Kryton International Inc
1645 East Kent Avenue
Vancouver
British Columbia
Canada V5P 2S8

Tel: 00 1 604 324 8280 Fax: 00 1 604 324 8899
e-mail: info@kryton.com
website: www.kryton.com

Agrément Certificate
05/4217
Product Sheet 1

KRYSTOL WATERTIGHT CONCRETE SYSTEM

KRYSTOL INTERNAL MEMBRANE – HS (KIM-HS)

This Agrément Certificate Product Sheet(1) relates to Krystol Internal Membrane – HS (KIM-HS), a reactive crystalline admixture for use in concrete mixes to provide watertight concrete suitable for basements, roofs, swimming pools, tunnels, and culverts, without the requirements 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

Setting and hardening characteristics — concrete containing the product will be retarded when compared with the equivalent plain concrete (see section 6).

Water penetration — concrete containing the product has reduced permeability when compared to the equivalent plain concrete (see section 7).

Reinforcement protection — concrete containing the product has enhanced resistance to reinforcement corrosion when compared to the equivalent plain concrete (see section 9).

Mechanical properties — the mechanical properties of concrete are not adversely affected by the incorporation of the product (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 Sixth issue: 23 October 2018

Originally certificated on 30 March 2005

John Albon – Head of Approvals
Construction Products

Claire Curtis-Thomas
Chief Executive

Regulations

In the opinion of the BBA, the use of Krystol Internal Membrane 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, 3.4 and 3.5) of this Certificate.

Additional Information

NHBC Standards 2018

In the opinion of the BBA, Krystol Internal Membrane – HS (KIM-HS), 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 8). 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 Krystol Internal Membrane – HS (KIM-HS) is a reactive crystalline admixture for incorporation in concrete to enhance:

- set-retarding properties
- the watertightness and durability in its hardened state.

1.2 The product is supplied as a powder consisting of blended Portland cement and proprietary chemicals.

2 Manufacture

2.1 The product is manufactured by a blending process.

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 supplied on shrink-wrapped pallets in the packaging and weights given in Table 1.

Table 1 Packaging and weights

Packaging type	Weight (kg)	No per pallet	Pallet weight (kg)
Pails	5	96	480
	25	36	900
Bag	5-10	96-192	960

3.2 Each container bears the manufacturer's and product name, batch number, Health and Safety information and the BBA logo incorporating the number of this Certificate.

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 has a shelf-life of two years, when stored under these conditions.

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).

3.5 When handling, the normal Health and Safety procedures associated with cementitious materials should be observed.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Krystol Internal Membrane – HS (KIM-HS).

Design Considerations

4 Use

4.1 Krystol Internal Membrane – HS (KIM-HS) is satisfactory for use in concrete mixes at an addition rate of 2% by weight of the total cementitious content to provide set-retarding properties and watertight concrete for basements, roofs, swimming pools, tunnels and culverts, without additional applied protection.

4.2 The effect of the product on the properties of concrete designed to BS EN 480-1 : 1998 is shown in Table 2.

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

Property (unit)	Control concrete	Krystol Internal Membrane – HS (KIM-HS)
Water/cement ratio	0.49	0.47
Slump (mm)		
0 min	70	65
30 min	40	45
Plastic density ($kg \cdot m^{-3}$)	2410	2420
Air content (%)	1.0	0.9

(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.

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 Setting and hardening characteristics

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

6.2 The setting time of the concrete mixes containing the product will be 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.

6.3 The effect of the product on the setting properties of concrete designed to BS EN 480-1 : 1998 as shown in Table 3.

Table 3 Effects of the product on the setting properties of fresh wet concrete(1)

Property	Control concrete	Krystol Internal Membrane – HS (KIM-HS) concrete	Test reference
Water/cement ratio	0.49	0.47	
Setting time (minutes)			
initial set	150	200	BS 5075-1
final set	250	700	

(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 penetration

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

7.2 Tests conducted on a concrete containing the product, at an addition rate of 2% by weight of cement, showed a water permeability(1) of 1.28 x 10^{-14} m·s^{-1} compared with 4.29 x 10^{-14} m·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.

8 Water vapour permeability

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

8.2 Test results showed that concrete containing 2% by weight of the total cementitious content has a water vapour permeability(1) of 463 x 10^{-12} g·m(N·s)$^{-1}$ compared with 561 x 10^{-12} g·m(N.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.

8.3 Concrete made with a high water/cement ratio can have a water vapour permeability above 3000 x 10^{-12} g·m(N·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.

