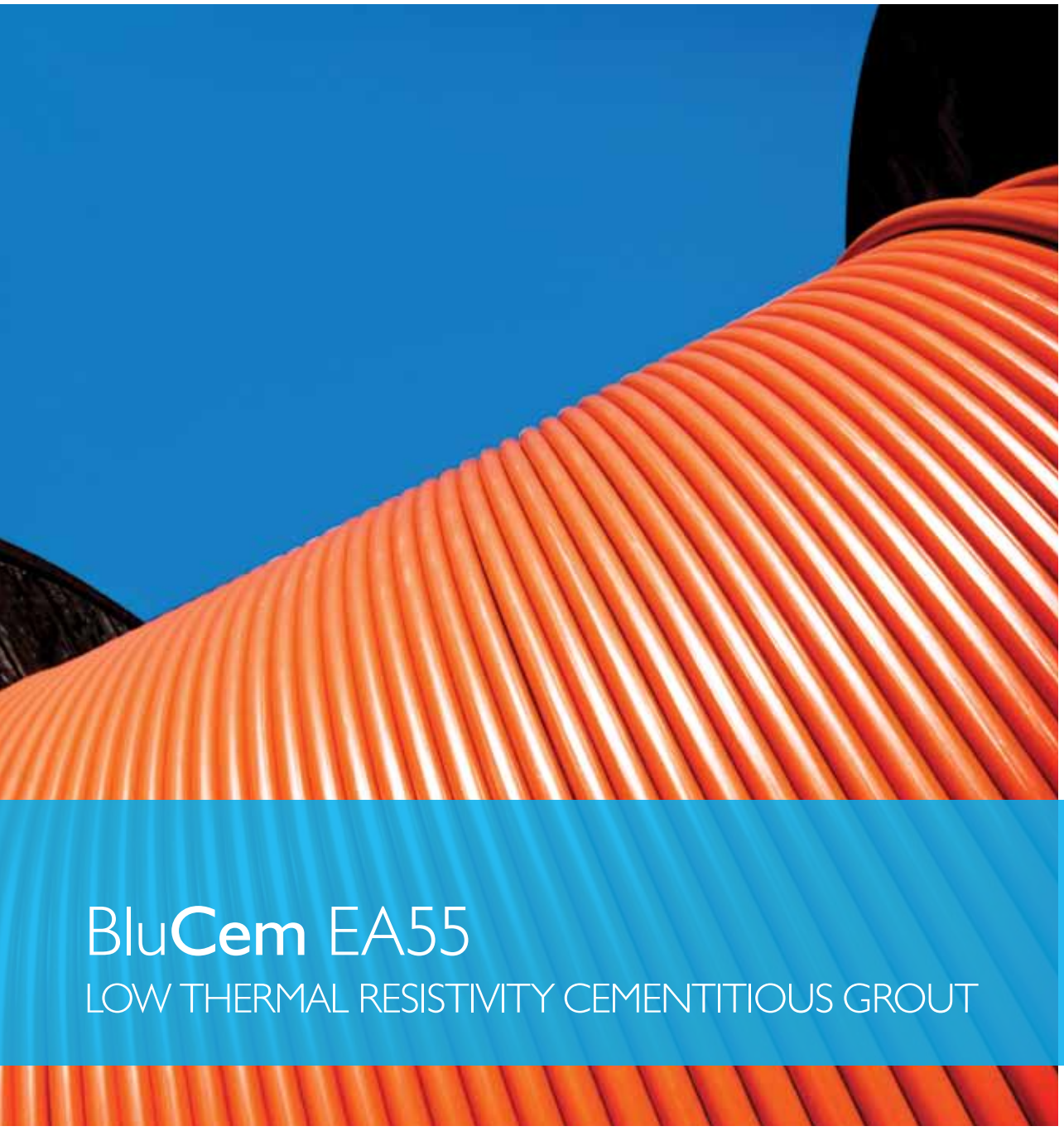
bluey®

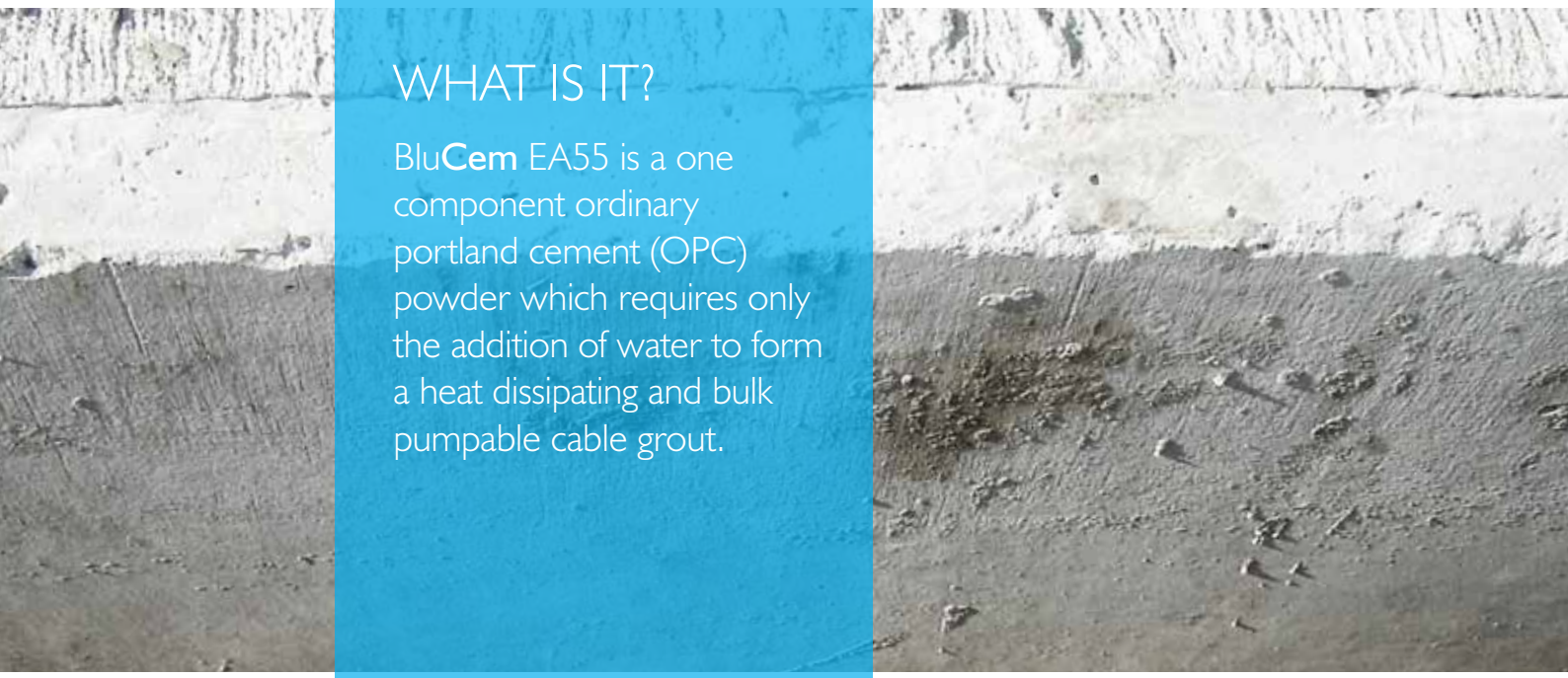


BluCem EA55

LOW THERMAL RESISTIVITY CEMENTITIOUS GROUT

BluCem EA55

LOW THERMAL RESISTIVITY CEMENTITIOUS GROUT



WHAT IS IT?

BluCem EA55 is a one component ordinary portland cement (OPC) powder which requires only the addition of water to form a heat dissipating and bulk pumpable cable grout.

BluCem EA55
PRODUCT INFORMATION

BluCem EA55 has been designed as a durable, flowable grout and is used for encasement of conduit casings.

WHERE DO WE USE BLUCEM EA55?

BluCem EA55 is suitable for long distance pumping applications and bulk grouting where heat dissipation is required.

WHY BLUCEM EA55?

Low heat generation during curing

Very low thermal resistivity

Unique additives to minimise shrinkage and bleed

Durability, low porosity and chloride free ensures long performance life

BluCem EA55
PRODUCT SUPPORT

RESEARCH, EXPERIENCE, PRODUCT, SUPPORT

BluCem EA55 is manufactured and supported by Minova International Ltd, a group of companies with 50 years of accumulated experience in providing products for the mining industry.

Minova's range of products includes resin capsules for rock bolting, high volume output grouts for strata support, ventilation control devices and specialised coatings including Tekflex.

Minova has over 1,200 employees worldwide, and 12 manufacturing sites in seven countries, with key facilities in the U.S, Germany, Poland, Australia and South Africa.

BACKED BY ORICA

