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Agrément Certificate

18/5572

Product Sheet 1

CONCRETE AQUA GUARD WATERTIGHT CONCRETE SYSTEM

CRYSTAL ADMIX HD

This Agrément Certificate Product Sheet⁽¹⁾ relates to Crystal Admix HD, a crystalline technology admixture for use in concrete mixes to provide watertight concrete suitable for basements, roofs, swimming pools, tunnels and culverts without the requirement for additional applied protection.

(1) Hereinafter referred to as 'Certificate'.

CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.



KEY FACTORS ASSESSED

Water penetration — concrete containing the product has reduced permeability when compared to the equivalent plain concrete (see section 6).

Reinforcement protection — concrete containing the product has enhanced resistance to reinforcement corrosion when compared to the equivalent plain concrete (see section 8).

Mechanical properties — the mechanical properties of concrete are not adversely affected by the incorporation of the product (see section 9).

Setting and hardening characteristics — concrete containing the product will be retarded when compared with the equivalent plain concrete (see section 10).

Durability — concrete containing the product is more durable than the equivalent plain concrete mix due to its reduced permeability (see section 18).



The BBA has awarded this Certificate to the company named above for the product described herein. This product has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of First issue: 18 September 2018

John Albon – Head of Approvals
Construction Products

Claire Curtis-Thomas
Chief Executive

The BBA is a UKAS accredited certification body – Number 113.

The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk
Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA direct.

Any photographs are for illustrative purposes only, do not constitute advice and should not be relied upon.

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Regulations

In the opinion of the BBA, the use of Crystal Admix HD is not subject to the national Building Regulations.

Construction (Design and Management) Regulations 2015 **Construction (Design and Management) Regulations (Northern Ireland) 2016**

Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

See section: 3 *Delivery and site handling* (3.1, 3.2 and 3.4) of this Certificate.

Additional Information

NHBC Standards 2018

In the opinion of the BBA, Crystal Admix HD, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements in relation to *NHBC Standards*, Chapter 5.4 *Waterproofing of basements and other below ground structures*.

Unless it can be demonstrated that the water table is permanently below the underside of the slab, the product should be used in combination with either a Type A or C waterproofing protection where Grade 3 protection is required and the below ground wall retains more than 600 mm (measured from the top of the retained ground to the lowest finished floor level).

CE marking

The Certificate holder has taken the responsibility of CE marking the product, in accordance with harmonised European Standard BS EN 934-2 : 2009 (Table 9). An asterisk (*) appearing in this Certificate indicates that data shown are given in the manufacturer's Declaration of Performance.

Technical Specification

1 Description

1.1 Crystal Admix HD is a crystalline technology admixture used in concrete mixes to enhance the water resistance and durability properties of the hardened concrete.

1.2 The product is supplied as a grey powder.

2 Manufacture

2.1 The product is manufactured by batch blending processes.

2.2 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

3 Delivery and site handling

3.1 The product is delivered to site as described in Table 1.

Table 1 Packaging type and weights

Pack type ⁽¹⁾	Net weight per soluble bag or pail (kg)	Number of bags per pail	Gross weight per pail	Number of pails per pallet
Soluble bags in pail	1.0	18	18.8	48
Powder in pail	18.0	—	18.8	48

(1) Other pack sizes are available on request.

3.2 The product is labelled with the Certificate holder's and product name, batch number, and health and safety and CE marking information.

3.3 The product must be stored in sealed containers in a dry environment and protected from rain or other sources of moisture. The product will have a minimum shelf-life of two years, when stored in accordance with the Certificate holder's instructions.

3.4 The Certificate holder has taken the responsibility of classifying and labelling the product under the *CLP Regulation (EC) No 1272/2008 on the classification, labelling and packaging of substances and mixtures*. Users must refer to the relevant Safety Data Sheet(s).

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Crystal Admix HD.

Design Considerations

4 Use

4.1 Crystal Admix HD is satisfactory for use in concrete mixes at an addition rate of 1% by weight of the total cementitious content to provide a watertight concrete for basements, roofs, swimming pools, tunnels and culverts, without the need for additional applied protection.

