



At the Lab. In the Field.
By Your Side.

KIM® (KRYSTOL INTERNAL MEMBRANE™)

July 2008
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QUESTIONS: 1-800-267-8280 or www.kryton.com

DESCRIPTION

Krystol Internal Membrane™ (KIM®) is a chemical admixture in dry powdered form, effective in creating waterproof concrete. KIM is used in place of externally applied surface membranes to protect against moisture transmission, chemical attack, and corrosion of reinforcing steel.

HOW DOES KRYSTOL® TECHNOLOGY WORK?

When combined with water and concrete, Krystol® reacts with un-hydrated cement particles to form millions of needle-like crystals. Over a period of weeks and months, these crystals grow, filling the naturally occurring pores and voids in concrete, and permanently blocking the pathways for water and waterborne contaminants.

Later, if cracks form, incoming water triggers the crystallization process and additional crystals begin to grow, filling cracks and ensuring that the structure's waterproofing barrier is maintained and protected.

In addition to filling the pores and capillaries of the concrete matrix with crystals, the KIM® admixture enhances the natural hydration process by intensifying and prolonging the hydration of the cementing materials. This reduces the size and number of capillary pores within the concrete matrix, making it dramatically less porous and improving strength & durability characteristics.

GENERAL INFORMATION

Color	Gray
Texture	Powder
Particle size	40-150 microns
Relative bulk density	~1.4
Specific Gravity	~2.8
Hydrostatic head resistance	140 m (460 ft.)
Self-Sealing	0.5mm (0.02 inches)
Packaging	5 Kg, 25Kg Pails 10Kg Mixer Ready Bags
Shelf-life	Pails : 2 Years Bags : 1 Y (wrapped skid) 4 Months (open skid)

KIM® HS

This specialized version of KIM® is available with reduced air-entrainment properties. KIM HS is designed for applications where freeze/thaw resistance is not required. Typically, concrete with lower air content will produce higher compressive strength results.

FEATURES

- Replaces unreliable exterior membranes, liners and coatings
- Easily added directly to ready mix truck or at batch plant
- Self-seals hairline cracks up to 0.5mm (0.02 in)
- Reactivates in the presence of moisture—even years later
- Effective against hydrostatic pressure—up to 140m (460 ft) of head pressure
- Waterproof from any direction (i.e. positive or negative side)
- Impervious to physical damage and deterioration
- Certified non-toxic and safe for contact with potable water—NSF approved
- Reduces concrete shrinkage and cracking.
- Increases compressive strength of concrete
- Provides excellent resistance to waterborne chemicals such as sulphates , chlorides, and acids
- Reduces segregation in high slump concrete

ADVANTAGES

- Works where other systems fail to eliminate leaks and water damage
- Eliminates the cost of labor and materials that would normally be involved with membrane systems.
- Reduces potential for human error - insufficient seam coverage, poor surface preparation and inadequate adhesion
- Backfill sooner without concern for membrane damage
- Does not require replacement or maintenance
- Build to the property line - easily waterproof blind walls
- No waiting while contractors apply external membranes.
- Protects concrete from corrosion of reinforcing steel
- Protects concrete from damage due to freezing and thawing cycles
- Reduces insurance costs
- More cohesive mixes in high slump or highly fluid concrete compatible with SCC

TECHNICAL DATA

The Kryton Group of Companies.

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KEY BENEFITS

- Increased reliability and quality control
- Lower the cost of waterproofing by up to 40%
- Shave weeks off the construction schedule
- Reduce the cost of maintenance and repairs
- Increase revenues with a larger building footprint

WARRANTY

Kryton International Inc. warrants that its products are free from manufacturing defects and, when applied in accordance with the current specification and application instructions, will perform as so stated in its product literature. Waterproofing performance of the KIM® Admixture is warranted for 25 years. Kryton will provide sufficient material to waterproof areas shown to be defective due to KIM admixture material deficiencies. In addition to our standard product warranty, performance warranties are available for individual projects. Specific warranty time periods and inclusive details are provided based on project requirements and geographic region. Please refer to your Kryton representative for project specific performance warranty information.

TYPICAL APPLICATIONS

KIM® is recommended for all concrete that will be subject to water pressure.

