

USG DUROCK™ BRAND GYPSUM UNDERLAYMENT

REPAIR GUIDE

usg.com/repair

USG®

For more than 40 years, poured gypsum-based underlayments have played an important role in both fire and sound resistance in multifamily dwellings. Even though gypsum and lightweight concrete products can be used interchangeably as a heat sink, engineers and designers tend to give gypsum underlayments preferential consideration because they can achieve fire ratings at half the thickness of lightweight concrete. When repairing gypsum underlayment, maintaining the fire resistance of existing structures is critical for code compliance, which is why many products are tested per the ASTM E119/UL 263 standard for fire resistance.

INDUSTRY STANDARDS

The trouble encountered when rehabbing old, existing gypsum floors with low-compressive strengths is that the gypsum is often fractured, broken and crumbling. Loose materials must be removed, which can leave the thickness of the gypsum underlayment below the minimum requirement of 3/4 inches. When that happens only gypsum repair products that are UL Classified and specified are approved for use in that assembly.



ACHIEVE COMPLIANCE

The USG Gypsum Underlayment Repair Portfolio includes pourable and trowelable products that can be used to rejuvenate a bad floor and provide a new durable, smooth surface ready to receive today's most demanding types of floor coverings. All USG gypsum-based repair products are UL Classified and specified for use in more than 130 fire-rated floor assemblies.

The purpose of this guide is to provide you with general steps and procedures on how to properly repair damaged gypsum underlayment to achieve compliance. For further information, see usg.com/repair for specific product submittals or contact your local USG representative.



USG DUROCK™ GYPSUM UNDERLAYMENT REPAIR GUIDE

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USG REHABILITATION GUIDELINES FOR DAMAGED GYPSUM UNDERLAYMENTS

POURED GYPSUM FLOORS IN MULTI-FAMILY STRUCTURES

The use of poured gypsum underlayments began in the early 1970s as a substitute for lightweight concrete. The need for either gypsum underlayment or lightweight concrete is based on building codes that require all multi-family buildings provide a one-hour fire rating. Both gypsum underlayment and lightweight concrete products act as a heat sink that in turn delivers a one- or two-hour rated assembly.

A gypsum underlayment is beneficial for a few reasons:

1. **Reduction in thickness** – Gypsum underlayments can be poured at a minimum of 3/4 in. (19 mm) thick instead of the 1-1/2 in. (38 mm) that lightweight concrete requires. This means there's less material needed for the job and a lighter building.
2. **Faster setting** – Gypsum underlayment sets and develops strength very quickly which can allow trade traffic to resume in as little as one day.
3. **Reduced embodied carbon** – Gypsum underlayments contribute at least 75% less embodied carbon than lightweight concrete.*

All multi-family structures must be designed in accordance with the requirements of Underwriters Laboratory (UL) for fire-resistance. UL has created a library of floor-ceiling assembly specifications that are used by architects and code bodies to identify the exact methodology needed to construct the floor-ceiling assembly. Therefore, it is imperative that any repair/rehabilitation performed on a multi-family dwelling conform to UL standards. This means that the minimum thickness of the poured gypsum underlayment must be maintained at no less than 3/4 in. (19 mm) using a UL Classified product. There are no maximum thickness limits specified by UL.

Gypsum floors are installed by adding water and sand to a specially formulated gypsum binder powder at the jobsite. Care and control must be taken by the gypsum underlayment contractor to ensure that the manufacturer's recommended mixing instructions are followed.

Unfortunately, this does not always happen, and the contractor may have added too much sand or too much water or a combination of both. When this happens, the gypsum underlayment will exhibit specific defects such as a soft and chalky surface, cracks and low strength (both tensile and compressive).

In past decades, most multi-family dwellings used carpet and pad as the floor covering. As a result, many of the gypsum underlayment defects caused by over-sanding and/or over-watering were hidden. However, in recent years flooring trends have moved to 'hard surface' products such as ceramic tile, vinyl composition tile (VCT), luxury vinyl plank (LVP), engineered wood and laminated flooring products for common areas such as living and dining rooms, kitchens and bathrooms. These floor coverings are less forgiving than carpet. They require a smooth, dense and hard surface. Often flooring adhesive and floor-covering manufacturers will specify a minimum compressive strength for their products.

Note *Based on a per inch basis. Achieved when comparing a 1 in. pour of gypsum floor underlayment vs. a 3/4 in. pour of lightweight concrete.

