

# Felt Tips

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## Cementitious Waterproofing

This *Felt Tip* discusses waterproofing manufactured from materials containing portland cement. Cementitious waterproofing materials are intended for use on concrete and masonry substrates. Originally developed in Europe, cementitious waterproofing has been introduced to the North American construction industry by European-based manufacturers and American-based manufacturers. It is important that the unique characteristics of cementitious waterproofing materials be understood for their proper use. A project's technical requirements should be reviewed with the manufacturer before using the products.

There Are Two Categories of Cementitious Waterproofing Materials:

- ❖ **Cementitious Waterproofing Coatings:** Cementitious waterproofing is similar to most non-cement based waterproofing materials. It is applied to a concrete or masonry substrate and forms a barrier to water penetration. Cementitious waterproofing is a barrier directly bonded to the substrate, to form a tight matrix that covers the pores in the substrate.
- ❖ **Crystalline (or Capillary) Waterproofing:** Crystalline waterproofing compounds chemically react with chemical compounds in concrete or concrete masonry to seal the naturally occurring pores found in concrete materials to prevent water penetration. The chemical reaction is dependent upon a proprietary chemical catalyst in the mix, which causes chemical compounds in the concrete pores to crystallize and become plugged to prevent water passage.

Cementitious and crystalline waterproofing can be used above or below grade, and on interior or exterior surfaces. They can be installed as negative-side or positive-side waterproofing. The "side" of a construction assembly to which the waterproofing is applied depends on the source of the water. The "positive" side is the same side as the water source. The "negative" side is the side opposite the "positive" side. Typically, when waterproofing is applied to a structure, like a building foundation wall, the water source is on the exterior and waterproofing is applied to the exterior wall surface or the "positive" side of the wall. If the waterproofing is applied to the interior side of the wall, it is being applied to the "negative" side of the wall. One reason cementitious and crystalline waterproofing employ this "negative-positive" terminology is that these products are used to waterproof water distribution systems. Either side of a concrete pipe or tank can be waterproofed (depending on accessibility to the surface). The interior of concrete pipes and tanks is the "positive" side, while the exterior of the pipes and tanks is the "negative" side.

Acceptability of a substrate to receive these waterproofing products depends upon the waterproofing being used. Cementitious waterproofing may be used on concrete or masonry (clay and concrete). Crystalline waterproofing can be used on concrete or concrete masonry (no clay masonry). Substrates must be portland cement-based materials to allow proprietary chemicals in crystalline waterproofing to activate. Moisture must be present for crystalline waterproofing material to cure and perform its intended purpose.

Application life of cementitious and crystalline waterproofing depends on where they are used. Exterior below-grade applications will usually last 20 to 40 years. Exterior above-grade locations will usually last 15 years. This shorter life span, when compared with below-grade locations, is caused by degradation that results from exposure to weather and atmospheric pollution. Interior locations, when used as negative side application, will usually last 40 years.

Use of cementitious and crystalline waterproofing has limitations. These materials are not flexible, so they should not be applied to surfaces subjected to flexural movement. Areas that are subject to vibration loads (such as highway and railroad tunnels) will also suffer from cracking, and are undesirable locations for application of these materials. Also, the waterproofing must be applied to a "sound" substrate. Requirements for a substrate to be "sound" are:

1. No honeycombs.
2. No laitance. Laitance is a weak, crumbly, and dusty surface layer in concrete caused by excessive water that has bled to the surface and subsequently weakened the surface.
3. Vertical surfaces, when the surface is struck by a metal hammer head, should sound solid (usually with a "ringing" noise), and should not sound "hollow."
4. Horizontal surfaces, when a chain is dragged across the surface, should produce a "ringing" noise.

Although they prevent passage of liquid water, cementitious and crystalline waterproofing materials permit transmission of water vapor. Transmission of water vapor can be undesirable depending upon the use of the space on the negative-side of the substrate.

Cementitious waterproofing materials are chemically different from crystalline waterproofing materials. Cementitious waterproofing consists of portland cement-based compounds with proprietary chemical additives to affect curing, strength, and chemical resistance. Cementitious waterproofing products are often packaged as dry materials to be mixed with water and proprietary liquid additives at the job site, and then applied to the substrate. Crystalline waterproofing consists of portland cement, quartz or silica sand, and proprietary chemicals mixed as a dry powder form. The dry powder is mixed on the job site with water, and then applied to the substrate. Crystalline waterproofing works by chemically reacting with the existing chemicals in the concrete to seal the concrete pores to prevent the passage of liquid water.

The authors are not aware of any US, Canadian, British (BSI), German (DIN), or International (ISO) material or installation standards.

Many performance criteria may be considered when selecting cementitious or crystalline waterproofing. The following qualities should be considered when selecting the material, since they will affect product performance. The importance of the following items varies and depends upon project requirements. The following items have been culled from manufacturers' product literature and can be used to compare products from different manufacturers; no individual manufacturer reported on all of the following criteria. Manufacturers have advised the authors that as they receive requests for test data from users, they conduct the relevant test and add the information to their product literature. Criteria that may be used to evaluate cementitious or crystalline waterproofing products:

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|----------------------------------|---|
| Water Penetration (Permeability) | Resistance to various chemicals   |
| Compressive Strength             | Ultraviolet Radiation Resistance  |
| Tensile Strength                 | Radiation Resistance  |
| Shear Strength                   | Toxicity of materials that can be extracted from the coating.               |
| Flexural Strength                | Affect on Potable Water   |
| Adhesion/Bond Strength           | Shrinkage and Expansion Coefficient   |
| Water Vapor Transmission         | Certification Listings  |
| Abrasion Resistance              | Compliances with requirements of local governing or specifying authorities. |
| Freeze/Thaw Resistance           |   |