Commercial

- Underground parking Structures, foundations, elevator pits, condominiums and office towers
- Recreational Facilities such as aquatic centers, aquariums, zoos, water parks and marinas
- Architectural water features like fountains & waterfalls

Industrial

- Water containment reservoirs and water treatment tanks, sewerage and manholes
- Traffic tunnels, below-ground pipelines and subway tunnels
- Bridges, dams, and highway infrastructure

Residential

- Concrete homes, basements, foundations, swimming pools, decks, bathrooms, garages and exteriors

APPLICATION INSTRUCTIONS

A pre-pour conference with the general contractor, forming contractor, finisher, concrete supplier and materials testing engineer is strongly recommended. Be sure to distribute and follow the instructions contained in Technical Bulletins 301 through 307 as applicable. For more instructions or information contact the technical services of Kryton International or your local Kryton representative.

MIX DESIGN GUIDELINES

- Dose KIM at 2% by weight of cementitious materials (including fly ash and other supplementary cementing materials) to a maximum dosage of 8kg per cubic meter (13.5 lbs / cubic yard).
- KIM will typically increase air entrainment by 3 – 5%; Adjust or remove air-entraining admixtures accordingly.
- KIM-HS will increase air content by less than 1%.

- KIM is generally compatible with other concrete admixtures.
- KIM will typically delay the initial and final setting times of the concrete. Adjust or remove any set-retarding admixtures accordingly.
- Trial batches are required to determine actual plastic properties.

BATCHING AND MIXING

- Simply add KIM directly to the concrete mixer during batching. When using mixer ready bags, bags will disintegrate and can be added directly to the mixer (See Tech Bulletin 310).
- KIM can be added at any time during the batching process. However, the addition timing and order of admixture addition may affect plastic properties.
- Allow KIM to thoroughly mix at medium/high speed for at least 10 minutes prior to placing.

PLACING AND FINISHING

- Superior consolidation of the concrete is essential to achieve the performance and benefits of KIM.
- Place and finish in accordance with ACI guidelines as summarized in the KIM Best Practice Guide.
- KIM improves flow, pumpability and placement properties of plastic concrete.
- If the slump is below specification, add a mid or high range water reducer to achieve the required slump. Only add additional water with the approval of the quality control technician. Record all water additions on the batch ticket and do not exceed the specified water-cement ratio.
- KIM treated concrete will typically delay the initial and final setting times of the concrete. Adjust your finishing or stripping schedule accordingly.

CURING

- Proper curing is essential to achieve the performance and benefits of KIM.
- Cure in accordance with ACI guidelines (ACI 308.1).
- If a curing compound is use, it must conform to ASTM C309

JOINTS

- Static construction joints should be treated with the Krystol Waterstop System as described in Technical Bulletins 103-105. This may require minor modifications to concrete forms.
- Penetrations should be treated as per Technical Bulletin 204A.
- Tie holes should be treated as per Technical Bulletin 180.
- Shrinkage control joints should be installed to ACI requirements.

PRECAUTIONS

KIM® contains Portland cement and becomes caustic when mixed with water or perspiration. Avoid contact with eyes and skin. Avoid breathing dust. See the Material Safety Data Sheet for this product.

KIM will delay the setting times of concrete under most conditions. This may affect form pressure. Build forms in accordance with ACI standards.

TEST DATA WORKABILITY

ASTM C143 – Standard Test Method for Slump of Hydraulic Cement Concrete

The Kryton Group of Companies.

KIM enhances the workability and plastic properties of concrete in many ways. KIM provides plasticizing effects at low and high slump requirements and provides better flow and consolidation even at low slumps. KIM works very well with superplasticizers to achieve high slumps for long pumping distances and unique applications without segregation. Best results within 45 minutes. *HBT Agra Ltd., 1993*

PROPERTIES OF FRESH KIM® CONCRETE

Tested under auspices of HBT Agra Ltd.

Fresh Property	Test		Control Concrete	Concrete with 2% KIM addition by mass of cement
	CAN/CSA	ASTM		
Water Demand Kg/m ³			153	143
Slump, mm	A23.2-5C	C143	75	80
Air content %	A23.2-4C	C231	6.6	6.2
Plastic Density, Kg/m ³	A23.2-6C	C136	2312	2328
Total Bleeding (kg/m ²)		C232	0.21	0.48
Bleeding Rate (kg/m ² /hr)		C232	0.080	0.044

*Water Reducer and Air Entraining Admixture added to control.