DAMAGED GYPSUM FLOORS

During the renovation of multi-family complexes, the removal of old carpet and pad products will expose the gypsum underlayment. In many cases, the surface will exhibit the defects described above. The problem is simple – the old gypsum underlayment is not suitable to support the 'hard surface' products being used today. In addition, damaged gypsum floors bring with it the following issues:

1. The soft and chalky surface is not a good host for the use of adhesives or mastics. A soft and chalky surface will pull water out from the adhesive or mastic which will render the adhesive or mastic useless as there will be no adhesion between the adhesive and the gypsum underlayment.
2. Any cracks or surface blemishes will transfer through to the surface of flexible products like VCT and LVP after the adhesive has completely dried.
3. Floors will lack the durability needed to sustain foot traffic (especially high heels) or point loads from furniture and appliances because the old gypsum underlayment lacks enough compressive strength to withstand the load.

GYPSUM FLOOR REPAIR

Below are remediation techniques for the most common rehabilitation projects. We highly recommend that circumstances not presented here be discussed with a USG Technical Representative for appropriate actions.

There are three key components to properly rehabilitating damaged poured gypsum floors:

- Inspect
- Prepare
- Resurface

INSPECT

Once the gypsum underlayment has been exposed by the removal of existing floor covering (see *Notes/ Limitations* #5, pg. 8), a thorough inspection must take place. Typical characteristics of a floor needing rehabilitation include: surface softness, chalkiness, cracks, surface deformation or irregularities and loose gypsum that is no longer secured to the plywood or OSB subfloor. It is also very important to take note of floor areas that deflect under load. Deflection may indicate that the original structure used plywood or OSB less than ¾ in. (19 mm) (nominal), tongue-and-groove (T&G) plywood or OSB, or there is a structural issue that must be investigated further.

PREPARE

Remove all loose gypsum. Make sure there are no areas of gypsum that are no longer adhered to the wood subfloor. Using a stiff bristle broom, sweep the old gypsum surface. This will help to remove some of the old gypsum "scale" from the surface. It is highly recommended that a HEPA vacuum be used during and after the broom cleaning to remove as much dust as possible.

If the existing gypsum underlayment is clean, sound and consolidated and requires only a new smooth surface, then proceed to the *Resurface* section.

If the surface is soft, chalky and/or a low-strength gypsum underlayment, then a liberal coating of Sikalastic® FTP Primer to the entire gypsum surface – including any exposed plywood or OSB – is required. Sikalastic® FTP Primer is a low viscosity sealer developed to effectively seal and consolidate the surface of soft, chalky and low strength gypsum underlayment. The primer soaks into the gypsum mass and once cured, provides a sealed surface as well as strengthens the gypsum where it has penetrated. See *Sikalastic® FTP Primer* (pg.) for more information and how to properly apply.

RESURFACE

After Sikalastic® FTP Primer has cured, the gypsum underlayment is ready for resurfacing. There are several product options to resurface the gypsum underlayment, both trowelable and pourable. When selecting a product, take into account the size of the area being repaired, how thick the product needs to be applied or whether a sound attenuation product will be used.

To maintain the fire-rating of the floor-ceiling assembly, the gypsum underlayment must be at least ¾ in. (19 mm) over the subfloor. To determine the gypsum underlayment depth, core the floor by drilling through the gypsum until the wood subfloor is detected. If after cleaning and coring the surface, areas are under ¾ in. (19 mm), a UL Classified gypsum-based product must be used to resurface. **Important** – using a non-UL Classified product will violate building code requirements and will compromise the fire-rating of the floor-ceiling assembly. The following are all UL-Classified products approved for gypsum underlayment repair:

- USG Durock™ Tuf-Skim™ Floor Patch
- USG Durock™ Quik-Top™ Self-Leveling Underlayment
- USG Durock™ Multi-Use Self-Leveling Underlayment

If the sealed, cleaned, sound and consolidated gypsum underlayment requires only shallow repairs and a new flat surface, USG Durock™ Tuf-Skim Floor Patch can be applied directly to the sealed surface.

If the sealed, cleaned, sound and consolidated gypsum underlayment requires deep repairs or there is a need to cover the entire surface with a self-leveling underlayment, the surface needs to first be primed using USG Durock™ Primer-Sealer.

A value-added resurfacing product such as USG Durock™ Multi-Use Self-Leveling Underlayment can be applied at a minimum thickness of ½ in. (13 mm) over the existing gypsum (minimum ¾ in. (19 mm) thickness over the subfloor). USG Durock™ Multi-Use Self-Leveling Underlayment achieves a compressive strength of 4,100 psi (28.3 MPa), making it a perfect choice for all commercial flooring products. USG Durock™ Multi-Use Self-Leveling Underlayment can be walked on in approximately two hours, but will require time to dry completely prior to application of floor coverings. Drying times will vary based on the total depth of repair and the ambient condition of the space.

To hasten the drying time of the underlayment after set, place a box fan near, but not directly on, the repair(s) to promote air circulation. It will take 3-5 days to dry ½ in. (13 mm) of USG Durock™ Multi-Use Self-Leveling Underlayment, assuming a fan is used in ambient conditions where the air temperature is above 60 °F (15 °C) and the RH is below 50%. Refer to the *USG Durock™ Brand Multi-Use Self-Leveling Underlayment Submittal* (CB519) for more information.