4.2 The effect of the product on the properties of concrete designed to BS EN 480-1 : 2014 is shown in Table 2.

Table 2 Effects of the product on the properties of fresh wet concrete⁽¹⁾

Property (unit)	Control concrete	Crystal Admix HD
Water/cement ratio	0.50	0.41
Slump (mm)		
0 min	130	150
30 min	115	150
Plastic density (kg·m ⁻³)	2344	2417
Air content (%)	2.0	2.0

(1) The specific effect of the product on these properties, for a particular mix and site conditions, should be evaluated through site specific trials prior to use.

4.3 Concrete containing the product should be designed in accordance with BS EN 206 : 2013 and BS 8500-2 : 2015 for use as all normal types, including precast, pre-stressed, post-tensioned, ready-mixed, reinforced, slip formed, sprayed and pumped concretes.

4.4 The product is compatible with cement blends containing pulverized fuel ash, ground granulated blast-furnace slag and silica fume, as defined in BS EN 197-1 : 2011.

4.5 The use of the product with an air-entraining agent is outside the scope of this Certificate.

4.6 Joints should be designed with waterstops as recommended by BS 8102 : 2009, Section 9.2.1.4.

5 Practicability of installation

Concrete mixes containing the product can be placed, compacted and cured by operatives with experience of using conventional concreting methods and equipment.

6 Water penetration

6.1 Concrete containing the product has greater resistance to water penetration than an equivalent plain concrete.

6.2 Tests conducted on a concrete containing the product, at an addition rate of 1% by weight of cement, showed a water permeability⁽¹⁾ of $6.58 \times 10^{-14} \text{ m}\cdot\text{s}^{-1}$ compared with $8.31 \times 10^{-13} \text{ m}\cdot\text{s}^{-1}$ for control concrete.

(1) The specific effect of the product on these properties, for a particular mix and site conditions, should be evaluated through site specific trials prior to use.

7 Water vapour permeability

7.1 Concrete containing the product has a lower permeability by water vapour than an equivalent plain concrete.

7.2 Test results showed that concrete containing 1% by weight of the total cementitious content has a water vapour permeability⁽¹⁾ of $2.68 \times 10^{-10} \text{ g}\cdot\text{m}(\text{N}\cdot\text{s})^{-1}$ compared with $3.85 \times 10^{-10} \text{ g}\cdot\text{m}(\text{N}\cdot\text{s})^{-1}$ for the control concrete.

(1) The specific effect of the product on these properties, for a particular mix and site conditions, should be evaluated through site specific trials prior to use.

7.3 Concrete made with a high water/cement ratio can have a water vapour permeability above $3000 \times 10^{-12} \text{ g}\cdot\text{m}(\text{N}\cdot\text{s})^{-1}$. The permeability of the concrete is highly dependent on the exact mix design, and the figures given in section 7.2 indicate the levels that can be obtained using the product.

7.4 The appropriate thickness for concrete with a specific permeability to achieve a water vapour resistance of 200 or 550 $\text{MN}\cdot\text{s}\cdot\text{g}^{-1(1)}$ (suitable for Grade 3 of BS 8102 : 2009) is given by:

for 200 $\text{MN}\cdot\text{s}\cdot\text{g}^{-1}$, $t = 0.20 \times 10^{12} \times p$

for 550 $\text{MN}\cdot\text{s}\cdot\text{g}^{-1}$, $t = 0.55 \times 10^{12} \times p$

where:

t is the concrete thickness in mm

p is the water vapour permeability in $\text{g}\cdot\text{m}(\text{N}\cdot\text{s})^{-1}$ (from BS 3177 : 1959 test).

(1) This figure may be used where a high resistance to water vapour is required.

8 Reinforcement protection

8.1 The high alkalinity required to prevent corrosion of the reinforcement ($\text{pH}>13$) will not be adversely affected by the incorporation of the product into the concrete.