PROPERTIES OF HARDENED KIM CONCRETE

Tested under auspices of HBT Agra Ltd.

Hardened Property	Test		Control Concrete	Concrete with 2% KIM addition by mass of cement
	CAN/CSA	ASTM		
Comparative Strength, MPa @ 24 hrs @ 3 days @ 7 days @ 28 days @ 56 days	A23.2-9C	C39		
			8.4	8.0
			20.6	23.7
			28.1	33.4
			35.7	41.0
41.6	46.7			
Boiled Absorption % @ 7 days		C642	5.3	4.7
Permeable Void % @ 7 days		C642	11.7	10.7
Hardened Air Voids Parameters Air Content % Specific Surface mm ² /mm ³ Spacing factor, um**	A23.2-17C	C457		
			5.6	6.5
			30.9	22.8
			150.0	180.0

*Water Reducer and Air Entraining Admixture added to control.

**Meets CAN/CSA A23.1-M90: Clause 14.3 Requirements for Spacing Factor Not exceeding 230 um.

PERMEABILITY

DIN 1048: Part 5 - Permeability of Hardened Concrete

Concrete specimens containing KIM (@ 2% cmts) were cast and aged for 28 days. The specimens were then subjected to hydrostatic pressure of 72.5 psi (500KPa) for a period of 72 hours. This pressure is equal to 167 vertical feet (51m) of water head pressure. Maximum penetration: less than 1/8th inch (<3mm). The specimens exhibited no leakage or dampness.

Al-Fattaim Tarmac Laboratories, 2002

ICBO/ICC Water Percolation Test (Modified ASTM D4068 annex A2)

Concrete specimens containing KIM (@ 2% cmts) were cast and aged for 28 days. The specimens were then subjected to hydrostatic pressure imposed by water columns 48 inches in height. The specimens met the acceptance criteria, which is no water passing through the specimens and maximum 0.5 inches of water drop in the columns after 48 hours.

Inspection Concepts California, 1993

CRD C48 - 92 – USACE Standard Test Method for Water Permeability of Concrete

Six concrete specimens containing KIM (@ 2% cmts) were cast and aged for 28 days. The specimens were then subjected on one side to hydrostatic pressure of 200 psi (1.38MPa) for a period of 10 days. This pressure is equal to 460 vertical feet (140m) of water head pressure. There was no leakage through any of the specimens.

A similar test was conducted by AGRA Earth and Environmental in 1995, which compared reference concrete mixes of high strength concrete (50-60 MPa) with and without the addition of KIM. Results of permeability testing show that even for these mixes, KIM achieved 57% and 75% reductions in permeability over the reference mixes.

Agra Earth & Environmental Ltd., 1995

RAPID CHLORIDE PERMEABILITY

ASTM C1202-97 – Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration

AASHTO T277-89 – Rapid Determination of the Chloride Permeability of Concrete

Commonly referred to as the Rapid Chloride Permeability (RCP) test, the test determines the penetration of chloride-laden water into concrete by measuring the electrical conductance (in coulombs) of the specimens. The RCP test is widely accepted as a test for concrete permeability. Lower values reveal less chloride penetration and thus lower permeability.

Concrete specimens containing KIM (@ 2% cmts) were tested on separate occasions by *The Port Authority of New York & New Jersey* and by *AMEC Earth and Environmental*. Chloride permeability was shown to be reduced by 45% in both tests.

Testing Services Test	Days	Result of Control Mix (Coulombs)	Result of Same Mix with KIM (coulombs)	% Reduction in Permeability
Port Authority of New York & New Jersey- Nov.9,'98 Coulomb test AASHTO T277	28 days	5358	3509	35%
	56 days	4072	2608	36%
	90 days	3048	1681	45%
AMEC Earth & Environmental Ltd. - Sep.21,'00 Shotcrete Mix Coulomb test ASTM C1202-97	28 days	1176	650	45%
	90 days	493	327	34%

Summary Reports from Independent Testing Services

SULPHATE RESISTANCE

Krytol treated concrete specimens exhibited excellent sulphate resistance when tested in accordance with US Bureau of Reclamation guidelines. Specimens were alternately soaked in sodium sulphate solution and oven dried. The specimens were tested for strength loss and weight change. The Krytol treated specimens dramatically outperformed both the control specimens and the competitor's specimens.