If a fast-track solution is needed, then USG Durock™ Quik-Top™ Self-Leveling Underlayment can be used. USG Durock™ Quik-Top underlayments are self-leveling and 'self-drying' with high compressive strengths (up to 10,000 psi) and can be walked on two hours after installation. Floor coverings can typically be installed after 15 hours when USG Durock™ Quik-Top Self-Leveling Underlayments are applied at a 1 in. (25 mm) thickness or less. Drying time will vary depending on underlayment thickness and ambient climate conditions.

USG Durock™ Quik-Top Self-Leveling Underlayments can be poured from a featheredge up to a 3 in. (76 mm) depth. Refer to *USG Durock™ Brand Quik-Top Self-Leveling Underlayment Submittal* (CB515) at usg.com for more information.

FLOOR-COVERING INSTALLATION

USG recommends priming the new gypsum underlayment surface prior to floor-covering adhesive application. Follow floor-covering manufacturers' recommendations for surface-sealing requirements. If the floor-covering or adhesive manufacturer requirements are more stringent, their requirements take precedence.

For tile applications using cement-based mortars, the use of Sikalastic® FTP Primer is required.

For a detailed, step-by-step guide to properly inspect, prepare and resurface a damaged gypsum underlayment, refer *USG Durock™ Gypsum Underlayment Repair Steps* (page 9).

NOTES/LIMITATIONS

1. Do not use in exterior applications.
2. Do not install where continuous exposure to moisture is a possibility.
3. Do not install over dimensionally unstable, improperly prepared subfloors.
4. Do not use oil-based sweeping compounds to clean and prepare the old gypsum underlayment. Use of such sweeping compounds leaves an oil film on the surface of the underlayment. Use a HEPA vacuum or a dry broom to remove the dust and debris.
5. If the old gypsum underlayment was previously covered with a flooring product that was glued or otherwise adhered to the surface of the gypsum underlayment, do not use adhesive-removing chemicals or solvents to eliminate contaminants from the old gypsum underlayment. Use of such chemicals can transport oil, grease, and other contaminants further into the gypsum underlayment. These chemicals can migrate back to the surface at a later time to interfere with the floor-covering adhesives, thus compromising the bond performance. Mechanically removing the organic adhesives, asphalt, coal-tar based adhesives and other oil-based contaminants is the sole recommended method of preparing the gypsum underlayment. Use mechanical removal methods such as scraping, scarifying or sanding to clean and prepare the old gypsum underlayment contaminated with adhesives, asphalt or oil. Do not apply over subfloors containing asbestos. Do not mechanically remove organic adhesives, asphalt, coal-tar based adhesives or other materials containing asbestos.
6. Do not overwater or over mix the trowelable or pourable USG Durock™ products.
7. Do not add any non-approved chemical additives or polymers to the USG Durock™ products.
8. Do not mix with other products or self-leveling materials.
9. Structure shall be designed so that deflection does not exceed L/240 from combined dead and live loads and L/360 from live loads. Certain floor coverings such as marble, limestone, travertine and wood may have more restrictive deflection limits. Consult the appropriate floor-covering manufacturer.
10. All subfloors must be structurally sound, stable and solid. Please be advised that old gypsum underlayments may have compressive strengths below 1,000 psi (6.9 MPa). Most manufacturers' resilient vinyl tile or vinyl plank compressive strength requirements specify a minimum of least 3,000 psi (20.7 MPa) – some manufacturers may require compressive strengths exceeding 3,500 psi (24.1 MPa). It is very difficult to measure the existing compressive strength of a gypsum subfloor without the use of an instrument such as a Windsor Pin Test System, manufactured by James Instruments (ndtjames.com). Special consideration must be used when evaluating a low compressive strength underlayment. A thin coating of a troweled or poured repair product may not be able to withstand heavy loads, especially point and rolling loads when the repair product thickness is less than ½ in. (13 mm). For a pourable solution that requires a thickness of ½ in. (13 mm) or less, USG fiber-reinforced underlayments are recommended. A judgment call must be made by the repair contractor as to whether the existing gypsum underlayment is strong enough to support the repair. Note - USG is not liable for failures resulting from pre-existing materials.



USG DUROCK™ GYPSUM UNDERLAYMENT
REPAIR STEPS

USG DUROCK™ GYPSUM UNDERLAYMENT REPAIR STEPS

To repair damaged gypsum floors and maintain their fire rating, look no further than USG. Our gypsum floor underlayments and patches are UL Classified and specified for use in 130+ fire-rated assemblies.