8.2 Corrosion of reinforcement is normally caused by the ingress of chloride to the steel and/or by the reduction in alkalinity of the concrete by the diffusion of carbon dioxide. The reduced permeability of concrete containing the product will slow down diffusion of aggressive agents into the concrete and so confer improved protection against reinforcement corrosion.

8.3 The water soluble chloride ion content of the product is $< 0.1\%^*$.

9 Mechanical properties

9.1 The 7 day and 28 day compressive strength and flexural strength of concrete containing the product will be significantly higher than the equivalent plain concrete with similar consistence slump. The results are shown in Table 3.

9.2 The 28 day static modulus of elasticity of concrete containing the product will be higher than the equivalent plain concrete. The results are shown in Table 3.

Table 3 Effects of the product on compressive strength and modulus of elasticity

Property	Control concrete ⁽¹⁾	Crystal Admix HD ⁽¹⁾	Test reference
Compressive Strength (MPa)			
7 days	46.7	61.0	BS EN 12390-3
28 days	58.5	75.3	
Flexural Strength (MPa)			
7 days	4.9	6.5	BS EN 12390-5
28 days	5.5	7.5	
Modulus (28 days) (MPa)	37284	44044	BS 1881-121

(1) Refer to Table 2 for mix design information.

10 Setting and hardening characteristics

10.1 The effect of the product for a specific mix and site conditions should be evaluated through site trials prior to use.

10.2 The setting time of the concrete mixes containing the product will be significantly retarded when compared with equivalent plain concrete. The amount of retardation will depend on the concrete mix design used and ambient temperature during placing and curing.

10.3 The effect of the product on the setting properties of concrete designed to BS EN 480-1 : 2014 as shown in Table 4 of this Certificate.

Table 4 Effects of the product on the setting properties of fresh wet concrete⁽¹⁾

Property	Control concrete	Crystal Admix HD	Test reference
Water/cement ratio	0.50	0.41	—
Setting time (minutes)			
initial set	190	500	BS 5075-1
final set	260	1210	

(1) The specific effect of the product on these properties, for a particular mix and site conditions, should be evaluated through site specific trials prior to use.

11 Drying shrinkage and wetting expansion

The drying shrinkage and wetting expansion of concrete containing the product is reduced compared with that of an equivalent plain concrete (see Table 5).

Table 5 Effect of the product on the shrinkage and expansion properties of hardened concrete⁽¹⁾ (typical laboratory results)

Property	Control concrete	Crystal Admix HD	Test reference
Drying shrinkage (%)	0.043	0.040	BS 1881-5
Wetting expansion (%)	0.025	0.014	BS 1881-5

(1) The specific effect of the product on these properties, for a particular mix and site conditions, should be evaluated through site trials prior to use.

12 Carbonation resistance

Concrete containing the product will have a similar resistance to carbon dioxide diffusion as that of an equivalent plain concrete.

13 Frost resistance

Concrete containing the product has a greater resistance to frost than an equivalent plain concrete.

14 Sulfate resistance

The lower permeability of concrete containing the product reduces the ingress of sulfates. However, if sulfate-resistant concrete is required, the advice of the Certificate holder should be sought.

15 Alkali/silica reaction (ASR)

15.1 Concrete containing the product should be designed according to BS EN 206 : 2013 Section 5.2.3.5, and BS 8500-2 : 2015 Section 5.2.

15.2 The sodium oxide equivalent of the product, when measured in accordance with BS EN 480-12 : 2005 was 15.84 % by mass of dmixture. The Certificate holder should be consulted for current typical values and maximum declared values of the sodium oxide equivalent of the product.

16 Resistance to leaching

The lower permeability of concrete containing the product will reduce the leaching of lime from the hydrated cement in the concrete.

17 Maintenance

For a specific installation, a maintenance regime should be considered to ensure that the required design life of the concrete is achieved.

18 Durability

18.1 Under normal conditions of service, concrete containing the product is more durable than an equivalent plain concrete owing to its reduced permeability.

18.2 Where exposure to aggressive soil conditions or chemicals is anticipated, a full assessment of the site should be made. In these situations the Certificate holder should be consulted on the suitability of the product.

