

KRYSTOL INTERNAL MEMBRANE™ (KIM®) FOR SHOTCRETE

Section 03 & 07 - Integral Crystalline Waterproofing of Concrete

PART 1 GENERAL

1.01 SUMMARY

Section Includes: Furnishing of all materials, services, application instructions, testing guidelines, quality control requirements and supervision necessary for the supply and installation of crystalline integral waterproofing admixture to concrete structures as indicated on the drawings and as specified herein. The crystalline waterproofing admixture shall be added to the concrete mixture at the time of batching and the concrete shall be designed, batched, placed, finished and cured in accordance with the guidelines set out by the American Concrete Institute and the instructions of the manufacturer.

Related Sections:

1. Section 03 15 00 – Concrete Accessories
2. Section 07 10 00 – Dampproofing and Waterproofing

1.02 REFERENCES

Applicable Standards: The following standards may be referenced.

- A. ACI 212.3R – 10 (Chapter 5)
- B. ACI 305R – Hot Weather Concreting; 2010.
- C. ACI 306R – Cold Weather Concreting; 2010.
- D. ACI 308 – Standard Practice for Curing Concrete; 1992 (Reapproved 1997).
- E. ASTM C 39/C 39M – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 1999.
- F. ASTM C 309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 1998a.
- G. ASTM C 666 – Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing; 1997.
- H. BS 5075-2: 1998 – Concrete Admixtures: Specification for Air Entraining Admixtures.
- I. ASTM E 329 – Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction; 1998a.
- J. COE CRD-C 48 – Standard Test Method for Water Permeability of Concrete; 1992.
- K. AASHTO T277 – Standard Method to Test for Rapid Determination of Chloride Permeability of Concrete.
- L. NSF/ANSI Standard 61 Drinking Water System Components - Health Effects ; 2000a.
- M. BS 12390-8 – Testing Hardened Concrete – Depth of Water Penetration Under Pressure.
- N. ACI 506R – Guide to Shotcrete

1.03 SYSTEM DESCRIPTION

- A. **Crystalline Integral Concrete Waterproofing Admixture System:** The admixture must be a Permeability Reducing Admixture for Hydrostatic Conditions (PRAH) as indicated by ACI 212.3R-10 (Chapter 15). The admixture is a dry chemical admixture supplied in sealed plastic buckets and/or in disintegrating paper bags. The admixture will initiate and promote the growth of long, narrow crystal structures sufficient to fill and block capillary pores and microcracks within the concrete in order to prevent the passage of water. The admixture must remain available within the hardened concrete and must react to any future presence of water to self-seal minor cracking that may occur in the future.
- B. **Additional System Requirements** include construction joint details, penetration details, waterstops and remedial waterproofing steps.

1.04 SYSTEM PERFORMANCE REQUIREMENTS

- A. **Permeability:** The coefficient of permeability for admixture treated concrete will be reduced by a minimum of 70% compared to untreated concrete when tested using BS EN 12390-8 at 150 psi of pressure for 96 hours (Taywood-Valenta Method, ACI 212.3R-10).
- B. **Permeability:** No passage of water through treated samples when exposed to a verticle water head equal to 140 meters (460 feet).
- C. **Compressive Strength:** Treated concrete must have compressive strength equal or higher than plain concrete when tested in accordance with ASTM C 39/C 39M at 28 days and at one year.
- D. **Drying Shrinkage:** Minimum 20% reduced drying shrinkage for treated concrete compared to untreated concrete when tested according to ASTM C157 or equivalent.
- E. **Self-Sealing:** Autogenous crack sealing of treated concrete for cracks with width of up to 0.5mm (0.02 inches) or greater; verified by independent testing.
- F. **Chemical Resistance:** Minimum 20% less weight loss compared to untreated specimen after exposure to 5% sulfuric acid for 70 days.
- G. **Carbonation Resistance:** No increase in rate of carbonation compared to untreated concrete when exposed to a 4% carbon dioxide atmosphere for 28 days.
- H. **Sulfate Resistance:** Improved resistance to sulfate attack compared to untreated concrete when tested to the US Bureau of Reclamation Accelerated Method.
- I. **Potable Water Contact Approval:** Certified by NSF to NSF/ANSI Standard 61 Drinking Water System Components - Health Effects for use in structures holding potable water.
- J. **History:** The waterproofing admixture must have demonstrated success in similar applications that are no less than 15 years old.

