Spray Applied Fireproofing: The Differences between Cementitious & Mineral Fiber

Selecting the right materials for a project is never an easy job – particularly spray-applied fireproofing. This process uses relatively simple materials applied in various thicknesses to insulate the structural steel in the event of a fire. When specifying fireproofing, it is crucial to select a product that will protect the building for its total life cycle, performing as specified for 30-50 years, without degradation of performance.
Cementitious materials contain binders of Portland cement or gypsum in the range of 50-80% by weight which when mixed with water, forms a slurry suitable for pumping and wet spray application. The high binder content and wet mixing assures a strong, durable and homogeneous coating that is totally integrated throughout the applied thickness.

Sprayed fiber materials contain rock wool fibers manufactured from spinning molten iron slag at high temperatures. These fibers are mixed with a cement binder of 20-30% by weight. This dry mixture is air conveyed and mixed with water at the application nozzle as the fiber travels past the water mist. The low binder content and method of water introduction prevents the material from forming a uniform coating throughout the applied thickness.

Cementitious Definitions

UL(CHPX): Materials that are “mixed with water to form a slurry and conveyed through a hose where compressed air is typically used to disperse the materials into a spray pattern”

Masterspec: Materials are “mixed with water at the Project site to form a slurry or mortar before conveyance and application.”

Cementitious refers to a product that is mixed to form a consistent uniform slurry and is then pumped to a nozzle where it is sprayed onto the substrate. The term cementitious only refers to a product that is mixed and then pumped as a slurry. From the above definitions, it is also clear that the presence or absence of Portland cement used as a binder does not determine if the product is cementitious.

Sprayed Fiber Definitions

UL(CHPX): Materials that “are conveyed by low pressure air through a hose to a nozzle where the material is mixed with atomized water and sprayed.”

Masterspec: Materials that “are conveyed in a dry state and mixed with atomized water at place of application.”

Sprayed fiber refers to a product that is air conveyed in the dry state to a nozzle where water is added prior to spray application to the substrate. Sprayed fiber products that are formulated with Portland cement are not “cementitious” products.

** Terminology was originally developed by ASTM and UL and has been utilized for many years to clearly distinguish between two distinctly different types of fireproofing material.

Material Differences

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The Bottom Line

Cementitious materials provide a more homogeneous coating when compared to Sprayed fiber materials. Additionally, when comparing products, the percent weight of binder is critical because it affects all aspects of physical properties, including density, bond strength, compressive strength and erosion resistance.
Application Differences

Cementitious (Wet Mix)

Cementitious materials are mixed with water and the slurry is pumped through a hose to a hand held nozzle where it is applied close to the substrate.

Sprayed fiber is fluffed or "carded" in a dry state at the pump and is then blown through a hose to the nozzle. Water is added only at the nozzle for the split second it takes to exit the nozzle. To attain fire resistance ratings Underwriters Laboratories designs state that a mandatory overspray of water is required to achieve a surface crust. Sprayed mineral fiber is most often applied to structural steel with a pole gun up to fifteen feet above the floor making close examination and exact application impossible. A final water overspray application is required to make a thin egg shell crust on the surface of the in-place fiber. The thin eggshell crust of the material is then relied upon to protect the softer material under the crust.

The Bottom Line

Cementitious materials are thoroughly mixed and sprayed in close proximity to the steel to ensure accurate application. Sprayed fiber relies on a brief period of time for water to react to the binder. Additionally, the material is frequently applied at distances from the steel that would make it challenging to determine application thickness. Failure to perform the final overspray step would significantly impact the durability of the material.

Sprayed Fiber (Dry Mix)

Product Performance Differences

The product's ability to withstand abuse during the construction phase and life of the building can be predicted by the physical properties of the material.

Bond strength

Bond strength measures fireproofing material's ability to bond to itself and to a substrate. Fireproofing that lacks sufficient bond can be easily knocked off or damaged from construction or maintenance activities which compromise the required fire-rating.

Cementitious materials exhibit higher bond strengths because of higher binder content and more uniform mixing.

Sprayed fiber products have lower binder content and require an overspray of water to create a surface crust that does not improve bond strength through its applied thickness. Acceptable bond strengths are difficult to achieve because the individual sprayer controls the ultimate density and bond value by water addition at the nozzle, distance of nozzle from the steel and consistency of the final overspray.

The Bottom Line

Starting with a consistent uniform slurry at the mixer, cementitious fireproofing results in consistent in place density and higher in place bond strengths. Sprayed fiber mixtures rely on the experience level of the sprayer to control the density and bond strength by the amount of water added, distance of nozzle from the steel and consistency of the final overspray. Cementitious fireproofing reduces the potential for human error and increases the likelihood of a consistent product mix and application.