Installation

19 General

19.1 When the product is used in concrete mixes, it enhances durability and improves protection against reinforcement corrosion by providing a concrete with reduced permeability that protects it against water ingress via hydrostatic pressure.

19.2 Use of the product will produce a concrete with the following enhanced properties relative to a control:

- reduced porosity
- reduced capillary absorption
- increased water resistance
- increased corrosion resistance.

19.3 Structures built incorporating the product should be designed to the relevant sections of BS 8102 : 2009 and BS EN 1992-1-1 : 2004, BS EN 1992-1-2 : 2004 and BS EN 1992-3 : 2006 and their UK National Annexes.

19.4 Concrete mixes containing the product are suitable for Type B protection as described in BS 8102 : 2009, Table 1, and can satisfy the requirements for all grades defined in Table 2 of that Standard. For Grade 3 (where control of water vapour is required), it will be necessary to provide a mix with a sufficiently low vapour permeability in combination with an adequate section thickness (see sections 7.3 and 7.4). The use of suitable ventilation, dehumidification or air-conditioning, appropriate to the intended use, must also be considered.

19.5 Basements for dwellings should be designed in accordance with the guidance given in the *Guidance Document – Basements for dwellings*⁽¹⁾.

(1) Published by Basement Information Centre, Product code: TBIC/007.

20 Mix design

20.1 Concrete containing the product is normally supplied as ready-mixed concrete but may be prepared on site where there is adequate mix control. Concrete preparation on site should be carried out in accordance with BS 8000-2-1 : 1990, the Certificate holder's instructions and this Certificate.

20.2 Concrete mixes must have a minimum cement content of 325 kg·m⁻³ and be batched with a maximum water/cement ratio of 0.45 to achieve a consistence slump class of S3 as defined in BS EN 206 : 2013. For water/cement ratios above 0.45 and the suitability of mixes the Certificate holder or their approved representatives must be consulted.

20.3 Once the fresh concrete is mixed, further materials must not be added except for water reducing or superplasticiser admixtures (see section 20.4).

20.4 The consistency of the concrete can be adjusted using a suitable⁽¹⁾ water reducing or superplasticising admixture complying with BS EN 934-2 : 2009, Tables 3.1 and 3.2, to ensure that the maximum water/cement ratio given in section 20.2 of this Certificate is not exceeded. The superplasticiser must be added after the addition of Crystal Admix HD. Specific admixtures have not been considered and are outside the scope of this Certificate.

(1) The Certificate holder's advice should be sought regarding the suitability and compatibility of water reducing or superplasticising admixtures. Admixtures should be evaluated before use and site trials carried out to establish the appropriate dose required.

21 Mixing

21.1 The product is added to the concrete mix or cement at the correct dose (see section 4.1) in accordance with the Certificate holder's instructions.

21.2 When a superplasticiser is required, it should be added after the addition of the product.

21.3 The resulting concrete should be mixed for a further ten minutes at high speed to ensure even distribution of the product throughout the concrete.

21.4 Where the product is to be added to concrete on site, care must be taken to ensure that adequate mix control is available.

22 Placing

22.1 Concrete containing the product should be placed in the same way as normal concrete, in accordance with BS 8000-2-2 : 1990, BS EN 13670 : 2009, and following the Certificate holder's health and safety guidance and the normal routine precautions for handling concrete.

22.2 Concrete mixes containing the product should not be placed at temperatures of 5°C or below.

22.3 Concrete containing the product should be fully compacted.

23 Curing

The concrete should be cured strictly in accordance with BS EN 13670 : 2009, BS EN 1992-1-1 : 2004 and its UK National Annex, and the Certificate holder's recommendations (where site-specific information exists).

24 Joints

24.1 Joints must be designed with waterstops as recommended in BS 8102 : 2009, to maintain the watertightness of the whole structure. The advice of the Certificate holder should be sought on particular applications.

24.2 Penetrations of the concrete, such as pipe entries or formwork ties, must also be securely sealed to maintain watertightness. The Certificate holder can advise on suitable systems.

