

# ECO Ultra-Low Carbon Concrete

## Zero Cement, Ultra-Low Carbon alternative to Portland Cement Concrete

### INTRODUCTION

Axtell ECO Low Carbon concrete is a practical sustainable solution for reducing the greenhouse gas emissions within the construction industry. Axtell ECO activates ground blast furnace slag (GGBS) producing an ultra-low carbon alternative to concrete mix designs that traditionally use Portland cement.

Axtell ECO incorporates the use of a patented Alkali Activated Binder and innovative admixtures to offer a range of strengths from general groundworks up to C30 piling applications.

The concrete contains specially selected and graded aggregates, cementitious components and advanced chemical admixtures which comply with BS EN 934.

Axtell ECO Ultra-Low Carbon concrete presents a viable alternative to CEMI in decreasing the effect on the environment in terms of energy conservation and lower CO<sub>2</sub> emissions.

### CEMENTITIOUS REACTION

GGBS reacts like Portland cement when in contact with water. But as the rate of reaction is slower, an activator is necessary. GGBS is also environmentally friendly as it reduces the use of ordinary Portland cement (CEMI) clinkers in proportion to the amount of GGBS that is substituted for CEMI.

It also decreases the amount of CO<sub>2</sub> generated from the thermal decomposition of limestone; a material used to produce OPC clinkers.

GGBS is a low performance cementitious material but can achieve conventional compressive strengths when an alkaline activator is used.

### Activators

Activators are required to initiate hydration. Although slag without an activator does react with water, the rate of hydration is very slow. Its hydraulic reactivity depends on chemical composition, glass phase content, particle size distribution, and surface morphology.

A coating of aluminosilicate forms on the surfaces of slag grains within a few minutes of exposure to water, and these coatings are impermeable to water. Unless a chemical activator is present, further hydration is inhibited. In general, Portland cement, gypsum, and many alkalis have been used as activators and the rate of hydration is faster at high alkali concentrations. The final products of the GGBS reaction are like the products of cement hydration; the major difference is the rate and intensity of the reaction.

When GGBS is used in concrete, the resulting hardened cement paste has more, smaller gel pores and fewer larger capillary pores than is the case with concrete made with normal Portland cement. This finer pore structure gives GGBS concrete a much lower permeability and makes an important contribution to the greater durability of this concrete.

The resulting hardened cement paste using GGBS is also more chemically stable. It contains much less free lime, which in concrete made with Portland cement leads to the formation of further reaction products such as ettringite or efflorescence. In addition, GGBS contains no C<sub>3</sub>A, making GGBS concrete much less reactive to sulphates

### COLOUR – “GREENING”

Axtell ECO may have blue-green or mottled green areas on the surface, during the first few days after placement of the concrete. This is a typical occurrence relating to complex processes, which happens when iron sulphide and manganese sulphide in the slag cement react with other compounds. The blue/green colour will generally start fading as these products oxidise, and the concrete will become the usual colour after being exposed to air.

This temporary phase is referred to as “greening.” Generally, this will not persist for more than a week after being exposed to dry air and sunlight.

Factors that may result in slower oxidation (fading) are prolonged wet curing, wet weather conditions, cold weather, shade and sealed/densified surfaces.

Greening is an indication of the concrete being well cured and is excellent for strength development purposes and does not compromise on later concrete performance which includes strength, durability and lower permeability.

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### ADVANTAGES

Axtell ECO is concrete designed specifically for Ultra-Low Carbon architectural applications. As such it has many characteristics beneficial to contractors.

- Reduced Carbon and Greenhouse emissions.
- Embedded CO<sub>2</sub>, a carbon reduction of up to 90% is achievable.
- Improved chemical resistance.
- Improves resistance to chloride ingress.
- Improved sulphate, acid and fire resistance.
- Reinforcement - Potential reduction in crack-control steel.
- Reduced shrinkage, enables engineers to design elements outside of conventional aspect ratios, reducing the number of joints.
- Lower Heat of Hydration, thermal cracking – Mass concrete structures.
- Strength Class from C8 to C30\*

\*Alkali Activated Cementitious Material develops compressive strength slower, with strength compliance considered from 56-days.

