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MAXIMISING UNDERGROUND CABLE CAPACITY IN THE TRANSITION TO RENEWABLE ENERGY INFRASTRUCTURE

The UK's transition to low-carbon, renewable energy is accelerating and placing increasing demands on power transmission infrastructure. **Daniel Clayton** of **Heidelberg Materials UK** explains why heat dissipation and the choice of bedding materials in underground cable systems are critical in reducing transmission loss.

In April 2023, National Grid launched The Great Grid Upgrade, the largest overhaul of the electricity network in the UK for decades. The project is designed to expand the electricity network to accommodate increasing volumes of low-carbon and renewable energy, helping to meet the UK's net-zero goals.

As the volume of energy from renewable sources such as wind and solar continues to grow, the efficiency and resilience of the infrastructure carrying that energy are becoming equally important factors in helping the UK achieve its net-zero targets.

MANAGING HEAT IN HV UNDERGROUND CABLES

Transferring energy via underground high-voltage (HV) and ultra-high-voltage (UHV) cables generates heat due to electrical losses in the conductor. These cables retain more heat than overhead lines because the insulation and surrounding soils can limit heat dissipation.

If this heat is not effectively dissipated, then high temperatures cause standard underground power cables to overheat and subsequently lose capacity, decreasing the overall efficiency of the electrical transfer.

The performance of underground cable systems is strongly influenced by the materials chosen for bedding and backfill. Sector guidance⁽¹⁾ defines maximum limits for thermal resistivity of bedding materials as 2.7Km/W for unbound materials and 1.2Km/W for cement-bound materials, to ensure that heat generated by standard

underground cables can be safely dissipated.

Traditional materials used in cable bedding, such as sand and loose aggregates, generally fall within this range, but may be insufficient for modern, high-capacity HV and UHV networks.

MATERIALS FOR IMPROVED THERMAL PERFORMANCE

In response to these challenges, bedding and backfill materials with improved thermal resistivity are increasingly being adopted. One solution for HV underground cable installations is Heidelberg Materials' ENA TS 97-1-compliant⁽¹⁾ cement-bound sand (CBS) range. Its PowerSand CBS offers a thermal resistivity of 1.2Km/W, while its PowerSand CBS Extra achieves 0.75Km/W.

PowerSand CBS has a sand:cement ratio of 14:1 and is engineered to absorb and distribute mechanical loads better than sand or loose aggregates, protecting the cables from damage.

For applications requiring even greater thermal performance, thermally conductive concretes such as PowerCrete are being specified. This special concrete has a thermal resistivity of 0.33Km/W and contains a cementitious blended binder with extremely high thermal conductive properties, which improves heat dissipation of HV and UHV cables.

Improved heat dissipation not only improves network efficiency but also reduces energy loss and associated carbon emissions over the infrastructure's lifecycle. PowerCrete mixes can also incorporate evoBuild GGBS as

a replacement for some of the cement content, further improving the concrete's sustainability credentials. The GGBS achieves a Global Cement and Concrete Association⁽²⁾ low-carbon 'A' rating and clarity on its environmental performance is provided in an Environmental Product Declaration (EPD), published by EPD programme operator EPD-Norge, in accordance with BS EN 15804⁽³⁾.

Effective thermal management also supports longer asset life, decreasing the likelihood of premature failure and reducing the need for remedial intervention or early replacement.

INCH CAPE WINDFARM LANDFALL

The Inch Cape Landfall project is a critical part of Scotland's renewable energy infrastructure, where offshore wind generation is connected to the national grid. Located in Cockenzie, Edinburgh, the project involves the construction of an onshore transmission hub substation.

Heidelberg Materials UK supplied 242m³ of PowerCrete from its Glasgow concrete plant, supporting the burial of HV cables as they reached land from the offshore windfarm.

As part of the UK's transition to low-carbon energy, the Inch Cape project required a robust and thermally efficient solution for cable burial at the landfall site. PowerCrete heat-conducting concrete was selected for its proven performance in energy sector applications, offering enhanced heat dissipation and structural integrity, thereby maximising power capacity.



USKMOUTH SUBSTATION

The Uskmouth Substation project in Newport, Wales, is a landmark development in the UK's renewable energy transition. The project involves constructing a 230MW battery energy storage system (BESS) on the site of a former coal-fired power station, to store surplus energy from solar and windfarms.

Heidelberg Materials UK supplied 1000m³ of PowerSand CBS Extra from its Cardiff and Bridgend plants, which was chosen for its high performance in cable bedding applications, offering excellent compaction and thermal conductivity. In addition to its technical advantages, it also provided a lower-carbon alternative to traditional backfill solutions, supporting more sustainable infrastructure development. **C**

References:

1. ENERGY NETWORK ASSOCIATION, Technical Specification 97-1. *Special backfill material for cable installations*. Issue 2, ENA, London, 2016, available at: <https://tinyurl.com/phbnps4>.
2. GLOBAL CEMENT AND CONCRETE ASSOCIATION. *GCCA Global Ratings for Cement*. GCCA, London, 2024, available at: <https://tinyurl.com/mr37p798>.
3. BRITISH STANDARDS INSTITUTION, BS EN 15804. *Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products*. BSI, London, 2012+A2:2019.



MAIN IMAGE, TOP:
Inch Cape windfarm landfall connection.

ABOVE:
Uskmouth substation cable bedding.