When applying cementitious or crystalline waterproofing products, the surface must be clean and free of dirt, laitance, oils, curing compounds, and other materials that may adversely affect the adhesion of the coating to the substrate. Structural defects, "unsound" concrete, honeycombs, form ties, and cracks must be removed and replaced with patching materials to form a surface that is the same as the remainder of the substrate. The surface should not be smooth, since this will not enhance adhesion of the coating to the substrate. This may require that the surface be etched (chemically or mechanically) to create a rough surface that will provide enough texture for the coating to adhere. Active leaks must be repaired to eliminate the passage of water, before application of the waterproofing coating. Often this requires the use of proprietary materials that will plug the leak and be chemically compatible with the coating. The surface should be cool and damp. These coatings, since they contain portland cement, should be treated like concrete; they should not be dry or hot, since water is needed for the chemical activation, adhesion, and curing of the waterproofing. The surface may need to be dampened with water. A moisture meter can be used to learn if the moisture level in the substrate is within the manufacturer's acceptable limits. Since cementitious waterproofing coatings are not flexible, movement joints, substrate control joints, expansion joints, and joints surrounding substrate penetrations must be sealed with flexible sealing materials to prevent water passage.

Besides the previous requirements, crystalline waterproofing has some unique requirements that do not apply to cementitious waterproofing. The concrete surface should be moist and damp, but should not have liquid water on it. The concrete does not need to be fully cured when crystalline waterproofing is applied to the surface.

Mixing should comply with the manufacturer's instructions to obtain the desired consistency. Various consistencies may be created depending upon application method and desired coating thickness.

Several methods of applying cementitious or crystalline waterproofing may be used. Application by brush, trowel, or spray is acceptable. Spraying is most efficient for large surface areas. Resistance to hydrostatic pressure is the primary purpose of cementitious waterproofing, and the resistance is afforded by total coating thickness and the quantity of coats applied to the substrate. The quantity and overall thickness should comply with the manufacturer's recommendations and application instructions to achieve the desired hydrostatic pressure resistance. Time sequencing of multiple coat applications should comply with the manufacturer's instructions. Application should occur when the ambient and substrate surface temperatures are within the manufacturer's recommended temperature range, which is often between 4°C (40°F) and 32°C (90°F).

Some special requirements pertain to applying cementitious waterproofing. At intersections of vertical surfaces, and at intersections of vertical and horizontal surfaces, a recess should be routed out from the substrate to form a reglet. The reglet should be filled with cementitious waterproofing material before application of the coating to the substrate's surface.

Like cementitious waterproofing, some special requirements pertain to applying crystalline waterproofing. Use of crystalline waterproofing as a concrete admixture is not recommended. When applied by spraying, the spray must be under pressure to force the mixture into the pores of the concrete. Check with the waterproofing manufacturer for acceptable spray equipment and application pressures. If the crystalline waterproofing is applied to a slab, which will receive a topping slab, apply the topping slab while the crystalline waterproofing has initially hardened but while the waterproofing is still curing. Some crystalline waterproofing manufacturers report that their product may be applied as a dry-shake to slabs during the trowel finishing activities. Crystalline waterproofing does not require flashing since it is self-flashing.

Curing these products should comply with the manufacturer's instructions. The coatings must be protected from conditions that will cause them to dry before they have cured. Adverse conditions include direct exposure to sunlight and dry winds. Protect the coating from physical damage, freezing, and flowing water. Curing temperatures should comply with the manufacturer's instructions. Often this will require the ambient air, and substrate surface, to be between 4°C (40°F) and 32°C (90°F). During curing, the coating must be kept damp yet not receive too much water, since excessive moisture will increase the potential for freeze-thaw damage (particularly with crystalline waterproofing). The coating may have moisture-bearing backfill placed against it before curing is complete, which would enable the coating to absorb moisture from the backfill material and accelerate the chemical reaction. The quantity of moisture applied to the coating during the

curing process should be verified with the product's manufacturer so the moisture level is adequate but not excessive. Curing time is approximately 7 days, which is shorter than the usual 14 days for traditional portland cement stucco parge coatings.

Protection of cementitious and crystalline waterproofing, after curing is complete, differs slightly from other waterproofing materials. Since these materials, when fully cured, are hard and resistant to physical abuse, protection barriers are usually not required. However, these waterproofing materials should not be exposed to hydrostatic pressure or traffic until fully cured. Drainage boards or mats may be desirable, since boards and mats provide a passage for water to flow away from the surface of the substrate.

Cementitious and crystalline waterproofing offer distinct advantages over other waterproofing materials. They also have unique disadvantages that can be limiting to their use. Individual project conditions will need to be considered for use of these products. Evaluation of products from competing manufacturers requires careful analysis and comparison of competing claims from the manufacturers. No standard material specifications are available for use. This will require the use of a combination of proprietary and performance specifying.

Care should be exercised when selecting or specifying these products, since their manufacturers do not test the same qualities. When the same qualities are tested by the manufacturers, they may not use the same test methods. This lack of standardized testing makes it difficult to compare the performance data provided by the manufacturers. As a result, the selection of products is subjectively based upon the individual specifier's concerns and project requirements, and the evaluation of alternate manufactured products. These factors can make selection and specifying an arduous process. The manufacturers of these products should, under the auspices of ASTM, agree to standard test methods with the goal of creating a standard material specification and a standard installation specification. Without consistent performance data from product manufacturers, greater use of these products will be hindered.

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