Minova is part of the Orica Group (www.orica.com) which provides products and services to the mining, manufacturing and construction and consumer markets. Orica, with a market capitalisation of approximately AU$7 billion, is one of the top 50 companies listed on the Australian Stock Exchange, and has over 13,000 employees in approximately 50 countries and services customers in 98 different countries around the world.

BluCem EA55
PRODUCT APPLICATIONS

BluCem EA55 has a range of encasement uses including:

- Backfill for High Voltage feeder cables and High Voltage Alternate Current Underground Cables (HVAC)
- Railway under bores
- Metropolitan High Voltage upgrades
- Power plants

BluCem EA55
PRODUCT FEATURES & BENEFITS

KEY FEATURES	KEY BENEFITS
Low thermal resistivity	Increase in cable load capacity
Pumpable over long distances	Bridges across live cracks
Low heat generation during curing	Won't damage PVC conduits
Bulk placement	Suitable for large projects

BluCem EA55
PRODUCT DEVELOPMENT

Bluey Technologies was approached by the energy industry to develop a low shrink grout for encasing cables. It was recognised that air had very poor heat transmission properties.

POTENTIAL RISK	CONSEQUENCES	BLUCEM EA55 SOLUTIONS
Shrinkage Cracking	Allows moisture ingress	Blu**Cem** EA55 has no bleed to prevent voids forming and moisture ingress
High TR	Slow heat dissipation	Blu**Cem** EA55 was developed using igneous fillers to allow heat to dissipate faster to make the grout more effective
High heat of hydration	Melting of conduit during curing	A modified cement system results in a maximum exothermic temperature of 33°C
Poor flow when placing	Voids and high pressures during installation	State of the art plasticizers result in very high flow
Drying out	Increase in TR over time	Blu**Cem** EA55 will not dry out or change in TR

BluCem EA55
PRODUCT DEVELOPMENT

WHAT IS CABLE RATING?

