

Tech Solutions 518.2

Benefits of Magnesium Oxide Sheathing vs. Traditional Materials in Multifamily and Commercial Construction

Summary

In [Tech Solutions 518.0](#), we detailed the origin of Magnesium Oxide (MgO), one of the most prevalent minerals in the world, as well as its long-standing history as an important ingredient of fire-resistive magnesia cements used in the construction of bridges, stadiums, and many other structures across the world.

In Tech Solutions 518.2, we will identify key benefits of MgO sheathing, a construction board based on magnesia cement, to the multifamily and commercial design and construction industry. Keep reading to learn how fire, structural, and other benefits of MgO sheathing outperform traditional construction materials such as Portland cement, gypsum, oriented strand board (OSB), and Fire Retardant Treated Wood (FRTW).

Valuable Benefits Compared to Traditional Materials

Fire-Resistance

Magnesium Oxide, generally derived from naturally occurring magnesite (MgCO_3) through a manufacturing process known as calcination, can readily be turned into a fire-resistive material

known as Sorel cement by combining it with a brine of a magnesium salt solution containing either chloride, sulfate or phosphate.⁴ These magnesia-based fire-resistive cements have been used in the construction of the Great Wall of China and bridges, commercial buildings such as Tapei 101, stadiums, and many other structures for generations.⁵

Perhaps the most innovative application of Sorel cement is fire-resistant MgO sheathing boards, produced by casting magnesia cement and inert fillers onto a mold, followed by curing under controlled conditions.⁶ Many recent fire-resistive building enclosure assemblies incorporate MgO sheathing on its own or in combination with other exterior building enclosure materials to garner valuable fire ratings, listings, and approvals that meet and exceed critical modern building code requirements for occupant comfort and life safety. MgO sheathing has a leading edge in fire-resistance properties when compared to wood construction materials, such as OSB and even FRTW.

Best-in-class MgO sheathing used on projects in the U.S. should



ArmorWall™ Plus FR SIS installed on the Cherokee County Schools building in Cherokee, NC.

pass various industry established fire testing standards on its own and/or with minimal additional materials, and be verified through third party listings. These tests include:

- **ASTM E119** for 1- and 2-hour fire-rated wall assemblies¹
- **NFPA 285** in assemblies for use with combustible cladding and in combustible construction²
- **ASTM E84** where it has a zero-flame spread and zero smoked developed index³

Structural Strength

MgO sheathing is known for its incredible strength and durability, beating gypsum and other common materials in fastener withdrawal and shear. These structural properties make MgO sheathing ideal for cladding attachment support on the exterior of multifamily and commercial buildings. MgO sheathing provides a smooth, structural substrate for direct attachment of many types of claddings, meaning the cladding attachment fasteners no longer require attachment back to the stud frame assembly or structure.

MgO sheathing outperforms traditional exterior sheathing materials in structural strength with regard to cladding attachment. MgO sheathing offers greater fire performance than exterior gypsum while matching the structural attachment support of OSB and plywood. MgO provides comparable structural values to OSB and plywood, allowing it to be used as a structural sheathing for exterior wall loads.

A half-inch of DuPont ArmorBoard structural sheathing has a maximum shear stress of over 280 psf. A single #10-13 pancake head screw in this MgO sheathing product has a fastener withdrawal strength of greater than 155 lbs, which is much greater than the common requirement of 32 lbs. This feature helps save projects time and money while improving performance, as installers are not required to locate and fasten back to the stud or structure, and can likely eliminate costly rails, girts, or sub-girts.

Additionally, these values enable architects to detail direct attachment of most types of claddings and rainscreens directly to the MgO sheathing. This includes ACMs and MCMs, terra cotta, thin brick veneers, phenolic panels, UHPC and fiber cement, among others. When MgO sheathing is combined with insulation in Structural Insulated Sheathing (SIS) panels, additional structural value is provided.

Durability

Third-party testing supports a variety of durability benefits for MgO sheathing:

- **Water-Resistance:** According to a recent third party study, "MgO sheathing is dimensionally stable when exposed to moisture. This durability is its primary attribute and the basis for performance under higher moisture loads."⁷ It is recommended that an MgO board be combined with a water-resistant barrier for long-term performance.

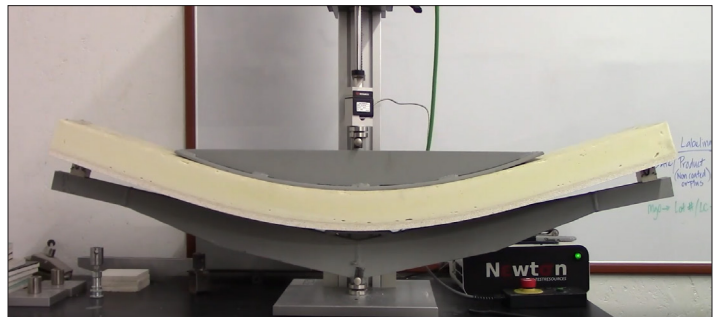
- **Exposure:** When combined with a high-performance water-resistant barrier and properly sealed, MgO sheathing can be left exposed to the elements for many months while waiting for cladding.