STEP 1: PREPARE EXISTING UNDERLAYMENT

- Scrape and remove adhesives
- Determine structural soundness and make repairs as needed
- Vacuum using a HEPA vacuum to ensure all dust is removed



STEP 1

STEP 2: APPLY CONSOLIDATOR

- **Sikalastic® FTP Primer** is a consolidator that will increase surface hardness and internal strength of the gypsum underlayment
- Apply to rejection using a 1/2-inch roller nap (coverage will vary from 100 to 200 sq. ft. per gallon depending on the porosity)
- Allow to dry for a minimum of 8 hours but no more than 14 hours



STEP 2

STEP 3: APPLY PRIMER

- **USG Durock™ Primer-Sealer** will help enhance the bond between the existing underlayment and the resurfacing product
- Mix and apply one-part primer to one-part water by volume at approximately 250 – 300 sq. ft. per gallon; roll or spray until saturated without puddles
- Allow to dry clear

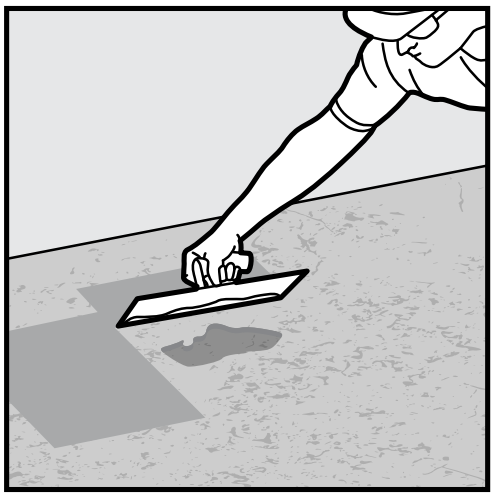


STEP 3

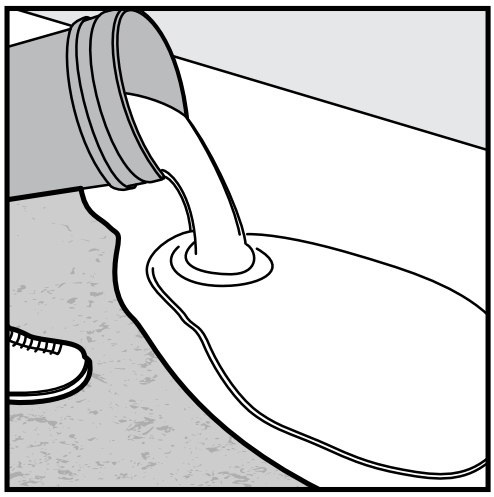
USG DUROCK™ GYPSUM UNDERLAYMENT REPAIR STEPS

STEP 4: RESURFACE

- For trowelable applications, apply **USG Durock™ Tuf-Skim™ Floor Patch**
- For pourable applications, apply **USG Durock™ Quik-Top Self-Leveling Underlayment**



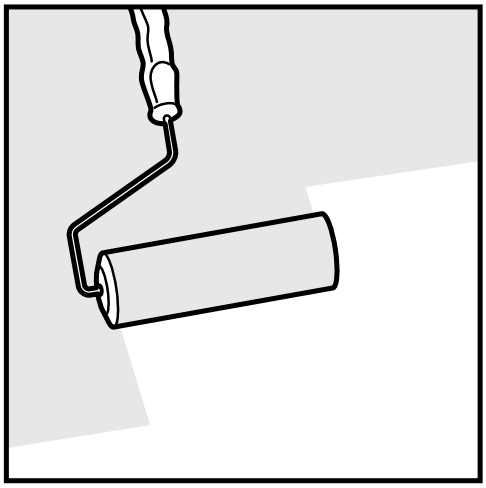
STEP 4—trowelable



STEP 4—pourable

STEP 5: APPLY SEALER

- **USG Durock™ Primer-Sealer** will seal the resurfaced underlayment and enhance the bond between it and the flooring adhesive
- Mix and apply one-part primer to four-parts water by volume at 300 – 350 sq. ft. per gallon; roll or spray until saturated without puddles
- Allow to dry clear



STEP 5

STEP 6: APPLY FLOOR-COVERING ADHESIVE

Follow flooring adhesive manufacturer's installation recommendations to maintain flooring adhesive manufacturer's warranties.

STEP 7: APPLY NEW FLOOR COVERING

Follow floor-covering manufacturer's installation recommendations to maintain floor-covering manufacturer's warranties.

For more information on gypsum repair solutions, gypsum underlayment repair videos, and specific product submittals and SDSs visit usg.com/repair.