The cable rating will be the current that will generate the maximum permissible cable temperature for a given set of conditions.

If the conditions change, e.g compaction of ground, ground temperature etc, so will the cable rating.

WHAT IS THE MAXIMUM PERMISSIBLE CABLE TEMPERATURE?

CABLE INSULATION TYPE	SOFTENING TEMPERATURE
XLPE	90°C
EPR	90°C
PAPER	70°C
PVC	60°C

The maximum permissible temperature varies as it is determined by the electrical insulation type. If this temperature is exceeded, the life of the cable will be shortened and damage to the cable may occur.

Thermal expansion may also cause problems.

The IEC and AS standards give the operating temperatures as shown below.

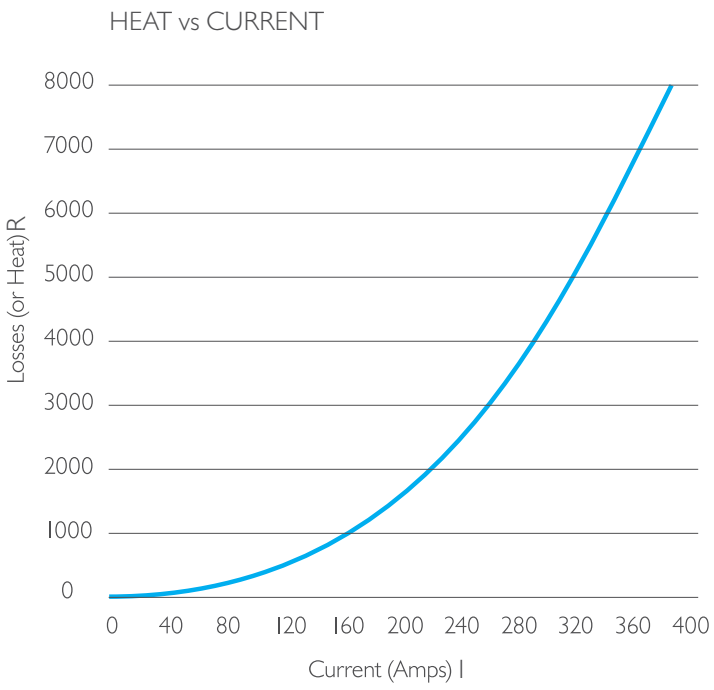
Most new cables are XLPE or EPR insulated.

WHAT IMPACTS THE CABLE RATING?

All cables have a resistance (R), when electrical current (I) is passed through this resistance, some of that electrical energy is converted to heat energy according to the relationship I^2R.

The 'heat' causes the cable temperature to rise, the temperature of the cable will get hotter and hotter if the heat cannot dissipate. This will cause the cable to overheat and be damaged. If the heat can't dissipate, even 1 amp would eventually cause the cable to overheat.

To reduce the heat generated you must reduce either the resistance by selecting a larger cable or reduce the current.



BluCem EA55
PRODUCT DEVELOPMENT

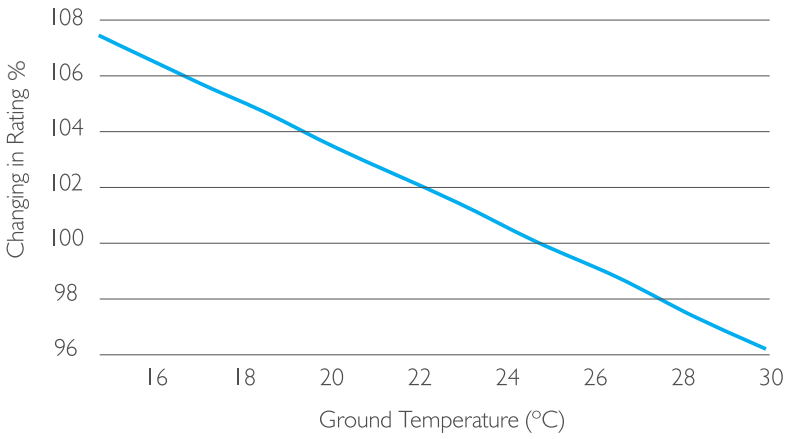
EFFECT OF SOIL TEMPERATURE

A buried cable will have a different rating in summer than it will in winter due to the seasonal change in soil ambient temperature.

So if the ground temperature is 25°C, then XLPE can only 'rise' by 65°C before the maximum temperature of 90°C is reached.

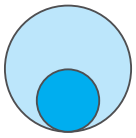
However if the soil temperature was at just 18°C, it would be allowed to rise by 72°C, resulting in a higher rating.

RATING VARIATION WITH GROUND TEMPERATURE



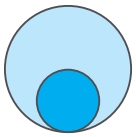
GROUND TEMPERATURE 18°C

CONDUCTOR TEMPERATURE 90°C
CURRENT RATING = 300A



GROUND TEMPERATURE 25°C

CONDUCTOR TEMPERATURE 90°C
CURRENT RATING = 285A



BluCem EA55
PRODUCT DEVELOPMENT

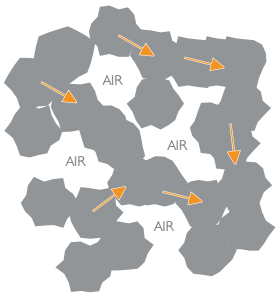
EFFECT OF SOIL THERMAL RESISTIVITY

Thermal resistivity (TR) is a material property. It is a measure of the materials ability to resist heat conduction. As we want to ensure that the cable doesn't overheat, we need to understand what is surrounding the cable.