1.05 SUBMITTALS

- A. **General:** Submit listed submittals in accordance with conditions of the Contract and with Division 1 Submittal Procedures Section.
- B. **Product Data:** Submit Technical Data Sheets, the KIM Best Practices Guide and Application Instructions including all instructions relating to jointing and penetration details.
- C. **Test Reports:** Submit, for acceptance, complete test reports from approved independent testing laboratories certifying that waterproofing system meets the performance and testing requirements specified herein.
- D. **Project References:** Provide case study documents demonstrating successful applications of the waterproofing admixture in similar projects over a period of no less than 10 years.

1.06 QUALITY ASSURANCE

- A. The waterproofing admixture shall comply with CAN/CSA A266 – 1-M in the latest addition as both a WR type water reducing admixture and optionally as an air entraining admixture and with ASTM C494 and as a Type D, water reducing and set retarding admixture.
- B. Waterproofing admixture to be certified by the International Code Council (ICC) as a Chemical Admixture Used in Concrete (AC198).
- C. Waterproofing admixture must be certified to NSF/ANSI Standard 61 – Drinking Water System Components – Health Effects
- D. Waterproofing admixture must bear a CE mark and conform to the performance and quality requirements of EN 934- 2:2001.
- E. Waterproofing admixture shall hold a valid Agrément Certificate from the British Board of Agrément.
- F. Waterproofing admixture shall hold a valid Appraisal certificate from BRANZ Limited.
- G. A meeting of involved parties must be held prior to installation. This meeting will clarify procedures, roles and

responsibilities among the parties. This meeting requires the presence of representatives from the manufacturer, owner, concrete supplier, consulting engineer/architect and all involved contractors.

- H. The concrete supplier shall conduct laboratory and field trials as necessary to successfully incorporate the waterproofing admixture into their concrete mixture. Follow the manufacturer's testing guidelines.
- I. All parties shall follow the manufacturer's written instructions as contained in the KIM Best Practices Guide, published by the manufacturer.
- J. All parties shall follow the manufacturer's written instructions as contained in the Application Instructions, published by the manufacturer.
- K. All waterproofing system components shall bear a traceable manufacturer's lot number.

1.07 DELIVERY, STORAGE AND HANDLING

- A. **Delivery:** Deliver materials in manufacturer's original, unopened packages bearing the complete product label and lot number.
- B. **Storage:** Store materials in a warm and dry location. Protect from humidity or moisture contamination at all times.
- C. **Handling:** Observe all occupational health and safety requirements. Read and follow the Material Safety Data Sheet for each product. Conform to all local regulations.

1.08 WARRANTY

- A. Provide 25-year manufacturer's limited standard material warranty for the waterproofing admixture.
- B. Provide 10-year manufacturer's limited labor and material performance warranty for the waterproofing admixture system. (additional service costs are applicable to this option)

PART 2 PRODUCTS

2.01 MATERIALS

- A. **Acceptable Manufacturer:**
Kryton International Inc.
1645 Kent Ave. NE
Vancouver, BC, Canada
www.kryton.com
T: 1.604.324.8280
TF: 800.267.8280
Fax: 1.604.324.8899
Email: info@kryton.com
- B. **Acceptable Products:**
 1. Krystol Internal Membrane (KIM)
 2. Krystol Waterstop Grout (External)
 3. Krystol Waterstop Treatment
- C. **Substitutions:** Substitutions are not permitted.
- D. **Source Quality:** Obtain all crystalline integral waterproofing products from a single manufacturer.

2.02 DOSAGE

- A. KIM dosed at 2% of cementing materials by weight, to a maximum dosage of 8 kg/m³ (13.5 lb./cu. yd). Dosage may be varied for specific projects in consultation with Kryton's Technical Services Department.

PART 3 EXECUTION

3.01 GENERAL

- A. **Safety:** Comply with local regulations for health and safety. Read and observe all precautions contained in the Material Safety Data Sheets for the products.
- B. **Compliance:** Follow all of the manufacturer's written Application Instructions.