Constructability

Because of the stiffness of MgO sheathing, thinner sheets may be used when compared to similar exterior sheathing products. Thin sheets of MgO offer an advantage in that they can be bent or warped to follow gentle curves, as it is more flexible and less brittle than Portland cement boards, while being less flexible and sturdier than gypsum.



ArmorWall™ Plus FR SIS installed on a radius wall on a Medical Office Building in Boiling Springs SC



A piece of an ArmorWall™ FR SIS panel during Flexural Strength testing.

Environment

MgO sheathing has the potential to reduce the environmental footprint of structural materials used in the enclosure of commercial buildings.

Raw materials are abundant, as Magnesium is the eighth most abundant element in the Earth's crust and the third most abundant mineral in seawater. A common source of magnesium is magnesite ($MgCO_3$), which is mined at the surface and requires no chemical processes for its utilization. Conversion to reactive MgO (light-burnt magnesia) needed to produce MgO cements requires a lower temperature calcination step (700-1000°C) than for both Portland cement and unreactive MgO (1400-2000°C), which reduces energy use and air pollution.⁶

Reduced Jobsite Materials and Waste

Unlike more brittle materials like gypsum, the durability of MgO sheathing helps limit damage during transportation or handling, which reduces material waste on jobsites or in factories. Due to its structural properties that enable direct attachment of most types of cladding, MgO sheathing can reduce the amount of various forms of metal or aluminum girts, sub-girts, rails, or

clips used for cladding attachment. When used as a Structural Insulated Sheathing that combines MgO sheathing with other layers in place of traditional standalone materials, less material waste is created on the jobsite.

Disposal Process and End of Life

Boards can be disassembled and reused, ground and used as inorganic filler material, or sprinkled into the soil as a nutrient. Decomposition products are MgO or $\text{Mg}(\text{OH})_2$, MgCl_2 or MgSO_4 (Kieserite), which all contribute as a magnesium source for plant growth and soil nutritional balance, and are harmless to wildlife.⁸ Boards do not contain other toxic substances that would be source of contamination to land or water sources

In comparison, most Portland cement waste has limited use and ends up in landfills. Gypsum disposal in landfills is getting more regulated, as it cannot be disposed of where biodegradable material is present to avoid hydrogen sulfide release, such as in the UK.⁹

Comparison to Wood Products

Although wood itself has environmental benefits linked to bio-sourcing, engineered wood products such as OSB and FR-treated plywood require manufacturing and transportation of raw material, and finished products account for CO_2 emissions. Formaldehyde, a dangerous toxin, is often used as an adhesive or binder in the manufacturing of engineered wood products and is subject to off-gassing. Even alternate binders can release formaldehyde when the material is burnt. Pressure-treated fire-resistant wood production involves other toxic or corrosive compounds and it is generally not safe to burn.

MgO sheathing is mold and mildew resistant and is able to better manage wetting and drying cycles without degradation to its structural properties. When tested per ASTM G21, a test method commonly cited for fungal resistance of building materials, MgO sheathing scores a 0/0/0 rating.

Health and Safety

Cutting and working with MgO sheathing does not require OSHA-approved respirators as there are no silica-based materials in the product. As most MgO sheathing is magnesium-based with minimal reinforcing materials such as fiberglass, standard Personal Protective Equipment (PPE) used on jobsites such as safety glasses, long sleeves, and gloves are recommended. When cutting MgO sheathing, a dust mask is recommended.

DuPont offers a variety of building enclosure products with MgO sheathing for the multifamily and commercial markets.

DuPont™ ArmorWall™ Plus Fire-Rated (FR) Structural Insulated Sheathing (SIS) and ArmorWall™ SP Plus FR SIS are ICC-ES listed, high strength, fire-resistant exterior wall sheathing products that incorporate DuPont™ ArmorBoard, an MgO sheathing, as a core component along with a factory-applied, high quality air and water-resistive barrier and a fused polyurethane insulation

layer. Both products incorporate five traditional building enclosure elements into a single panel product: structural sheathing, fire-resistance, air barrier, water-resistive barrier, and a high-performance continuous insulation layer.

The five-in-one system can replace several traditional individual components that, on their own, add cost, labor and complexity to a project. With ArmorWall™ Plus FR SIS and ArmorWall™ SP Plus FR SIS, there are fewer components and materials to install, which has the ability to reduce the number of installation revolutions to one. One installation revolution enables both products to help reduce the time needed to weather-in a building by weeks, not days, further reducing labor, material, and other project costs.

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