DANTONIT

DantoCon Thermal C2L/C2L-M

Documented sealing and optimal heat transfer in geothermal boreholes

www.dantonit.dk

We develop watertight solutions using bentonite.

Dantonit is part of NCC Industry A/S and is the only Scandinavian manufacturer of bentonite products. We extract the bentonite in our own quarry on the island of Tåsinge, and produce a wide range of products for such purposes as sealing wells and boreholes in large construction projects, and for membranes to protect areas against pollution.

DantoCon Thermal C2L/C2L-M is our specially developed bentonite-based material for the targeted sealing of geothermal boreholes. The product has been tested, documented, and used in a number of Danish and international projects in which density, environmental safety and thermal conductivity are crucial.

What is bentonite?

Bentonite is a natural, plastic clay with a high mont-morillonite content– formed around 50 million years ago. The material can absorb large amounts of water, making it ideal as a sealant in environmentally critical applications.

Bentonite is self-sealing, free of additives and 100% natural. It is used in solutions where longevity, density and chemical resistance are required – e.g. to protect groundwater and prevent contamination.

Quality and environment – certified according to international standards

Dantonit's management systems are certified in accordance with environmental, quality and occupational health and safety standards (ISO 14001, 9001, 45001). Our products have been developed with a focus on environmental protection and tested in German laboratories according to recognized guidelines. They are also certified in accordance with the "Certificate on Environmental Safety" and classified in a Water Hazard Class.

DantoCon Thermal C2L/C2L-M

DantoCon Thermal C2L/C2L-M are specially developed bentonite-based sealing materials for sealing boreholes in geothermal heating installations. For these kinds of installations, there are often requirements that the sealing material must not only protect against seepage, but also have high thermal conductivity – and this has been the focal point in the development of the product.

The materials are supplied in powder form and mixed with water immediately before use. Once mixed correctly, a smooth and uniform consistency is achieved with no aqueous phase separation, ensuring a tight, effective seal in the borehole.

The development process included a special focus on user-friendliness and pumping properties. This has resulted in materials that are easy to handle on the construction site and suitable for both small and large projects.

When cured, the materials form a strong, sealing barrier that:

- prevents seepage into groundwater
- protects against surface contamination, while at the same time enabling efficient heat transfer between ground and heating coils
- is sulfate-resistant
- can be used in salt water

This means that DantoCon Thermal C2L/C2L-M combines density, thermal conductivity and environmental safety in one single product.

DantoCon Thermal C2L

Description	value	Standard/equipment
Concentration (water content) [%]	43	
Density of the ready mixture [kg/l]	1.56 – 1.63	500 ml measuring
Thermal conductivity after 2 weeks [W/mK]	≥ 2.0	cylinder
Hydraulic conductivity [m/s]	≤ $5x10^{-11}$	ASTM.D5334-14
Compressive strength (temp. 20°, 28 days) [MPa]	≥ 1	DIN 18130–1
		ASTM D 2166
Concentration for 1 m3 ready mixture		
Water (l)	664	
DantoCon Thermal C2L (kg)	886	
Concentration per 1,000 kg dry material		
Water (l)	750	
DantoCon Thermal C2L (kg)	1,000	

DantoCon Thermal C2L-M

Description	value	Standard/equipment
Concentration (water content) [%]	43	
Density of the ready mixture [kg/l]	1.56 – 1.63	500 ml measuring
Thermal conductivity after 2 weeks [W/mK]	> 2.0	cylinder
Hydraulic conductivity [m/s]	≤ $1x10^{-10}$	ASTM.D5334-14
Compressive strength (temp. 20°, 28 days) [MPa]	≥ 1	DIN 18130–1
Magnetic susceptibility (SI unit)	0.0486	ASTM D 2166
		SM 30 SH Instruments
Concentration for 1 m3 ready mixture		
Water (l)	680	
DantoCon Thermal C2L-M (kg)	900	
Concentration per 1,000 kg dry material		
Water (l)	750	
DantoCon Thermal C2L-M (kg)	1,000	