GYPSUM MISCONCEPTIONS

This white paper reveals the misconceptions and inherent features and benefits of gypsum cement by exploring the basic science behind it. For the sake of clarity and time, we have taken a few short-cuts with the descriptions of science and may have used literary license to keep the extremely technical information to a minimum. First, a few basic terms and definitions:

Binder A binder is defined as "something (as tar or cement) that produces or promotes cohesion in loosely assembled substances."[1]
Cement Cement is defined as "a binding element or agency: as a substance to make objects adhere to each other."[2]

Therefore, for all practical purposes, "binder" and "cement" can be used interchangeably.

Concrete A word often misused. Concrete is defined as "formed by coalition of particles into one solid mass."[3] The definition does not specify what binder is used to create the mass, nor does it specify the types of particles. Aggregates can be sand or gravel or a combination of both.
Therefore, a product such as gypsum, when mixed with sand (such as USG Levelrock® Brand Floor Underlayment) is, in fact, a concrete (i.e. gypsum concrete).

1. Binder [Def. 3]. 2016. In *Merriam-Webster.com*, Retrieved May 17, 2016, from http://www.merriam-webster.com/dictionary/binder.
2. Cement [Def. 2a]. 2016. In Merriam-Webster.com, Retrieved May 17, 2016, from http://www.merriam-webster.com/dictionary/cement.
3. Concrete [Def. 2]. In *Merriam-Webster.com*, Retrieved May 17, 2016, from http://www.merriam-webster.com/dictionary/concrete.

GYPSUM BASICS

Gypsum offers unique physical characteristics that other binders cannot. By definition, gypsum is a "mineral of crystalline structure composed of calcium (Ca), sulfate (SO_4) combined with two molecules of water." The chemical equation is: $CaSO_4 \cdot 2H_2O$. **Gypsum** is also commonly known as **calcium sulfate dihydrate** (di meaning two and hydrate meaning "contains water").

Natural gypsum is pH neutral – neither acidic nor alkaline. It is a very common mineral found around the world. **Limestone** is commonly known as **calcium carbonate**, and is also a calcium-based mineral, represented by the chemical equation: $CaCO_3$, where Ca is calcium and CO_3 is carbonate.

GYPSUM SOURCES

Gypsum occurs in sedimentary depositional basins in many parts of the United States and Canada including the Permian age strata and the Mississippian strata that contains gypsum mined in Nova Scotia.

USG and Gypsum
Historically, United States Gypsum (USG) built manufacturing plants at the site of natural gypsum sources. USG continues to quarry and mine gypsum plants such as Sweetwater, TX, Southard, OK and Ft. Dodge, IA, to name a few. Mined gypsum is not the only gypsum USG uses for wallboard and USG Levelrock floor underlayment; for more than a decade, USG is also a consumer of Flue Gas Desulfurization (FGD) gypsum to manufacture products. In fact, USG's newest plant is located near electric power plants that burn coal. It is there that FGD gypsum is created.

FGD Gypsum
Flue Gas Desulfurization is one of the processes of 'cleaning' the combustion gases of coal-burning power plants. The result of the cleaning process produces fly ash and FGD gypsum in two distinctly different places within the cleaning process. In simple terms, the cleaning of the exhaust gases from a power plant is done in this two-step process:

Step 1 involves the removal of the coal 'soot' which uses dry filters to capture the exhaust. The soot that is extremely fine in size and floats in the exhaust air is called 'fly ash.'

Step 2 is to eliminate as much of the sulfur dioxide from the exhaust. This is done by passing the filtered exhaust gases through a 'wet' scrubber. This scrubber is a mixture of finely ground limestone mixed with water to create a thick soup. As noted before, limestone is calcium carbonate. As the gas passes in the scrubber, the soup is sprayed into the gas and a chemical reaction takes place – the sulfur dioxide reacts with the calcium carbonate and the calcium carbonate becomes calcium sulfate dihydrate (aka gypsum).

THE MIRACLE MINERAL

Ground gypsum in and by itself will not get hard when mixed with water. Gypsum has to be converted to a "hemihydrate" by first cooking it. The process of cooking gypsum is called "calcination." As previously mentioned, two molecules of water are part of the gypsum (dihydrate) crystal. The calcination process removes 75% of the water, yielding a crystal composition known as calcium sulfate hemihydrate. Adding water to hemihydrate converts it back to the original form, calcium sulfate dihydrate. As you can see, the process is reversible.

The conversion from hemihydrate back to dihydrate is fascinating. When water is added to calcium sulfate hemihydrate, the hemihydrate crystals immediately go into solution and as fast as they go into solution, gypsum crystals begin to grow. The crystals grow in every direction and into each other. Once each crystal has re-hydrated, growth of the crystal system stops. Due to the crystal growth, the developed mass expands ever so slightly. This is a powerful mechanism for products made from gypsum as the expansion helps in several ways:

1. Eliminate shrink cracks normally associated with other types of cements (such as Portland cement (PC) and calcium aluminate cement (CAC)).