R. M. Hardy and Associates, 1976

The lower permeability of KIM-HS concrete will reduce the ingress of sulphates.

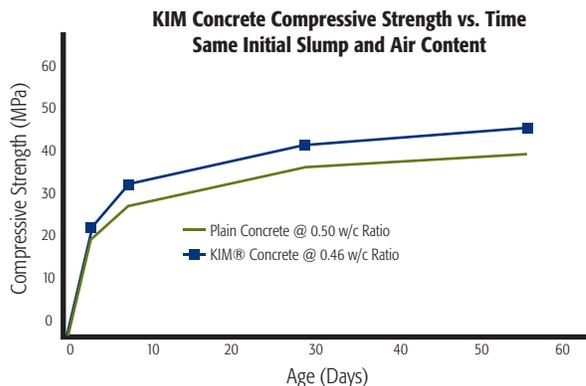
British Board of Agreement (BBA), 2005

COMPRESSIVE STRENGTH

ASTM C494: Type D, CAN/CSA A266.2-M: Type WR – Chemical Admixtures for Concrete

Concrete specimens containing KIM (@ 2% cmts) displayed increases in compressive strength of 12% to 19% at ages 3, 7, 28 and 56 days compared to control specimens of equal slump and air. This exceeds the CAN/CSA A266.2-M requirements for a Type WR water-reducing set-retarding admixture.

HBT Agra Ltd., 1993



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SHRINKAGE AND CRACK REDUCTION

AS 1012.13-1992 – Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory

Results have clearly shown drying shrinkage reduction and resulting crack reduction in KIM modified concrete. Evaluation of KIM concrete showed a reduction in drying shrinkage of 20-25%.

Materials Testing & Environmental Services of Boral Resources (NSW) Pty. Ltd.

C341/C341M-06 Standard Practice for Length Change of Cast, Drilled, or Sawed Specimens of Hydraulic-Cement Mortar and Concrete

Restrained shrinkage cracking in KIM concrete with similar slump, air content and cement content is less than plain concrete by 80%
AMEC Earth & Environmental Ltd.

NOTE: Kryton does not recommend eliminating standard shrinkage control joints. Follow ACI guidelines.

FREEZE/THAW DURABILITY

STM C233, CAN/CSA A266.1-M – Air Entraining Admixtures for Concrete.

KIM acts as an effective air-entraining admixture when evaluated against the requirements. Both plastic and hardened air contents and spacing factors allow KIM concrete to maintain excellent freeze/thaw durability.

HBT Agra Ltd., 1993

New York DOT Test Method 503-3P

Concrete specimens containing KIM (@ 2% cmts) were cast and aged for 28 days. The specimens were then subjected to freezing and thawing cycles in a saturated condition. No loss of weight.

Future Tech Consultants New York, 2000

POTABLE WATER CONTAINMENT

NSF/ANSI Standard 61: Drinking Water System Components – Health Effects

KIM has been tested extensively and approved for waterproofing concrete drinking water containment by NSF International, US Environmental Protection Agency, US Department of Agriculture, Health and Welfare Canada, and Bureau de Normalisation du Quebec.

SPECIFYING

Detailed CSC and CSI formatted specifications are available on disk or by download from our website: <http://www.kryton.com>.

MATERIALS

- A. Permanent, self-sealing, corrosion-free, concrete waterproofing admixture in dry powder form, which intensifies and prolongs hydration of cementing materials in concrete.
- B. Admixture shall provide air-entrainment conforming to CAN/CSA A266.1 (ASTM C233) - "Air-entraining Admixtures for Concrete."
- C. Admixture shall provide water reduction and set-retardation conforming to CAN/CSA A266.2 Type WR (ASTM C494 Type D) "Chemical admixtures for concrete."
- D. The admixture shall not contain chlorides
- E. The admixture shall not waterproof by the use of hydrophobic materials such as oils, stearates, silanes, silicates or other hydrophobic treatment.