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

for 200 MN·s·g^{-1}, t = 0.20 x 10^{12} x p

for 550 MN·s·g^{-1}, t = 0.55 x 10^{12} x p

where:

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

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

9 Reinforcement protection

9.1 The high alkalinity required to prevent corrosion of the reinforcement (pH>13) will not be adversely affected by the incorporation of the product into the concrete.

9.2 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.

9.3 The Certificate holder has declared the chloride ion content of the product as <0.1%*.

10 Mechanical properties

10.1 The compressive strength of concrete containing the product will be higher than the equivalent plain concrete with the same slump.

10.2 The flexural strength of concrete containing the product is similar to the equivalent plain concrete with the same slump.

10.3 The static modulus of elasticity of concrete containing the product is higher than the equivalent plain concrete.

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 4).

Table 4 Effect of the product on the shrinkage and expansion properties of hardened concrete(1) *(typical laboratory results)*

Property	Control concrete	Krystol Internal Membrane – HS (KIM-HS) concrete	Test reference
Drying shrinkage (%)	0.040	0.030	BS 1881-5
Wetting expansion (%)	0.030	0.020	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 has a greater resistance to carbon dioxide diffusion than an equivalent plain concrete.

13 Frost resistance

Concrete containing the product has a greater resistance to frost than an equivalent plain hardened concrete (see Table 5).

Table 5 Effect of the product on the frost resistance properties of hardened concrete(1) *(typical laboratory results)*

Property	Control concrete	Krystol Internal Membrane – HS (KIM-HS) concrete	Test reference
Freeze/thaw expansion (%)	0.742	0.099	BS 5075-2

(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.

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 : 1998, was 7.15 % by mass of admixture. The Certificate holder's declared value of ≤10%* for the sodium oxide equivalent of the product should be used when calculating its contribution to the total alkali content of a given concrete mix. This in turn can be used to assess the susceptibility of that concrete to alkali-silica reaction.

16 Resistance to leaching

Use of the product reduces the leaching of lime from the hydrated cement in the concrete.

17 Maintenance

For a specific installation, the 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 8.3 and 8.4). 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 $kg \cdot m^{-3}$ and be batched with a maximum water/cement ratio of 0.5. Further details of suitable mixes can be obtained from the Certificate holder or their approved representatives.

20.3 Once the fresh concrete is mixed, further materials must not be added.

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. 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 at the correct doses (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 to ensure even distribution of the product throughout the concrete.

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, 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 lower than 5°C.

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 tests on Krystol Internal Membrane – HS (KIM-HS) concrete were assessed to determine:

- characteristics of the admixture including
  - conventional dry material content
  - water soluble chloride
  - total chloride
  - pH
  - alkali content
  - IR trace.

26.2 The results of tests on the effect of Krystol Internal Membrane – HS (KIM-HS) concrete on the typical properties of concrete were assessed to determine:

- setting and hardening concrete characteristics, including
  - density
  - slump
  - setting time
  - workability
  - air content
- hardened concrete characteristics, including
  - compressive strength
  - modulus of elasticity
  - flexural strength
  - drying shrinkage
  - wetting expansion
  - liquid water permeability
  - water vapour permeability
  - bond strength to steel
  - freeze/thaw resistance
  - 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 1881-5 : 1970 *Testing concrete — Methods of testing hardened concrete for other than strength*

BS 3177 : 1959 *Method for determining the permeability to 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 5075-2 : 1982 *Concrete admixtures — Specification for air-entraining admixtures*

BS 8000-2-1 : 1990 *Workmanship on building sites — Code of practice for concrete work — Mixing and transporting concrete*
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 below ground structures against water from the ground*

BS 8500-2 : 2015 + A1 : 2016 Concrete — Complementary 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 : 1998 *Admixtures for concrete, mortar and grout – Test methods – Reference concrete and reference mortar*
BS EN 480-12 : 1998 *Admixtures for concrete, mortar and grout – Test methods – Determination of the alkali content of admixtures*

BS EN 934-2 : 2009 + A1 : 2012 *Admixtures for concrete, mortar and grout — Concrete admixtures — Definitions, requirements, conformity, marking and labelling*

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 13670 : 2009 *Execution of concrete structures*

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 or 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.

British Board of Agrément
Bucknalls Lane
Watford
Herts WD25 9BA

tel: 01923 665300
clientservices@bbacerts.co.uk
www.bbacerts.co.uk