2. As expansion occurs, the mass finds every nook and cranny to grow into. Unless the surface is perfectly smooth like glass, the dihydrate will "lock" itself into place. This feature of gypsum provides a very important benefit in the underlayment marketplace. Therefore there is no need to create a host surface via shot-blasting or scarifying.
3. Thickness indifference. CAC and PC require water for proper hydration throughout the curing process. If a pour has variations in cross-sectional thickness (from thick to thin), the thin areas may evaporate quicker than the thick areas, thereby creating differential shrink over the entire mass. Gypsum only requires water for hydration until it has set (gets hard), therefore the cross-sectional thickness is not susceptible to differential shrink.

USG AND GYPSUM MANUFACTURING

Calcium sulfate hemihydrate, as described above, is the base binder for USG Levelrock Floor Underlayments, as well as many other USG products including, USG Moulding Plaster (Plaster of Paris), USG Hydrocal® Brand Gypsum Cements, USG Hydro-Stone® Brand Gypsum Cements and USG Sheetrock® Brand Wallboard.

Through the marriage of base hemihydrate (via unique manufacturing process sciences) and chemical formulation, USG can formulate products to suit a wide variety of applications with specific features. As an example, USG Durock™ Quik-Top™ Self-Leveling Underlayment will not only develop a compressive strength of up to 10,000 psi and have self-leveling properties, but has been designed to be 'self-drying' in that the rehydration process will consume almost all the water used to create the slurry.

GYPSUM CONCRETE STRENGTH

Two factors have the most profound effect on the final strength of rehydrated gypsum – the amount of water and the aggregate used in the hemihydrate mix.

WATER

A hemihydrate crystal only requires about 18.6% water to rehydrate and become gypsum. This is often called "theoretical water." Using math, this means that 100 pounds of pure hemihydrate powder requires 18.6 pounds of water to convert into gypsum. However, in the real world, 18.6% volume of water will not be enough to create a fluid slurry. It is not uncommon that some hemihydrate products require up to 4-5 times theoretical water.

The rule of thumb about the effect of water with respect to hemihydrate is simple: The more water used to create a slurry (greater than the actual hemihydrate theoretical need), the weaker the hardened mass will be. This is because the excess water has no effect on the hydration process and literally takes up space. This 'free' water, sometimes referred to as 'water of convenience' ultimately sits in the hardened mass and then later evaporates, leaving behind tiny air voids. The more air voids the lower the density and the lower the strength, be it compressive, flexural or tensile strength.

The excess water has to leave the system through natural evaporation or through forced drying. The more water in the system, the longer it will take for it to be removed. Excess water will result in a lower strength mass. Once the mass has 'set up' and is fully hydrated, it is imperative that the hardened mass begin to dry. Last but not least, the ultimate strength of gypsum occurs only after the gypsum mass has completely dried.

Important to note – this is totally different than Portland cement (PC) or calcium aluminate cements (CAC). PC and CAC materials require water for an extended amount of time while the cement sets. This is often referred to as moist curing. Gypsum cements only require water to form new crystals as explained earlier. Once formed (usually within a few short hours), the system **no longer requires water**. This is counter-intuitive to those that work with or develop PC and CAC products. Note that all PC and CAC products provide strengths at different intervals up to 28 days to develop maximum strength. Gypsum's final strength can be accomplished as soon as the free water has evaporated from the set mass.

GYPSUM CONCRETE STRENGTH CONT.

AGGREGATES

The rule of thumb regarding the use of aggregates such as sand is: the addition of anything other than hemihydrate to a slurry will reduce the strength of the hardened mass. This is because the sand keeps the new hydrated gypsum crystals apart. Sand also prevents the new hydrated gypsum crystals from growing into each other. Further, the sand does not chemically bond to the newly formed crystals; instead, the sand becomes trapped and locked within the crystal matrix. One way to maximize how sand integrates with the slurry is to make sure the particles are not all the same size.

Particles of like size create space between each particle. By adding particles of various sizes, the spaces become smaller and more compact, providing a more efficient 'nesting' of aggregate. The shape of the sand is also very important. Sand that is too angular and flat is not as good as sand that has some rounded shape. Sands that have a more rounded shape tend to "roll" more than sand that is flat, which improves slurry flow. Sand to be used in USG poured gypsum underlayment products must be selected based upon maximizing the physical properties of the sand with the base formulation. It should also be noted that sand is not the same around the country and can contain impurities that have a negative effect on gypsum.

Given the rules as described above, one can deduce that excess water and the resultant negative effects on crystal growth etc. will result in an inferior dihydrate mass. It should be recognized that there are additives that are used in gypsum, PC and CAC-based formulations to make water more efficient. By using these chemicals, also known as 'consistency reducers' less water is required to create a flowable slurry.