25 Finishes

When water-based products are used to coat the hardened concrete, a bonding agent may be needed. For specific cases, advice should be sought from the Certificate holder.

Technical Investigations

26 Tests

26.1 The results of characterisation tests on Crystal admix HD were assessed to determine:

- homogeneity and colour
- conventional dry material content
- water soluble chloride
- alkali content (Na₂O equivalent)
- IR spectroscopy.

26.2 The results of tests on the effect of Crystal Admix HD on the typical properties of concrete were assessed to determine:

- setting and hardening concrete characteristics, including:
 - plastic density
 - slump
 - setting time (initial and final set)
 - air content
- hardened concrete characteristics, including:
 - compressive strength
 - flexural strength
 - modulus of elasticity
 - drying shrinkage
 - wetting expansion
 - liquid water permeability
 - water vapour permeability
 - bond strength to steel
 - freeze/thaw resistance (resistance to scaling)
 - efflorescence.

27 Investigations

27.1 The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

27.2 A user survey was conducted to investigate the performance of the product in service.

Bibliography

- BS 206 : 2013 + A1 : 200016 *Concrete — Specification, performance, production and conformity*
- BS 480-12 : 2005 *Admixtures for concrete, mortar and grout — Test methods — Determination of the alkali content of admixtures*
- BS 1881-5 : 1970 *Testing concrete — Methods of testing hardened concrete for other than strength*
- BS 1881-121 : 1983 *Testing concrete — Method of determination of static modulus of elasticity in compression*
- BS 3177 : 1959 *Method for determining the permeability of water vapour of flexible sheet materials used for packaging*
- BS 5075-1 : 1982 *Concrete admixtures — Specification for accelerating admixtures, retarding admixtures and water-reducing admixtures*
- BS 8000-2-1 : 1990 *Workmanship on building sites — Code of practice for concrete work — Mixing and transporting concrete (AMD 9324)*
- BS 8000-2-2 : 1990 *Workmanship on building sites — Code of practice for concrete work — Sitework with in situ and precast concrete*
- BS 8102 : 2009 *Code of practice for protection of structures against water from the ground*
- BS 8500-2 : 2015 + A1 : 2016 *Concrete — Complimentary British Standard to BS EN 206 — Specification for constituent materials and concrete*
- BS EN 197-1 : 2011 *Cement — Composition, specifications and conformity criteria for common cements*
- BS EN 206 : 2013 + A1 : 2016 *Concrete — Specification, performance, production and conformity*
- BS EN 480-1 : 2014 *Admixtures for concrete, mortar and grout — Test methods — Reference concrete and reference mortar for testing*
- BS EN 934-2 : 2009 + A1 : 2012 *Admixtures for concrete, mortar and grout — Concrete admixtures — Definitions, requirements, conformity, marking and labelling*
- BS EN 13670 : 2009 *Execution of concrete structures*
- BS EN 1992-1-1 : 2004 + A1 : 2014 *Eurocode 2 — Design of concrete structures — General rules and rules for buildings*
NA + A2 : 14 to BS EN 1992-1-1 : 2004 + A1 : 2014 *UK National Annex to Eurocode 2 — Design of concrete structures — General rules and rules for buildings*
- BS EN 1992-1-2 : 2004 *Eurocode 2 — Design of concrete structures — General rules — Structural fire design*
NA to BS EN 1992-1-2 : 2004 *UK National Annex to Eurocode 2 — Design of concrete structures — General rules — Structural fire design*
- BS EN 1992-3 : 2006 *Eurocode 2 — Design of concrete structures — Liquid retaining and containing structures*
NA to BS EN 1992-3 : 2006 *UK National Annex to Eurocode 2 — Design of concrete structures — Liquid retaining and containing structures*
- BS EN 12390-3 : 2009 *Testing hardened concrete — Compressive strength of test specimens*
- BS EN 12390-5 : 2009 *Testing hardened concrete — Flexural strength of test specimens*

28 Conditions

28.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page – no other company, firm, organisation or person may hold claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document – it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

28.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

28.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

28.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

28.5 In issuing this Certificate the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- actual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to CE marking.

28.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.