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 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 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

<table>
<thead>
<tr>
<th>KEY FEATURES</th>
<th>KEY BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low thermal resistivity</td>
<td>Increase in cable load capacity</td>
</tr>
<tr>
<td>Pumpable over long distances</td>
<td>Bridges across live cracks</td>
</tr>
<tr>
<td>Low heat generation during curing</td>
<td>Won’t damage PVC conduits</td>
</tr>
<tr>
<td>Bulk placement</td>
<td>Suitable for large projects</td>
</tr>
</tbody>
</table>

![Image of BluCem EA55 product features](image-url)
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.

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

<table>
<thead>
<tr>
<th>CABLE INSULATION TYPE</th>
<th>SOFTENING TEMPERATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>XLPE</td>
<td>90°C</td>
</tr>
<tr>
<td>EPR</td>
<td>90°C</td>
</tr>
<tr>
<td>PAPER</td>
<td>70°C</td>
</tr>
<tr>
<td>PVC</td>
<td>60°C</td>
</tr>
</tbody>
</table>

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.
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.

GROUND TEMPERATURE 18°C

CONDUCTOR TEMPERATURE 90°C
CURRENT RATING = 300A

GROUND TEMPERATURE 25°C

CONDUCTOR TEMPERATURE 90°C
CURRENT RATING = 285A
EFFECT OF SOIL THERMAL RESISTIVITY

Thermal resistivity (TR) is a material property. It is a measure of the material's 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)**

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>THERMAL RESISTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>45.0</td>
</tr>
<tr>
<td>Water</td>
<td>1.65</td>
</tr>
<tr>
<td>Sand</td>
<td>1.50</td>
</tr>
<tr>
<td><strong>BluCem EA55</strong></td>
<td>0.67</td>
</tr>
</tbody>
</table>

"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.

**COMPACTON**

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.

---

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

<table>
<thead>
<tr>
<th>TR (K.m/W)</th>
<th>RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.67</td>
<td>866</td>
</tr>
<tr>
<td>1.0</td>
<td>755 (-13%)</td>
</tr>
<tr>
<td>1.5</td>
<td>638 (-26%)</td>
</tr>
<tr>
<td>2.0</td>
<td>562 (-37%)</td>
</tr>
</tbody>
</table>
Bluey Technologies

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.

WHAT OPTIONS DO YOU HAVE TO ACHIEVE YOUR REQUIRED RATING?

Cable in an empty duct = a lower rating
Air TR = 45 KM/W

Cable in duct filled with BluCem EA55 = substantially higher rating
BluCem EA55 TR = 0.67 KM/W

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

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.

Bore hole to be filled with BluCem EA55 ensuring there are no air gaps

Casing

Ducts can be filled with a bentonite mix to improve rating

Casing to be filled with BluCem 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.
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 ASTM C348-02

EXOTHERMIC TEMPERATURE

BluCem EA55 MK2 Standard Cement Grout

<table>
<thead>
<tr>
<th>Exothermic Temperature °C</th>
<th>Cure Time Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>0</td>
</tr>
<tr>
<td>120</td>
<td>4</td>
</tr>
<tr>
<td>80</td>
<td>8</td>
</tr>
<tr>
<td>40</td>
<td>12</td>
</tr>
<tr>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>28</td>
</tr>
<tr>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>4</td>
<td>36</td>
</tr>
<tr>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>44</td>
</tr>
</tbody>
</table>
**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.
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.
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 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**
  - BluCem AP10
  - BluCem RF20
  - BluCem FC
  - BluCem HB range
  - BluCem HE10
  - BluCem HE80
  - BluCem HE80AG
  - BluCem HE80HT
  - BluCem HS100 range
  - BluCem HS200 range
  - BluCem EA02
  - BluCem GP60
  - BluCem UF40
  - BluCem UW range

- **bluGeo**
  - BluGeo Powerthread range
  - BluGeo SD Anchors range
  - BluGeo ST Rock Bolts range
  - BluGeo Swellex range
  - BluGeo Tekflex

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

- **bluSeal**
  - BluSeal Anchor Knob Sheet
  - BluSeal Britdex Membrane
  - BluSeal Moulding Putty
  - BluSeal Dust Control 10
  - BluSeal Road Sealer 10
  - BluSeal Containment Liner
  - BluSeal PVC Tunnel Liner
  - BluSeal Injection Kit
Bluey Technologies

CONTACT

BRISBANE
Bluey Technologies Pty Ltd
Suite 6, Level 1
531 Sandgate Road
Clayfield QLD 4011
Australia
+61 7 3135 9440

SYDNEY
Bluey Technologies Pty Ltd
Unit 3,
35 Higginbotham Road
Gladesville NSW 2111
Australia
+61 2 9114 9445

MELBOURNE
Bluey Technologies Pty Ltd
Unit D9,
Hallmarc Business Park
2A Westall Road
Clayton VIC 3168
Australia
+61 3 9017 4942

KUALA LUMPUR
Bluey Technologies Sdn Bhd
8A, 1-4 Prima Damansara
Jln Chempenai
Bukit Damansara
50480 Kuala Lumpur
Malaysia
+60 1734 97374

SINGAPORE
Bluey Technologies Pte Ltd
27 Foch Road
02-06 Hoa Nam Building
Singapore
209264
+65 8455 1291
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.

NOTE:

Field service where provided, does not constitute supervisory responsibility. Suggestions made by Bluey Technologies Pty Ltd either verbally or in writing may be followed, modified or rejected by the owner, engineer or contractor since they, and not Bluey Technologies Pty Ltd are responsible for carrying out procedures appropriate to a specific application.

© Bluey Technologies Pty Ltd