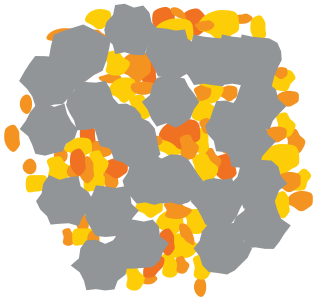
A cable surrounded by a product with a high thermal resistivity is like wrapping a 'doona' around the cable. It resists heat dissipation away from the cable which causes the cable to increase in temperature.

The heat needs to get away to the outside world through a thermally conductive path - the better the conduction, the better the rating.

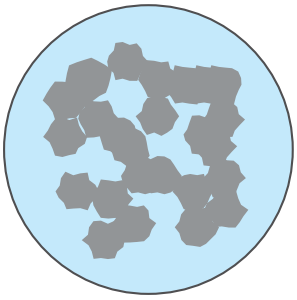
Variable moisture content also leads to unreliable assumptions of TR values to use for cable ratings.



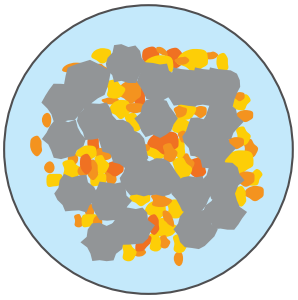
High thermal resistivity, lots of air gaps and not many paths for heat 'conduction' to occur.



Low thermal resistivity, less air gaps and many paths for heat 'conduction' to occur.



When material has a high moisture content, the air gaps (TR=45) are filled with water (TR=1.65). This means the thermal performance will be greatly improved.



With a high moisture content even poor material will perform reasonably, as long as it doesn't dry out.

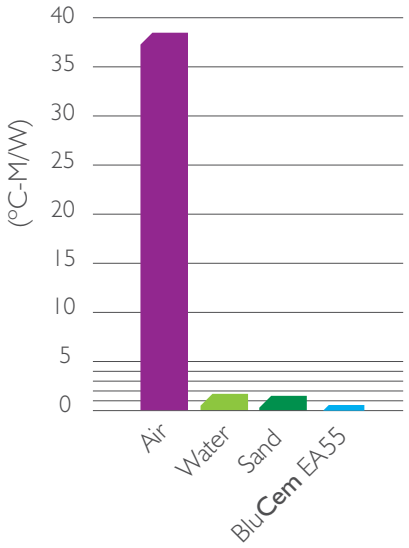
BluCem EA55
PRODUCT DEVELOPMENT

THERMAL RESISTIVITY (TR)

MATERIAL	THERMAL RESISTIVITY
Air	45.0
Water	1.65
Sand	1.50
BluCem EA55	0.67

"An index of a material's resistance to the transmission of heat; the reciprocal of thermal conductivity"

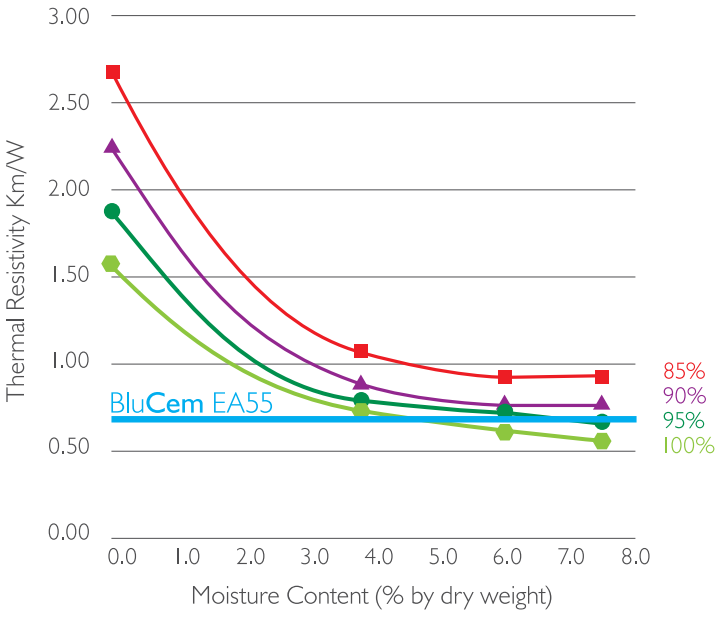
Air having a TR of around 45 K.m/W is the reason that a cable needs to be de-rated when installed in an empty duct.



COMPACTION

Where a dry mix backfill is used, the compaction rate can significantly affect the TR and hence the rating. That leads to high variability between sites and differing installation methods.

TR vs MC AT 85, 90, 95 AND 100% COMPACTION
Graph shows typical sand



Graph taken from Report to EA by Delmech Engineering and Garde Geotherm.

BluCem EA55
PRODUCT DEVELOPMENT

WILL THE MOISTURE BE THERE WHEN YOU NEED IT?