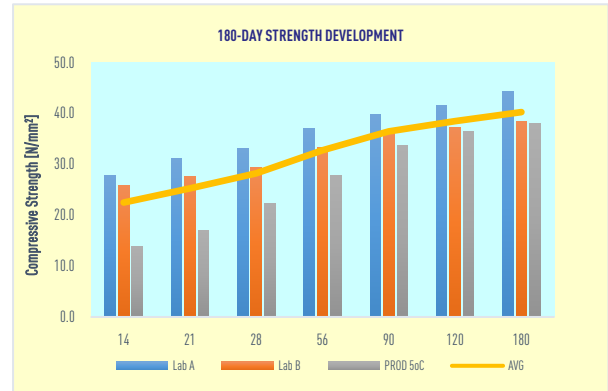
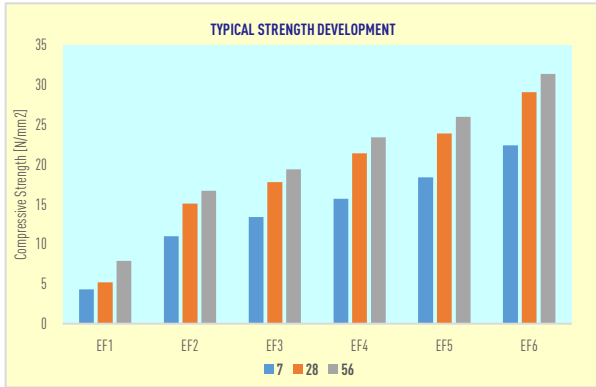
### REQUIREMENTS TO PAS 8820:2016

Concrete designers and specifiers will select products and materials against known performance requirements, which conform to a National Specification such as BS8500 and EN206 British Standards. Such standards for concrete are currently based exclusively on cement containing binders and equivalents do not exist for alkali activated cementitious materials (AACM's). If the concrete does not contain Portland cement it is automatically excluded from the existing standards.

PAS 8820:2016 specifies the performance requirements for alkali-activated cementitious materials comprising aluminosilicate main constituents and an alkali activator. It specifies a means of assessing concrete using AACM's for performance and durability, with specific tests for Carbonation, Chloride ingress, Freeze-Thaw resistance, Chemical attack and Alkali Silica reaction.

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### CARBON SAVING

By removing the cement, Axtell ECO has the capability to reduce the embodied carbon of concrete by up to 90%. Offering a justified proposal on projects that have high carbon reduction targets or to satisfy the requirements of clients who have a strong sustainability agenda.

As an example of the potential carbon savings, based on a 1000m<sup>3</sup> concrete volume, replacing a 100% Portland cement-based concrete with Axtell ECO could save 180 tonnes in embodied carbon, the equivalent of taking over 100 cars off the road or planting 900 trees.

\* Savings calculated using Mineral Products Association Fact Sheet 18, Table 1

Minimum strength class	CO <sub>2</sub> kg Saving 100 m <sup>3</sup>	Project Saving (Tons)	Planting TREES	Taking Cars off Road Whole Year	Turning Off LED Bulbs Whole Year
AXEF3 ECO FOUNDATION	150	15	75	9	510
AXEF4 ECO FOUNDATION	170	17	85	10	580
AXEF5 ECO FOUNDATION	180	18	90	11	610
AXEF6 ECO FOUNDATION	190	19	95	12	650

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CONCRETE:	CONTRACTORS:	THE CLIENT:
<ul style="list-style-type: none"> <li>• C8 to C30 (56-days)</li> <li>• Cohesive S3 consistence</li> <li>• Excellent Finish</li> <li>• Architectural Off-White Appearance</li> </ul>	<ul style="list-style-type: none"> <li>• Batched, placed, compacted and finished in the same way as conventional concrete</li> <li>• Lower heat of hydration, less risk of thermal cracking and shrinkage</li> <li>• Improved chemical and sulphate resistance</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced Carbon and Greenhouse emissions</li> <li>• Achieved environmental sustainability agenda</li> <li>• Government policies incentives</li> <li>• Patented AACM developed and manufactured in the UK, ensuring the highest standards are met at every stage of the process</li> </ul>

### TECHNICAL SERVICE

Our Technical Service department of Axtell Limited is available to assist and provide a technical and advisable service, which can be consulted early in the design process. This service can assist to create bespoke mixes, or if requested provide suggestions to ensure specification needs of the project.

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### HEALTH AND SAFETY

Wet concrete can cause serious alkali burns, a form of skin ulceration, from contact with freshly mixed concrete. Allergic contact dermatitis may be caused by individual sensitivity to compounds within the AACM.

Suitable protective clothing must be worn when working with concrete (long-sleeved clothing, gloves, full length trousers, safety glasses and impervious safety boots). Keep out of reach of children.

Back injuries are a hazard when lifting, stand clear of the truck when it's manoeuvring and discharging the load.

The information given is based on extensive research and product development and is offered in good faith for the user's consideration, investigation and verification. Whilst we guarantee the consistent high quality of our products, we have no control over the circumstances in which the materials are used, site conditions or the execution of the work therefore we do not warrant the results to be obtained in the case of misuse. Our product specialists are at the disposal of the users to help them with technical advice for the performance application and any problem encountered.

These products are covered by PAS 8820:2016

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