

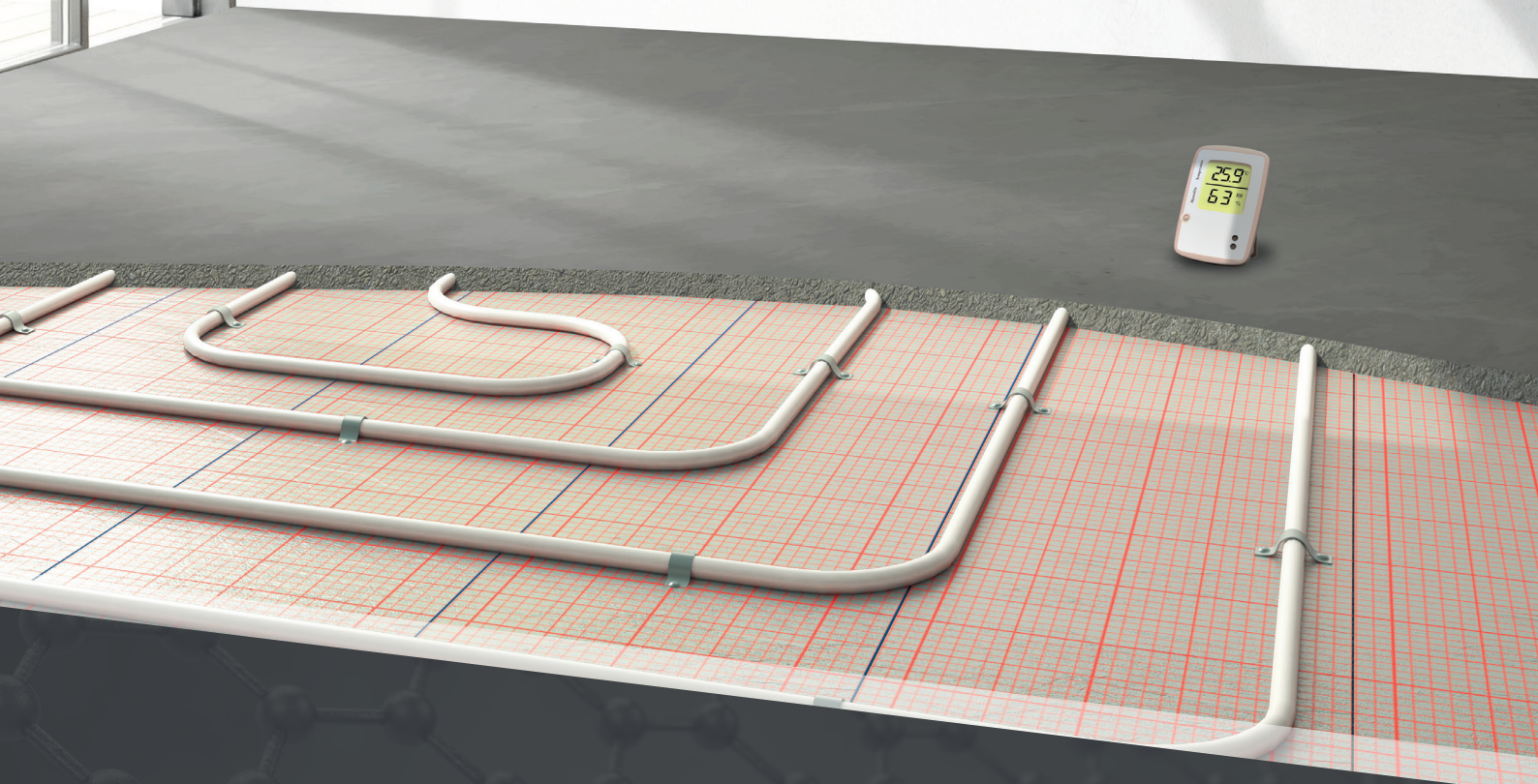


Graphenano
SMART MATERIALS



FloorGraphene

Smart**ADDITIVES**
GRAPHENE CONCRETE



www.graphenanosmartmaterials.com



Graphenano Smart Materials is a global pioneer in the manufacture of graphene-based additive technology for advanced high-performance and environmentally friendly construction materials.

It was founded in 2015 as a subsidiary of Graphenano Group, the only company producing graphene on an industrial scale, as a result of its research and collaboration agreement with the Catholic University of Murcia (UCAM).

Graphenano Smart Materials is currently working together with the University of Castilla la Mancha (UCLM), the Institute of Ceramic Technology of Valencia (ITC) and the Construction Technology Center of Murcia (CTCON).



¿What is graphene?



Nanomaterial

Its dimension is less than or equal to one millionth of a millimeter.

Two-dimensional

It has only two dimensions because it is one atom thick (10^{-9} mm).

Pure carbon

As well as *graphite** and diamond are carbon. Carbon atoms remain strongly bonded on a uniform surface, similar to a honeycomb.

* *Graphite* consists of many graphene sheets stacked on top of each other.