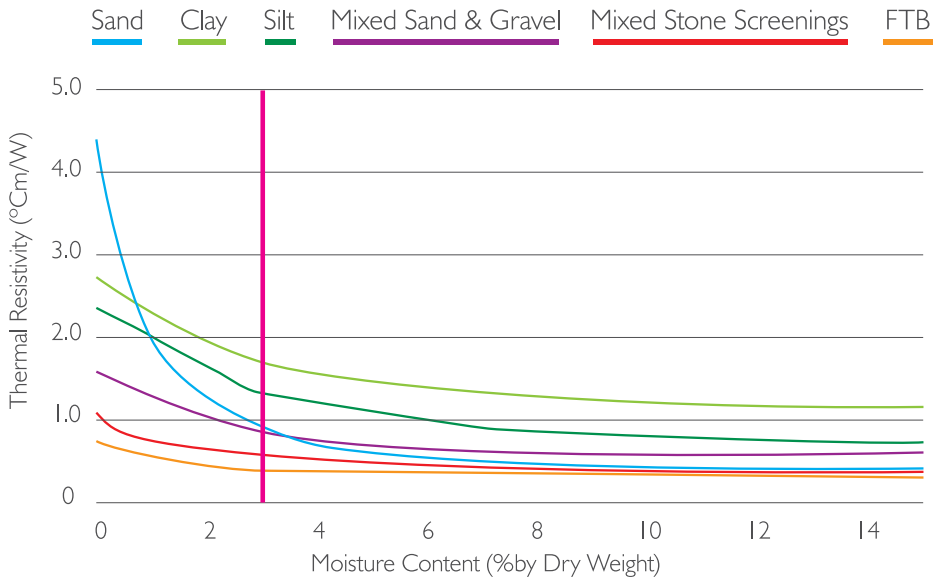
Elevated temperatures (particularly for long periods) tend to dry out the soil.

Thermal instability can occur for isothermal temperatures of 50°C for clay based soil and as low as 35°C for sand based soils.

If this drying exceeds the rate at which capillary action can "bring moisture back" you effectively reach a knee point as far as the moisture content is concerned - which you might not recover from.

- Heat causes drying
- Drying causes Thermal Resistivity (TR) to increase
- Increased (TR) causes cable to get hotter
- Hotter cable causes more drying

THERMAL "DRY OUT" CURVES



Graph from Paul Howarth Presentation, Energy Australia 2002

BluCem EA55
PRODUCT DEVELOPMENT

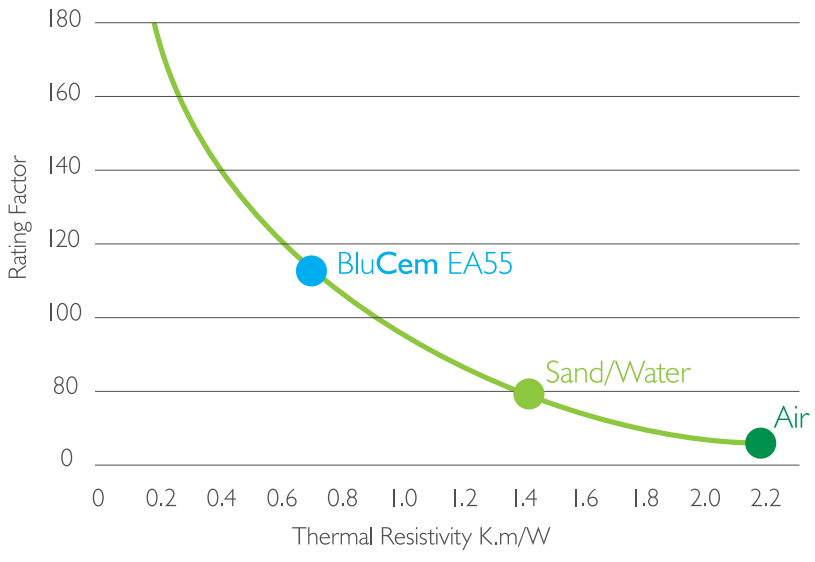
EFFECT OF TR ON CABLE RATING

"A cable's rating will reduce as Thermal Resistivity increases."

A cable with a 1000A rating at a TR of 1.2K.m/W at 750mm cover, would only achieve a rating of 800A at a TR of 2.0K.m/W, but the same cable could achieve a rating of 1400A at a TR of 0.5K.m/W.

TR (K.m/W)	RATING
0.67	866
1.0	755 (-13%)
1.5	638 (-26%)
2.0	562 (-37%)

EFFECT OF TR ON CABLE RATING



BluCem EA55
PRODUCT DEVELOPMENT

WHAT OPTIONS DO YOU HAVE TO ACHIEVE YOUR REQUIRED RATING?

Reduce your cable heating, by selecting a larger cable for the bore section.

Ensure you understand the soil types and the likely thermal resistivity when looking at the options.

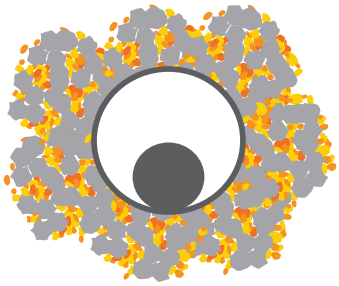
Maximise the spacing and ensure the spacing between ducts is filled to provide thermally conductive paths.