USG FORMULATION ROBUSTNESS

USG has determined the range of water and sand that is required for every formulation manufactured by USG. Using more water or sand than is recommended will not only reduce compressive strength, but may create soft, chalky surfaces. However, USG gypsum cement formulations have been created to be extremely robust and can account for moderate user variations. Further, all of our formulations are designed so that they require less water than competitive products, yet maintain high fluidity. All USG gypsum-based underlayments use state-of-the-art technology that is protected by intellectual property rights.

Additionally, USG has developed manufacturing processes that optimize calcination processes resulting in engineered hemihydrate crystal structures that are well defined – sort of 'designer' crystals. Current technology can create hydrated products whose compressive strength approach 20,000 psi. The combination of formulatory and manufacturing technology advancements are unique and are protected by intellectual property rights.

THE TRUTH ABOUT WATER AND GYPSUM

Perhaps the biggest fallacy and certainly the one most used by adversaries of gypsum-based products is that gypsum underlayments will 'dissolve' or 'melt' when exposed to water. Gypsum is slightly water soluble, but so is limestone which is used as a building material. Gypsum is soluble in water at a rate of *2 grams per liter of water*. So what does this mean?

At a solution rate of 2 grams per liter of water, one pound of gypsum therefore will require 227 liters of water to go into solution (as there are 454 grams per pound). 227 liters is equivalent to about 60 gallons of water.

An example: If 60 gallons of water were poured onto a floor that was being supported by a gypsum underlayment (such as in a bathroom or kitchen) in no way does this mean that that one pound of gypsum would "melt" away. Assuming the floor had a floor covering, be it tile or vinyl as an example, how much water would actually be able to saturate the gypsum underlayment?

Now let's say the flooring had not been applied, what then? The majority of the water will probably be absorbed by the gypsum underlayment. Even if the water is completely soaked into the gypsum underlayment, erosion will not take place because the water solution will be saturated at a rate of 2 grams/liter and will just soak into the gypsum underlayment. Assuming the water source is eliminated, the underlayment will dry. The water will simply evaporate, leaving the gypsum that had been in solution to reside within the interstitial spaces of the crystal structure. As a matter of fact, there could even have been a small portion of hemihydrate in the hydrated mass that was not rehydrated during the original pour. The intrusive water then reacts with the hemihydrate and is consumed as the hemihydrate rehydrates into dihydrate, further reducing the effects of water.

If however the water source is not eliminated, there is a possibility that surface erosion can take place. Keep in mind though that the volume of water would have to be extreme and the fact is that under circumstances enough to cause significant surface erosion, the effect of the water intrusion will also have an effect on other parts of the structure such as the plywood or OSB underlayment, or even the framing members of the structure. Water will probably cause the wood fibers of the plywood or OSB to swell, resulting in a floor/ceiling assembly that has been compromised to some degree.

In extensive lab tests conducted by USG CIC (Research), results proved that the gypsum structure did not lose physical strength or basic integrity.

IS GYPSUM CONCRETE A HYDRAULIC CEMENT?

ASTM C219-14a *Standard Terminology Relating to Hydraulic Cement* defines hydraulic cement as "a cement that sets in water and is capable of doing so under water." Gypsum completely fulfills this definition and it is totally proper to call all USG Levelrock products a "gypsum cement" (as it comes from the bag) and a "gypsum concrete" (after it is sets up and is on a floor).

GYPSUM REVIEW

- The setting of 'gypsum' is the result of the rehydration of the hemihydrates.
- The action of setting is also known as re-crystallization or hydration.
- Hemihydrate is the result of calcining (cooking) calcium sulfate dihydrate.
- Calcium sulfate dihydrate is the chemical name for gypsum.
- As hemihydrate converts to gypsum via crystal growth, the resultant mass expands slightly upon set.
- Hemihydrate requires about 18.6% water (by weight) to rehydrate.
- Water in excess of 18.6% is called 'free moisture' or 'water of convenience'.
- Too much water is bad because it keeps rehydrated crystals apart and the free moisture resides in the mass taking up space that ultimately becomes air voids once the free water evaporates.
- Adding sand dilutes the hydrated mass, reducing strength.
- Sand is not the same around the country and can contain impurities that have a negative effect on gypsum.
- Sand particle size and shape are important.
- Gypsum is slightly soluble at a rate of 2 grams per liter of water.
- Gypsum will not 'melt' when exposed to water. In some cases, the mass may become stronger.
- Soft, chalky poured gypsum underlayment is a result of too much water, too much sand or a combination of the two. Under mixing can exacerbate the problem.
- Once set, gypsum no longer has a need for water and develops ultimate strength once the gypsum mass is fully dry. The drying can be through normal evaporation or aided by forced drying.
- Through manufacturing and formulation techniques, gypsum concrete can achieve compressive strengths approaching 20,000 psi.