Advantages of DantoCon Thermal C2L/C2L-M

- **High thermal conductivity** - optimizes transfer between ground and geothermal heating installation
- **Smooth, homogeneous consistency** - easy to mix and pump without separation
- **Effective seal** - prevents both seepage and infiltration of contaminants
- **Long life and chemical stability** - ensures extended protection of groundwater
- **Environmentally certified** - tested in accordance with German guidelines and classified in low water hazard class

Tested and documented density

In collaboration with GEO and recognized German laboratories, Dantonit has tested DantoCon Thermal C2L/C2L-M in accordance with international standards, including the guidelines from IEA ECES Annex 27 and VDI 4640-Blatt 2. The results show:

- **High density:** Effective barrier against liquid seepage from leaks in geothermal heating systems
- **Environmental protection:** Prevents surface contamination from penetrating the groundwater zone
- **Chemical resistance and stability:** The product does not change properties over time
- **Verifiability:** The addition of magnetite enables traceability and control of location

With DantoCon Thermal C2L/C2L-M, you get a long-lasting sealing element documented as being safe in your installation.

Developed for geothermal boreholes – tested according to international standards

The most important documented properties include:

- **Density after mixing** - ensures that the material is pumpable and manageable on site
- **Viscosity** - guarantees uniform, easy-flowing consistency during installation
- **High thermal conductivity** - ensures good heat transfer
- **Hydration heat** - controlled temperature change during mixing
- **Aqueous phase stability** - minimizes separation and excess water in the borehole
- **Hydraulic conductivity** - low permeability for optimal seal
- **Frost/thaw resistance** - proven density after repeated temperature cycles
- **Compressive strength after curing** - maintains structural integrity of the borehole
- **Resistance to environments that are aggressive for concrete** - withstands the effects of naturally occurring salts
- **Environmental impact** - tested and classified as safe for the groundwater environment
- **Magnetic susceptibility** *(C2L-M only)* - addition of magnetite enables precise location in the borehole via induction log

Most tests are conducted in Dantonit's own laboratory, while frost/thaw properties and environmental impact are assessed in recognized laboratories in Germany.

Additional test – robustness in salt water
To document its usability in aggressive environments, DantoCon Thermal C2L-M has been tested with salt water from the Port of Esbjerg.

The material is both mixed with and cured in salt water, and the results show:

- **Lower hydraulic conductivity** - the product becomes denser in salt water
- **Increased compressive strength** - the cured product becomes stronger than when tap water is used

This confirms that DantoCon Thermal C2L/C2L-M is suitable for use in environments with high salinity – without compromising on either density or durability.

DantoCon Thermal C2L and C2L-M have been developed and tested to meet the requirements of both IEA ECES Annex 27 and VDI 4640 Blatt 2 – recognized standards for sealing materials in geothermal heating systems. The products meet a number of technical and environmental requirements that are crucial for function, durability and safety in sealing drilled installations.

Examples of applications and case studies

The Vridsløsemagle Thermonet project (Albertslund Municipality)

An innovative district heating system based on a low temperature and local storage of energy in the ground. DantoCon Thermal C2L ensures a tight seal and optimal heat transfer in the boreholes.

Source and photos: Termonet Danmark

Bromarken, Jyllinge – Stage D

Major residential development project with integrated energy distribution and climate adaptation via geothermal heating and sealing using DantoCon Thermal C2L.

Source and photos: Termonet Danmark

The roads of the future

Demonstration project in which road surfaces supply both heating and cooling via a Thermonet. DantoCon Thermal C2L also protects against extreme rain and ensures that rainwater does not penetrate into drilled structures.
Source and photos: Termonet Danmark

Additional information and documentation

Dantonit offers full documentation of all products – including data sheets, environmental certificates and test reports – via our website.

dantonit.group/data-sheets-reports

References

- IEA ECES Annex 27: Best Practice Guide for Borehole Systems, M. Reuss et al.
- VDI 4640-Blatt 2
- GEO (Denmark) - test and consulting partner
- Dr. Ing. Hauke Anbergen – Anbergen Geotechnik
- UBeG GmbH & Co. KG
- Horn & Co. Analytics GmbH
- Termonet Danmark – project partner