Consider multiple bores to reduce the number of required cables in each bore hole and therefore reduce the mutual heating.

Try to limit the number of cables to 4 or less per bore.

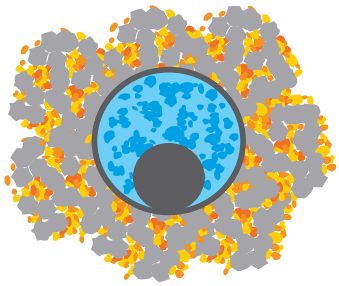
Use low TR materials such as BluCem EA55 to fill the bore hole, the casing and the ducts.

RATING



Cable in an empty duct
= a lower rating

Air TR = 45 KM/W



Cable in duct filled with Blu**Cem** EA55
= substantially higher rating

Blu**Cem** EA55 TR = 0.67 KM/W

- Bore hole to be filled with Blu**Cem** EA55 ensuring there are no air gaps
- Casing
- Ducts can be filled with a bentonite mix to improve rating
- Casing to be filled with Blu**Cem** EA55

BluCem EA55
PRODUCT DEVELOPMENT

BULK APPLICATION

BluCem EA55 has been designed to be applied on large scale project applications

LONG DISTANCE PUMPING

BluCem EA55 has high slump and flow properties to allow for placement of long distance bores

BluCem EA55
PRODUCT TESTING

TESTING COMPLETED

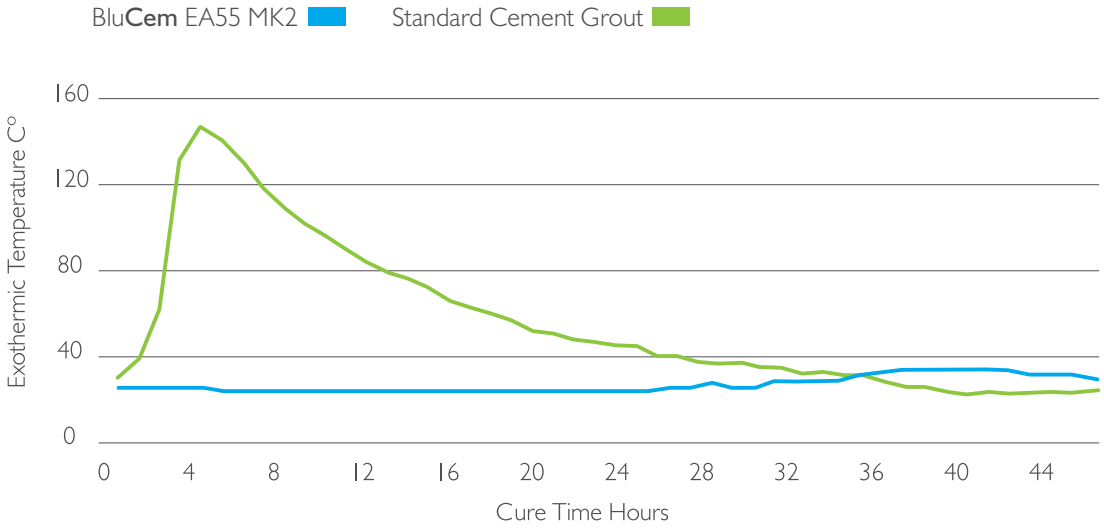
Thermal resistivity to ASTM D5334

50 mm cubes tested as per AS1478.2.2005 Appendix A

Set Times tested to AS/NZS 2350.4.2006 Method 4

Flexural strengths to ASTMC348-02

EXOTHERMIC TEMPERATURE



BluCem EA55
PRODUCT DATA

PRODUCT DATA

PACKAGING:	20kg bags
RATIO:	3 - 3.4 litres of water per 20kg bag of BluCem EA55
YIELD:	11.5 litres per 20kg bag
PUMP LIFE:	6 hours @ 20°C
MAXIMUM EXOTHERM:	33°C @ (300mm x 300mm @ 25°C ambient)
SET TIMES:	Initial – 17 hours
	Final – 28 hours
THERMAL RESISTIVITY:	0.67Km/W (Dry)
COMPRESSIVE STRENGTH:	7MPa @ 48 hours
	25MPa @ 7 days
	35MPa @ 28 days
FLEXURAL STRENGTH:	2MPa @ 48 hours
	5MPa @ 28 days
ELASTIC MODULUS:	4GPa @ 28 days
HUMBOLDT FLOW CONE:	30 seconds
SLUMP:	26cm
BLEED:	0%
SEPARATION:	Nil
MAXIMUM PARTICLE SIZE:	1mm
CLEAN UP:	Clean tools and surfaces using water prior to curing
STORAGE:	Store in dry conditions
SHELF LIFE:	12 months

BluCem EA55
ONSITE INSTALLATION

FORMWORK

Each end of the main case must be sealed water tight prior to grouting. It is recommended that the case is filled with water to test for leakage prior to grouting.

MIXING

The mixing procedure for BluCem EA55 is critical to the successful placement of the product. An appropriate mixer must be used.

Ensure all grouting materials are preconditioned to an ambient temperature below 25°C. Measure and place 80% of the specified potable water to a high shear mixing vessel. Start mixer and slowly add BluCem EA55 powder. If powder addition is too fast then large lumps will form and final mix will be slow reaching uniform consistency. Following addition of all powder, mix for 1-2 minutes or until uniform consistency then add final 20% of potable water.