Main properties of graphene



Strength
200 times stronger than steel



Two-dimensional
100,000 times thinner than human hair



Flexible
Up to 20% without liquidated damages



Eco-friendly
Sustainable and biodegradable



Biocompatible
New applications in medicine and dentistry



Transparency
98% of transparency, similar to that of glass



High conductivity
Better electrical and thermal conductivity than copper



Lightness
1 m² weighs less than 1 gram

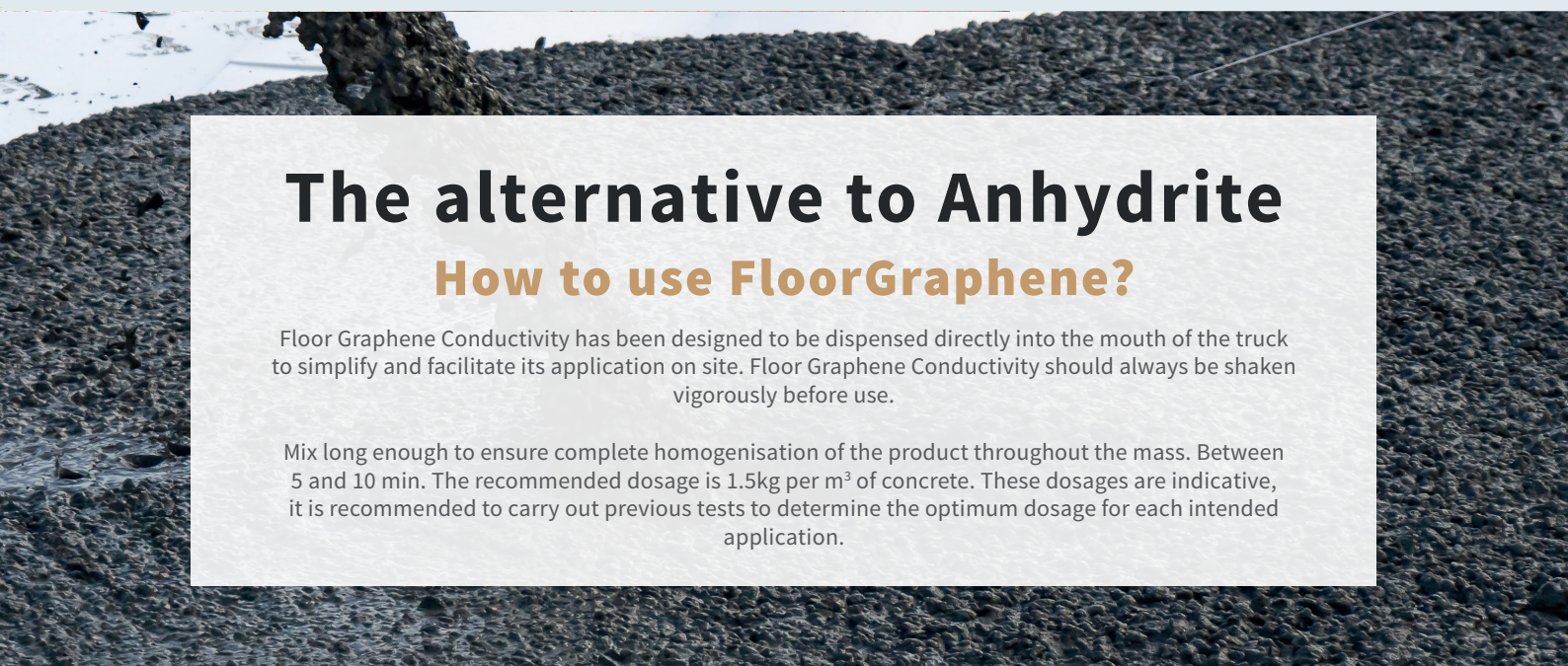




What is FloorGraphene?

Floor Graphene Conductivity is a highly active graphene-based additive that improves the thermal conductivity of concrete and self-levelling mortars.

This product has been designed by the Graphenano Group's R+D+a team to cover a need that is increasingly present in the construction sector, which is that of energy improvement and the search for energy efficiency

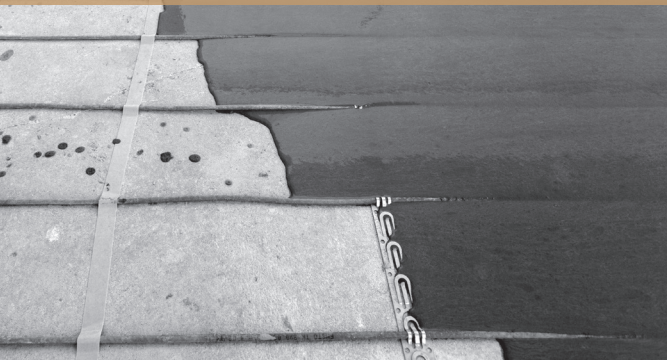


The alternative to Anhydrite How to use FloorGraphene?