Air Erosion

Air erosion is the amount of material removed by the movement of air across the surface of fireproofing typically in elevator shafts, plenums and utility conduits. Cementitious formulations have a high binder content and uniform mix, this creates a strong matrix in a one step application.

Sprayed fiber has a low binder content and non-homogeneous mixture requiring an overspray to create a surface skin that must be applied by the applicator. This step is often overlooked in order to save time.

The Bottom Line

During the life cycle of the building, if the crust of sprayed mineral fiber material is damaged, it exposes the "soft underbelly" of the in-place material. As a result, its ability to withstand air erosion has been lost because of the non-uniform nature of the in-place material.
Does writing a specification for cementitious products only, excluding mineral fiber based products, create a proprietary specification?

Fireproofing Products List

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<th>Cementitious Products</th>
<th>Cementitious Products</th>
<th>Sprayed Mineral Fiber Products</th>
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<td>Gypsum based</td>
<td>Cement Based</td>
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<td>Pyrolite 22, Carbone</td>
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The Bottom Line: As the list above demonstrates, writing a Cementitious fireproofing specification does not eliminate any major existing fireproofing materials manufacturer from being able to participate in a project. Only one major manufacturer of Cementitious fireproofing still makes a sprayed mineral fiber product.

Do the IBC or IFC have requirements that favor one product type over another?

No, but recent changes to both the IBC and IFC emphasize the importance of bond strength specifically and other performance related qualities that contribute to a fireproofing material’s ability to perform as intended during the life of the building. The IFC and many large insurance companies such as FM now require annual inspections of in-place fireproofing materials. (IFC section 703.1)

The Bottom Line: Annual inspections of in-place fireproofing require repair or replacement of damaged materials. This emphasizes the importance of well integrated Cementitious products that resist damage better than sprayed mineral fiber products. For building owners, the life cycle costs of maintaining fireproofing may outweigh any potential savings offered by sprayed fiber fireproofing during the construction period.

The IBC and its members recognized the importance of bond strength as a measure of a product’s ability to remain bonded to the steel to be effective in the event of a fire event. If the SFRM is not properly bonded to the steel, the SFRM may fall off the steel prematurely and then the steel may not be capable to support the loads for the intended time to ensure safe evacuation of the building occupants. Section 403.2.4 of the IBC outlines bond strength values required in the most vulnerable buildings.

What do architects and other experts in the field say about using cementitious and mineral fiber based spray applied fireproofing products from experience with both?

While UL testing measures the fire resistance performance in a laboratory controlled fire with materials installed under ideal conditions, UL tests do not measure a material’s ability to remain in place during the construction period and life cycle of the building.

There are national groups who have experience in post application inspections of in-place fireproofing and many architects with experience from past projects using both cementitious and sprayed fiber based products.

The National Association of State Fire Marshals On-site Inspections Subcommittee, prompted by the World Trade Center disaster, performed inspections in order to understand real world hazards associated with fire protection over time. In their report, they found, “…coatings on the steel beams and columns in the mechanical equipment room brushed off the beams easily, crumbled and turned into dust… the fire protection coating that was applied to the mechanical room steel is a fiber based coating.”

In the same facility, “in the room adjacent to the mechanical room, currently under renovation has fire protection coating on the steel beams that exhibited a consistent hard surface”. This material was determined to be a cementitious product.

The National Institute of Standards and Technology conducted a friability study of applied fireproofing and all of the cementitious products show no friability or low friability. All of the samples of sprayed fiber products rated moderate to high friability.

Many architects from all parts of the US specify only cementitious products based on experience. “Because of the concern with bond quality…a prominent nationwide architect believes dry-mix materials (sprayed fiber) are more easily abraded and damaged than wet-mix materials (cementitious). …there is concern in the industry that the mineral wool fibers contained in the dry-mix materials could become friable and subsequently airborne when exposed to air movement such as found in return air plenums and mechanical rooms.”

Writing about the mandatory water overspray that is required with all sprayed fiber products, one architect said, “it merely provides a “soft crust” if you will on the surface leaving the mineral fiber beneath unchanged. I liken it to the effect of hair spray.”

Where can I see for myself the differences between cementitious and sprayed fiber fireproofing?

If visiting a jobsite is not an option, there are videos detailing the mixing and application of both products as well as pictures from past project available at graceconstruction.com. Samples of the various products are also a good way of making a visual comparison and are available by contacting your local W.R Grace Representative.