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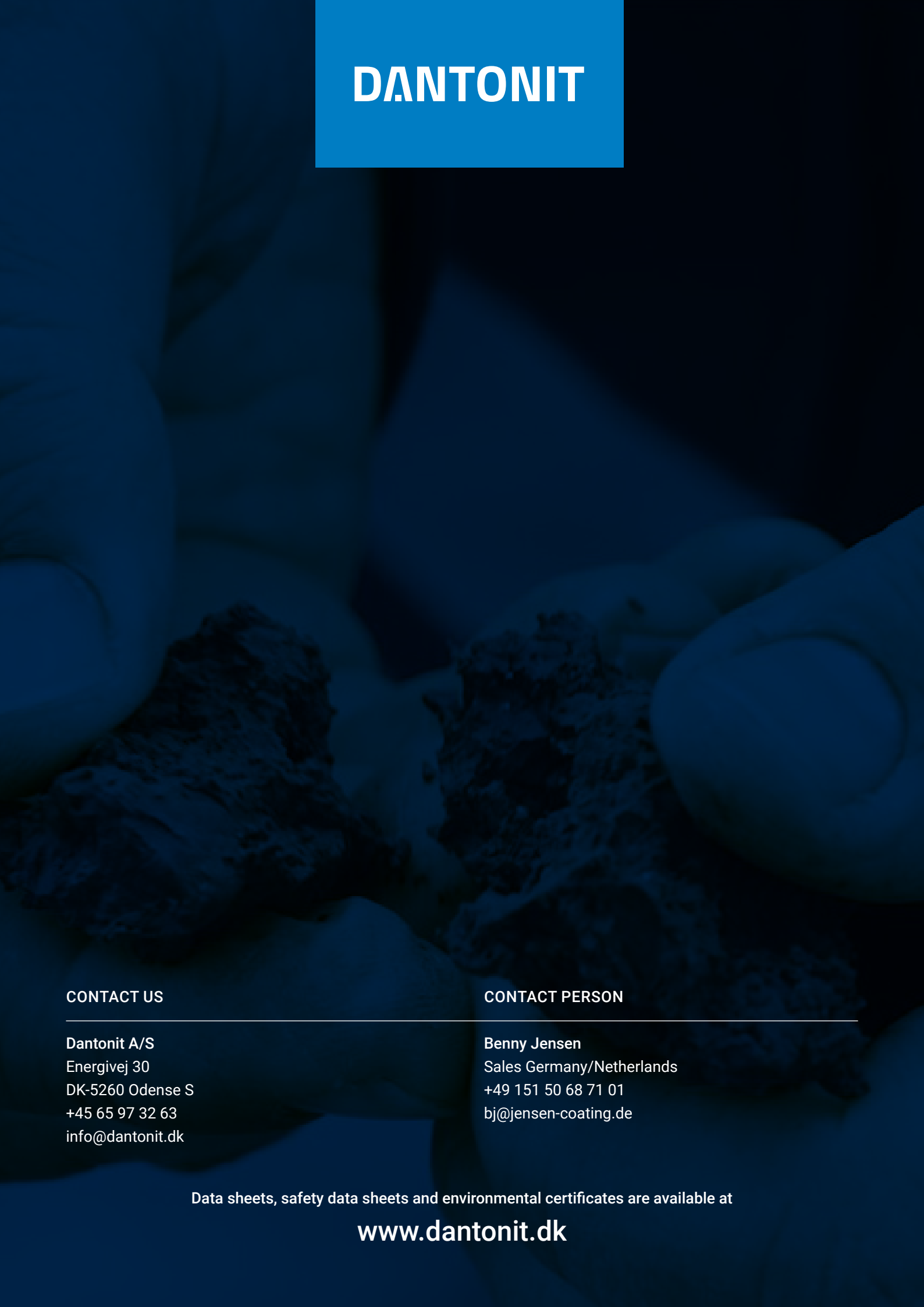

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Data sheets, safety data sheets and environmental certificates are available at

www.dantonit.dk