Floor Graphene Conductivity has been designed to be dispensed directly into the mouth of the truck to simplify and facilitate its application on site. Floor Graphene Conductivity should always be shaken vigorously before use.

Mix long enough to ensure complete homogenisation of the product throughout the mass. Between 5 and 10 min. The recommended dosage is 1.5kg per m³ of concrete. These dosages are indicative, it is recommended to carry out previous tests to determine the optimum dosage for each intended application.

Economic and environmental savings



Properties and advantages

Properties of Floor Graphene Conductivity

- Higher thermal conductivity
- Higher compressive strength
- Higher flexural strength
- Improved durability
- Neither the consistency nor the appearance of fresh concrete changes

Advantages of Floor Graphene Conductivity over other alternatives

- Increased energy efficiency
- Reducing CO2 emissions in home conditioning
- Lower installation and execution costs compared to anhydrite
- Great economic savings in energy consumption

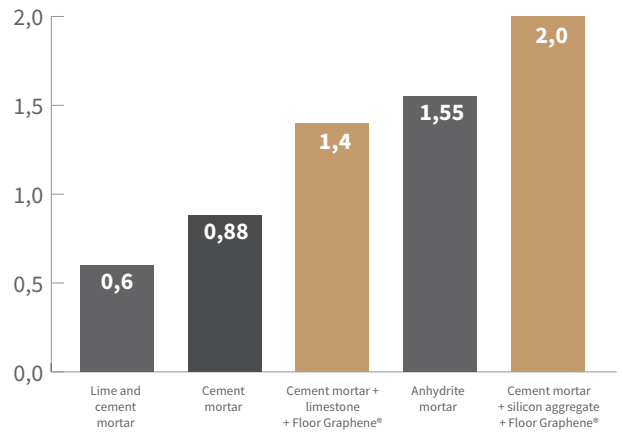
Materials comparison

One of the most important variables for studying heat output is the thermal conductivity (k) of materials. The higher the thermal conductivity, the better the heat conductor and the more thermal energy it is able to radiate.

$$Q = A \cdot K \cdot \Delta T /$$

Thermal conductivity values of different materials:

- Lime mortar₁ = 0.6
- Cement mortar₁ = 0,88
- Cement mortar+ limestone + FloorGraphene®= 1,4
- Anhydrite mortar₁ = 1.55
- Cement mortar + silicon aggregate + FloorGraphene®= 2



$$\text{Energy savings} = \left(\frac{\text{Thermal. Cond}_{\text{current material}}}{\text{Thermal. Cond}_{\text{current material}}} - 1 \right) \cdot \text{Heating power (KWH)}$$

Illustrative Example: Economic and Environmental Savings (Madrid)*

For the calculation of the energy cost, an annual scenario will be established in which the thermal installation is kept on for 10 hours every day during the 6 months of autumn and winter (~1800 hours). It should be noted that the efficiency of aerothermal plants is around 300%, i.e. each kW of electricity is equivalent to 3kW of thermal energy (COP=3). The average cost per kWh in Spain in 2022 will be 0.205 €/kWh.

$$\text{ANNUAL COST (€)} = \text{Heat power (kW)} / \text{COP} \cdot \text{Consumption time (h)} \cdot \text{Electricity cost (€/kWh)} = 11.9 \text{ kW} / 3 \cdot 1800 \text{ h} \cdot 0.205 \text{ €/kWh}$$

Annual savings= 20% - 40%

Material	K (W/m·k)	Heat power (Wh)	Energy efficiency
Lime and Cement Mortar	0,6	17.453	-31,8 %
Cement mortar	0,88	11.900	0,0
Cement mortar + calcareous aggregate + FG	1,4	7.480	59,1 %
Anhydrite mortar	1,55	6.756	76,1 %
Cement mortar+silicon aggregate + FG	2	5.236	127,3 %

The use of electricity results in the release of carbon dioxide into the atmosphere. The calculation of CO₂ emissions takes into account the emissions from each of the energy sources used in the electricity mix. In 2022, the average emission is 0.390 kg CO₂/kWh.

$$\text{EMISSIONS (kg CO}_2\text{)} = \text{Heat power (kW)} / \text{COP} \cdot \text{Consumption time (h)} \cdot \text{emissions electricity mix (kg CO}_2\text{/kWh)} = 10,1 \text{ kW} / 3 \cdot 1800 \text{ h} \cdot 0.390 \text{ kg CO}_2\text{/kWh}$$

Annual CO₂ reduction = 20% - 40%

Material	Cost (€/year)	Economic savings (€/year)	CO ₂ Emissions (kg/year)	Environmental savings (kg CO ₂ /year)
Lime and Cement Mortar	+2.146,76	683,06	4.084,08	1.299,48
Cement mortar	1.463,70	0,0	2.784,60	0,0
Cement mortar + calcareous aggregate + FG	920,04	-543,66	1.750,32	-1.034,28
Anhydrite mortar	831,00	-632,70	1.580,93	-1.203,67
Cement mortar+silicon aggregate + FG	644,03	-819,67	1.225,22	1.559,38

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