Flow cone testing should occur during pumping and additional water added if required.

BluCem EA55
ONSITE INSTALLATION

PUMPING AND PLACEMENT

Grout placement must commence from the lowest point within the case. A 20mm polypipe should be placed through the case to ensure grout delivery at this point. As the grout-head rises the polypipe must be slowly withdrawn but always remain below the grout surface. To prevent air entrapment it is recommended that grouting operations progress slowly and careful observation for leaks is made continuously. Grouting operations must cease immediately if a leak is observed. The leak shall be plugged using BluCem HE10 or other suitable plugging products. At the completion of grouting, the end of the polypipe shall be secured at least 1m above the conduit overt.

The polypipe shall be monitored until the grout reaches initial set for falls in grout level. If the grout level falls then the leak shall be identified and stopped. The polypipe shall be continuously topped up until the grout reaches initial set. Where grouting operations are not continuous, then multiple polypipes for grout placement may be required.

CURING

No special curing techniques are required.

BluCem EA55
ONSITE TESTING

ONSITE TESTING

Bluey's Engineers specialise in onsite techniques to ensure that the client, its designers and applicators receive full support during the entire material selection, application and testing process.

Bluey is able to offer training and quality inspections onsite either directly or through third party trained specialists accredited by Bluey. For all of our products we are also able to recommend competent applicators who have experience in applying our products.

FOR BLUCEM EA55, BLUEY RECOMMEND THE FOLLOWING MINIMUM TESTING REGIME:

Check bore is clear and free of water and drill fluid

Complete grout tests for TR prior to project commencement

During placement take one 50mm cube sample from every cubic metre poured to test later for adequacy of mixing

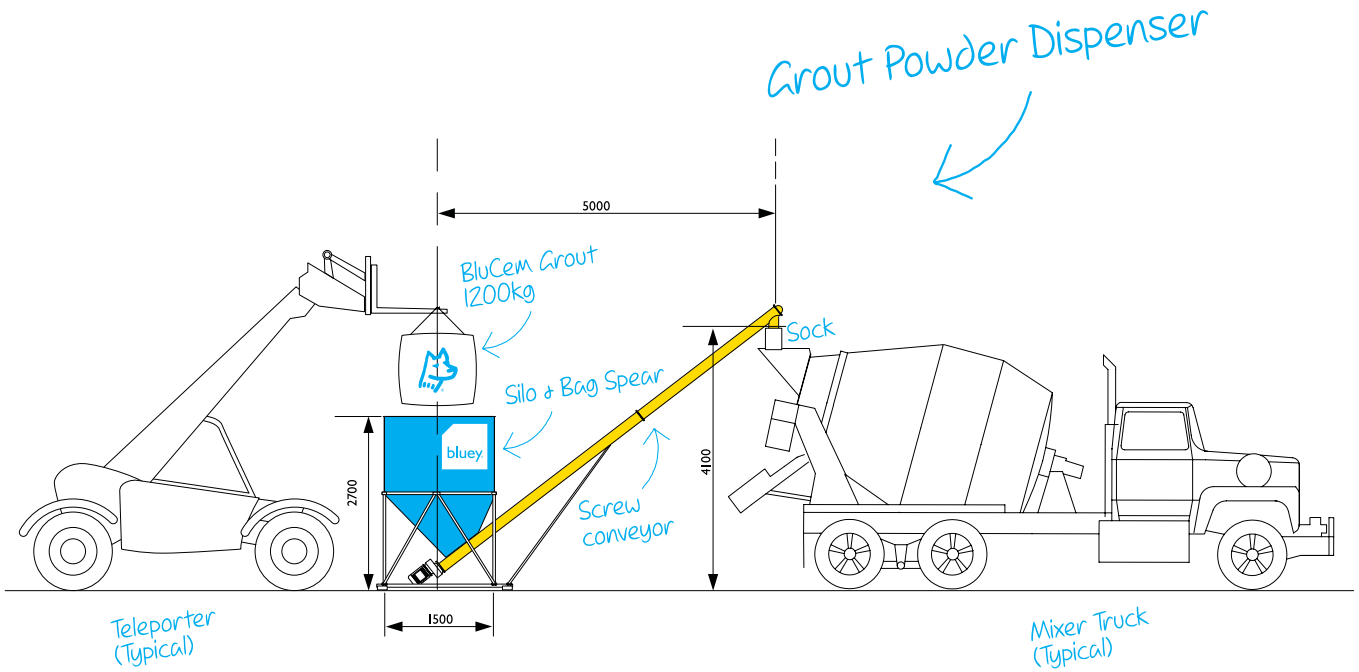
During placement take one additional sample from every cubic metre poured to test for TR values

It is important that all detailed drawings are completed and evaluated by a competent professional prior to commencement. The applicator is also required to develop specific work methods and inspection procedures for approval by Bluey prior to commencement. The obligation is on the purchaser of the products to engage Bluey for the onsite processes and utilise our services to ensure a high quality and conforming application.

BluCem EA55
PRODUCT SUMMARY

BLUCEM EA55
PRODUCT OFFERS

- Low heat generation during curing.
- Very low thermal resistivity.
- Unique additives to minimise shrinkage and bleed.
- Durability, low porosity and chloride free ensures long performance life.



