

# Technical Bulletin - M3P Chemistry

## MINERAL SILICATE CHEMISTRY

## M3P, M3P-X & CONPRO START

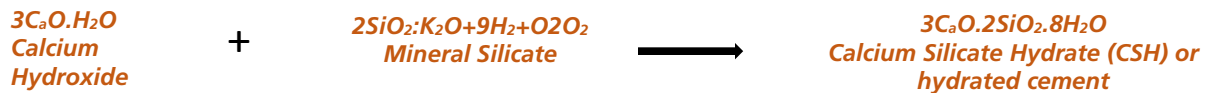
The first equation shows how Portland cement reacts with water to become a solid material. This process is referred to as hydration. The second equation shows how a mineral silicate solution reacts with one of the components of hydrated cement to create more cement<sup>1</sup>.

### HYDRATION OF CEMENT



Tricalcium silicate and water react to form calcium silicate hydrate (CSH), which is hydrated cement, and calcium hydroxide.

### MINERAL SILICATE REACTION



The calcium hydroxide produced by the hydration of cement reacts with mineral silicate solution to form CSH.

<sup>1</sup> The chemical equations above are correct but simplified for the purpose of the illustration.  
<sup>2</sup> The four major constituents of Portland cement are C<sub>3</sub>S tricalcium silicate, C<sub>2</sub>S dicalcium silicate, C<sub>3</sub>A tricalcium aluminate and C<sub>4</sub>AF tetracalcium aluminoferrite.

## PRODUCTS

Conproco manufactures three products based on mineral silicate technology. The oldest is Conproco Start, introduced in 1988 as part of our concrete and masonry program. Conpro Start is a consolidant. It is used to increase the density and compressive strength of cementitious materials.

M3P was introduced in 2002. While the chemistry has remained unchanged the application process has evolved. Today M3P requires two applications to achieve optimal aesthetic and performance characteristics. The result is a natural no-gloss opaque finish. When a more translucent appearance is desired, M3P can be diluted with M3P-X, a clear mineral silicate liquid.

## ANTI-CARBONATION TREATMENT

Carbon dioxide reacts with calcium hydroxide to form limestone. This reaction is referred to as carbonation. Mineral silicate solutions mitigate carbonation to the extent that the reaction consumes available calcium hydroxide and increases the density of the substrate. The increased density (lower porosity) provides an improved barrier to carbon dioxide, water and other contaminants.

## PERMANENCE

M3P, M3P-X and Conpro Start are mineral silicate-based materials that react as described above. This chemical reaction is permanent and cannot be reversed. The denser the surface the more resistant it is to the forces of deterioration.

## WATER REPELLENCY

M3P and M3P-X contain a silane component for water repellency. The combination of increased density of the substrate surface and a hydrophobe (a material added to a product to improve water repellency) provide effective protection from wind driven rain as tested using a modified ASTM E514.

## APPLICATION TO NON-CEMENTITIOUS SUBSTRATES

M3P is suitable for application on many non-cementitious substrates. Any material containing Si (silicon groups i.e. brick, terracotta, glass), OH (hydroxyl groups i.e. wood, paper) and NH (amino groups i.e. urethane, epoxy) will have an electrostatic attraction to mineral silicate. This electrostatic attraction is referred to as covalent bond (two atoms sharing the same electrons). This bond is not as strong as the chemical reaction with calcium hydroxide. However, the combination of covalent and mechanical bond is superior to the mechanical adhesion of most paints and coatings.

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### **COLOR**

Because M3P does not form a film, the substrate can have a significant influence on final color. Choosing a color from the Product & Color Selection Guide or Matrix fob is a good starting point. For best results send a 4" x 4" piece of the substrate so that the color chosen can be matched on the surface to which it will be applied.

### **APPEARANCE**

M3P produces a uniform, opaque appearance, ideal when the objective is to change the color of the substrate. The addition of M3P-X will produce a more transparent material for applications when the goal is to blend the various shades of the substrate to yield a more uniform appearance. When adding M3P-X always match the darkest shade of the substrate color. The higher the dilution rate (2:1, 3:1, etc.) the more the substrate will influence the final appearance. Always apply a sample for approval before proceeding.

M3P has a more natural appearance compared to film forming paints and coatings. M3P penetrates the substrate maintaining the characteristics of the surface without changing light reflection. Blemishes and repairs to the substrate will not be hidden as with more heavily bodied materials such as Conpro Lastic.

The final color of M3P is influenced by absorption rate of the substrate. In cases where there are repairs to the substrate the repair mortar and substrate may absorb M3P at a different rate, resulting in the appearance of color variation. This variation may not be acceptable. Always apply a sample of the specific color to both the parent substrate and the patch for approval.

Potassium silicate coatings may show some signs of chalking on the surface which is indicative of the chemistry. German DIN standards allow for some chalking (micro-chalking) as the product ages. This "micro-chalking" keeps the façade cleaner over time as new coating is revealed at the face of the façade.

### **MAINTENANCE**

Typically, no maintenance is required to M3P if applied correctly. The inorganic nature of potassium silicate chemistry keeps soiling and biological growth at bay. Leaking gutters or faulty water management on a façade can lead to premature wear of M3P.

### **LONGEVITY**

Because no film is formed on the surface, the M3P System will not peel or blister. Another benefit of non-film forming is greater resistance to dirt pickup. The surface will stay cleaner, longer. The chemical reaction with cementitious substrate is permanent. Premium quality pigments produce colors that are stable and will not fade. Very dark and vibrant accent colors can fade in the same manner as film forming paints.

### **RECOATING**

High-pressure water is sufficient to remove dirt and contaminants from the surface. Once clean M3P can be recoated without additional surface preparation.