3.02 PROJECT CONDITIONS

- A. **Structural Design:** The concrete structure shall be designed to meet local building codes and in addition shall be designed to minimize and control any occurrence of cracks within the concrete mass. Follow ACI 224.R and ACI 301 regarding the placement of reinforcement and crack control joints.
- B. **Scheduling:** Trial mixes conducted prior to the project start shall have determined workability and setting times and strength development. This data shall be used to plan appropriate schedules for shooting, finishing and removal of formwork if applicable.
- C. **Weather Conditions:** For mixing, transporting and placing concrete under conditions of high temperature or low temperature, follow concrete practices as referred to in ACI 305R-77 (Hot Weather Concreting) and ACI 306R-78 (Cold Weather Concreting) respectively. For flatwork being placed in either hot, dry or windy conditions, surface humidity must be maintained by fogging or use of monomolecular film (evaporation retardant). Shotcrete walls must be water cured following the procedures in ACI 308 or treated with a curing compound conforming to ASTM C309.

3.03 CONCRETE BATCHING & MIXING

- A. KIM admixture shall be added to the concrete at the time of batching at a concrete plant that is acceptable to the manufacturer. Dosage shall be properly supervised and a record kept of quantities and lot numbers.
- B. Concrete shall be batched following the approved mix design as determined through prior trials. Content of cementing materials shall not be less than 300 kg /m³ (500 lb. / cu. yd). Water content shall be kept to within the specified water to cementing material ratio and this ratio shall not exceed 0.45.
- C. KIM admixture shall be added to the dry ingredients prior to batching and if this is not possible, KIM should be added prior to the addition of other admixtures. Do not mix KIM with other admixtures prior to addition. Add KIM separately from other admixtures.
- D. Allow KIM to thoroughly mix at medium/high speed for 1 minute per cubic meter/yard in the batch and a minimum of 3 minutes. Place and finish in accordance with ACI guidelines. If possible, hold back a portion of super plasticizer during the initial batching and add the held portion at the jobsite immediately before discharging.

3.04 CONCRETE PLACING

Place concrete promptly. KIM concrete will be expected to perform as a waterproof membrane. Therefore, superior consolidation is required. For properly consolidating concrete, shotcrete shall be placed by an ACI certified nozzleman in accordance with ACI 506R – Guide to Shotcrete, with special attention given to joint locations.

3.05 CURING

Curing is essential to reduce or eliminate shrinkage cracking: Wet cure concrete in accordance with ACI 308 Guidelines. If wet curing is not possible, apply a curing compound that meets ASTM C309.

3.06 CONSTRUCTION JOINTS AND PENETRATIONS

- A. Construction joints and control joints must be designed and spaced to isolate and control shrinkage cracking following the guidelines in ACI 224.R and ACI 301. The locations of joints must be indicated on the project drawings and be acceptable to the architect/engineer.
- B. Install control joints as per Application Instruction 4.14 at a maximum spacing of 20 times the wall section thickness to a maximum of 16 feet / 5 meters.

- C. Install control joints within 10 feet of / 3 meters corners on either side.
- D. The Krystol Waterstop System, consisting of Krystol Waterstop Grout and Krystol Waterstop Treatment, shall be installed in all non-moving construction joints and shrinkage control joints according to Application Instructions 4.21 to 4.22 — Use of Krystol Waterstop System, as applicable.
- E. All pipe penetrations shall be treated as per the admixture manufacturer's recommendations. Application Instruction 5.32 – Waterproofing Pipe Penetrations (Existing Construction).

3.07 FIELD QUALITY CONTROL

- A. **Examination for Defects:** Do not conceal KIM concrete before it has been observed by a manufacturer's representative and other designated entities. Concrete shall be examined for structural defects such as faulty construction joints, cold joints and cracks. Such defects to be repaired in accordance with manufacturer's repair procedures.
- B. **Observance of Leaks:** Leaks that occur through well consolidated concrete or tight cracks will self-seal within a few days or weeks. Leaks that occur through poorly consolidated concrete or large cracks must be repaired in accordance with the manufacturer's repair instructions.

3.08 INTERACTION WITH OTHER MATERIALS

- A. **Backfilling:** Normal backfilling procedures may be used after concrete has been cured for at least seven days. If backfill takes place within seven days after concrete placement, then backfill material shall be moist so as not to draw moisture from the concrete. In no event shall backfilling take place before concrete has gained sufficient strength to withstand the applied load.

END OF SECTION