Bluey Technologies
PRODUCT RANGE

bluCem

- Blu**Cem** API0
- Blu**Cem** RF20
- Blu**Cem** FC
- Blu**Cem** HB range
- Blu**Cem** HE10
- Blu**Cem** HE80
- Blu**Cem** HE80AG
- Blu**Cem** HE80HT
- Blu**Cem** HS100 range
- Blu**Cem** HS200 range
- Blu**Cem** EA02
- Blu**Cem** GP60
- Blu**Cem** UF40
- Blu**Cem** UW range

bluGeo

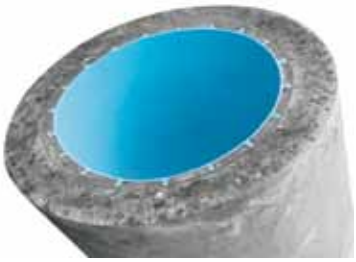
- Blu**Geo** Powerthread range
- Blu**Geo** SD Anchors range
- Blu**Geo** ST Rock Bolts range
- Blu**Geo** Swellex range
- Blu**Geo** Tekflex

bluRez

- Blu**Rez** Crackseal 111
- Blu**Rez** Crack Seal 150
- Blu**Rez** Crackseal NV
- Blu**Rez** Carbostop
- Blu**Rez** Carbostop 42D
- Blu**Rez** Epoxy 225
- Blu**Rez** Epoxy 480
- Blu**Rez** Epoxy 480UT
- Blu**Rez** Epoxy 575 CG
- Blu**Rez** Epoxy 655

bluSeal

- Blu**Seal** Anchor Knob Sheet
- Blu**Seal** Britdex Membrane
- Blu**Seal** Moulding Putty
- Blu**Seal** Dust Control 10
- Blu**Seal** Road Sealer 10
- Blu**Seal** Containment Liner
- Blu**Seal** PVC Tunnel Liner
- Blu**Seal** Injection Kit



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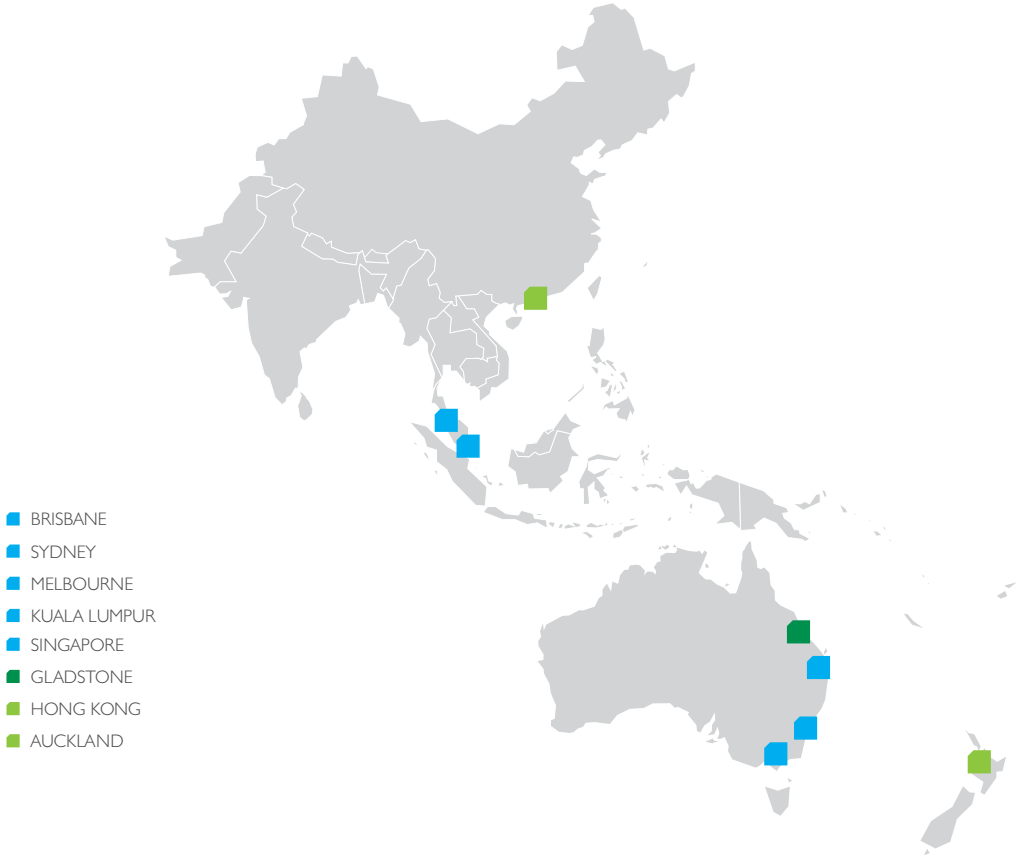

STATEMENT OF RESPONSIBILITY

The technical information and application advice given in this publication is based on the present state of our best knowledge. As the information herein is of a general nature, no assumption can be made as to a product's suitability for a particular use or application and no warranty as to its accuracy, reliability or completeness either expressed or implied is given other than those required by Commonwealth or State Legislation. The owner, their representative or the contractor is responsible for checking the suitability of products for their intended use.

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Bluey Technologies Pty Ltd

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