of $\lambda_{10}$ according to prEN14063-1:2001. The design thermal conductivity $\lambda$ is calculated on the basis of national temperature and humidity conditions. The Danish safety factor for constructions on ground is 1.2.

<table>
<thead>
<tr>
<th>Grade, mm</th>
<th>Declared thermal conductivity $\lambda_{\text{declared}}$, W/m K</th>
<th>Design thermal conductivity $\lambda$, W/m K</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dry construction</td>
<td>Construction on ground</td>
</tr>
<tr>
<td>LECA, 2-4, 4-10, 10-20</td>
<td>0.085</td>
<td>0.085</td>
</tr>
<tr>
<td>LECA-light, 4-8, 8-22</td>
<td>0.076</td>
<td>0.076</td>
</tr>
</tbody>
</table>

Angle of Internal Friction and Modulus of Elasticity

The Danish Geotechnical Institute has performed triaxial experiments to measure the angle of internal friction and determine modulus of elasticity for LECA. The results for LECA in road constructions, 10% compacted, is given at a stress level at 20 kN/m². For floor constructions the angle of internal friction and modulus of elasticity for LECA is determined by Danish Technological Institute. For normal ground floor constructions the stress level, 8% compacted, was 40-275 kN/m². Heavily loaded industrial floors are normally calculated with a modulus of elasticity at 6 MPa.

<table>
<thead>
<tr>
<th></th>
<th>Modulus of elasticity MPa</th>
<th>Angle of internal friction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road constructions</td>
<td>20</td>
<td>&gt;40</td>
</tr>
<tr>
<td>Floor constructions</td>
<td>11-7</td>
<td>-</td>
</tr>
<tr>
<td>Industrial floors</td>
<td>6</td>
<td>-</td>
</tr>
</tbody>
</table>

Density in Conjunction with Ground Water Level

LECA can, during long time under Ground Water Level, obtain max. 85% water content in the voids. LECA density, over the surrounding surface and over Ground Water Level, can be calculated as 45% water content in the voids. LECA density, under the surrounding surface and over Ground Water Level, can be calculated as 30% water content in the voids. LECA density, under the surrounding surface and over Ground Water Level, can be calculated as 30% water content in the voids.

<table>
<thead>
<tr>
<th></th>
<th>LECA</th>
<th>LECA-light</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-20 mm</td>
<td>400</td>
<td>470</td>
</tr>
<tr>
<td>4-10 mm</td>
<td>215</td>
<td>255</td>
</tr>
<tr>
<td>8-22 mm</td>
<td>310</td>
<td>345</td>
</tr>
<tr>
<td>4-8 mm</td>
<td>400</td>
<td>385</td>
</tr>
<tr>
<td>Dry loose density</td>
<td>215</td>
<td>255</td>
</tr>
<tr>
<td>235</td>
<td>170</td>
<td>185</td>
</tr>
<tr>
<td>280</td>
<td>345</td>
<td>345</td>
</tr>
<tr>
<td>425</td>
<td>385</td>
<td>385</td>
</tr>
<tr>
<td>Over G.W.L. 30%</td>
<td>385</td>
<td>425</td>
</tr>
<tr>
<td>Over G.W.L. 45%</td>
<td>460</td>
<td>500</td>
</tr>
<tr>
<td>Over G.W.L. 85%</td>
<td>1070</td>
<td>1100</td>
</tr>
</tbody>
</table>

* 10% compacted
Product Data

Non-capillary Properties
LECA coated are a special-purpose product intended solely for use as non-capillary layers. The product has been tested by the Technical University of Denmark (Building Materials and Thermal Insulation Laboratories) and the Danish Technological Institute (Institute of Building Technology).

Reports from both bodies verify the effectiveness of LECA coated as a non-capillary material.

Moisture content, % weight

<table>
<thead>
<tr>
<th>Test setup</th>
<th>Test results</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base layer, 0-2 cm (in contact with water)</td>
<td>25.0</td>
<td>25.0</td>
<td>25.0</td>
<td></td>
</tr>
<tr>
<td>Upper layer, 3-20 cm</td>
<td>0.2</td>
<td>0.1</td>
<td>0.1</td>
<td></td>
</tr>
</tbody>
</table>

Water absorption stabilised after 14 days.

Only the base layer, approx. 2 cm, which was in contact with the water, had a high moisture content.

Water released or absorbed from the ambient air until equilibrium is attained.

Sorption
Like all other building materials, LECA will release or absorb water until a situation of equilibrium is attained with the moisture content of the ambient air. This can be illustrated by means of sorption curves. Sorption isotherms for LECA, at 23 °C, have been determined by the Building Materials Laboratory of the Technical University of Denmark. Sorption isotherms have been determined for three dry densities of LECA.

Air Permeability
The air permeability of a material is an expression for how easily air can pass through it solely by means of difference in pressure. The greater the permeability, the easier the air penetrates the material.

The air permeability of bulk LECA and LECA blocks has been measured at the Danish Technological Institute in accordance with Nordtest method NT BUILD 360. The results of the analysis are shown here as the specific permeability of the materials expressed as a function of the air velocity.
LECA is a Danish product and stands for Light Expanded Clay Aggregate. The principle for LECA production was developed by the company Lemvigh-Müller & Munck A/S Copenhagen, Denmark, in 1939. In Denmark, LECA is manufactured by Dansk Leca A/S at Hinge near Randers.

LECA consists of small, lightweight, bloated particles of burnt clay. The thousands of small, air-filled cavities give LECA its strength and thermal-insulation properties. The base material is plastic clay which is extensively pretreated and then heated and expanded in a rotary kiln. Finally, the product is burned at 1100 °C to form the finished LECA product.

Entirely Natural Product
LECA is an environment-friendly, entirely natural product incorporating the same benefits as tile in brick form: LECA is indestructible, non-combustible, and impervious to attack by dry-rot, wet-rot and insects.

Natural Building Material
LECA is a natural material and a LECA building is a healthy building, so it is no coincidence that LECA has been used in competition projects for allergy-friendly, healthy homes. Used as a thermal-insulation material in houses, LECA has been saving energy for more than 50 years, and is now a standard component in low-energy development projects in Denmark.


Leca International is an organisation of LECA manufacturers committed to LECA research and to expansion of the LECA concept.

Rights
All rights to the manufacture of LECA and to the use of the Leca trademark are owned by Leca Trading & Concession A/S, Copenhagen, Denmark.

LECA is manufactured according to identical principles in Algeria, Argentina, Austria, Belgium, China, Denmark, Egypt, Finland, Germany, Iran, Italy, Norway, Portugal, Sweden, Switzerland and UK.

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