SIKALASTIC® FTP PRIMER



Two-component waterborne epoxy

- Ideal for surface consolidation of weak or damaged gypsum underlayments
- Superior penetration and bond to gypsum underlayments and green concrete
- Low VOC and low odor
- Fast cure time

DESCRIPTION

Sikalastic® FTP Primer is a one-coat, two-component, waterborne epoxy that has been specially formulated for interior applications, including as a consolidation primer for weak or damaged gypsum underlayments.

As a consolidation primer for weak or damaged gypsum underlayments, Sikalastic® FTP Primer reduces surface dust and chalkiness, and increases surface hardness and internal strength to an acceptable level for installation of USG Durock™ Tuf-Skim™ Floor Patch or USG Durock™ Quik-Top™ Self-Leveling Underlayment.

SUBFLOOR PREPARATION

All subfloors must be structurally sound, solid and secure. If there is any question about the structural soundness of the subfloor, consult with the engineer on the project or request the services of a professional structural engineer. Also ensure the subfloor temperature is between 41-85 °F (5-29 °C) and that the subfloor temperature is 5 °F (2.8 °C) above measured dew point prior to application.

Gypsum underlayment floors must be clean and free of dirt, tar, wax, oil, grease, latex compounds, sealers, curing compounds, release agents, asphalt, adhesives, paint, chemicals, loose gypsum, joint compounds from drywall installation or any other contaminant that might prevent proper bonding of Sikalastic® FTP Primer to the subfloor. Radiant heat systems should be shut off and cooled down during application and drying of the Sikalastic® FTP Primer.

If the surface is soft, chalky and/or a low-strength gypsum underlayment, sweep the old gypsum surface using a stiff bristle broom while wearing proper dust protection. This will help to remove the old gypsum "scale" from the surface. It is highly recommended that a HEPA vacuum be used after the broom cleaning to remove as much dust as possible.

Note that the gypsum underlayment must be at least ¾ in. (19 mm) over the subfloor when used in a UL listed assembly. To determine the gypsum underlayment depth, core the floor by drilling through the gypsum until the wood subfloor is detected. After cleaning and coring the surface, any areas that are less than ¾ in. (19 mm) deep will require a gypsum repair product that is Classified and specified by UL. All USG Levelrock® Floor Underlayments, USG Durock™ Floor Patches and USG Durock™ Self-Leveling Underlayments are UL Classified. **Important – using a non-UL Classified product will violate building code requirements for fire resistance.**

MIXING EQUIPMENT

- Safety glasses
- Protective gloves
- NIOSH-approved respirator
- Electric drill (300–400 rpm)
- Jiffy®-type mixer
- 5 gallon pails/mixing drums
- Nonshedding ¼ in. (6 mm) or ¾ in. (19 mm) nap nylon core roller cover
- Non-metallic cleated shoes

MIXING & APPLICATION

Subfloor temperature must be at least 5 °F (2.8 °C) above measured dew point temperatures prior to application. Minimum ambient and subfloor temperature during application and curing of material is 41 °F (5 °C); maximum is 90 °F (32 °C). Frequent monitoring of ambient and subfloor temperature should always be done when applying epoxy primers. Note that low temperatures will slow down the cure, and high temperatures will accelerate it.

AS A CONSOLIDATION PRIMER

Condition material to 65-85 °F (18-30 °C) before using. Mix Sikalastic® FTP Primer components A & B by adding the .28 gallon (1.0 L) of Part A to the .35 gallon (1.3 L) of Part B in the short filled Part B pail. Mix thoroughly with a low speed (300 - 500 rpm) drill with a Jiffy-type paddle for 3 minutes. This mixture will appear as a light olive green color when completely mixed.

Next, fill a clean 5 gallon bucket with 4.4 gallons (16.6 L) of potable water. Slowly add the A/B mixture to the water while mixing. Mix for an additional 2 minutes until all components are fully dispersed. Fully dispersed material will appear as light yellow to white in color.

Note–The order that the Sikalastic® FTP Primer components are mixed is critical to the performance of this product. Water must be added per instructions above. Failure to mix properly may result in an incomplete cure, despite a dry appearance.

For application of Sikalastic® FTP Primer over weak, damaged or old underlayments, spray Sikalastic® FTP Primer using a Hudson®-type sprayer or roll at a rate of no more than 200 sq. ft./gal. (4.9 m^2/L) and then back roll with a ¼ in. (6 mm) nap roller to eliminate any puddles. Allow for sufficient wetting of the slab and ensure that the recommended coverage rate is honored. Minimize the overlap from batch to batch or bead-to-bead applications while achieving complete surface coverage. There should be no loose dust on the surface if properly applied. Pot life is up to two hours based on temperature/humidity. Working time is shortened by higher temperatures.

The primed surface is ready for the application of USG Durock™ Tuf-Skim Floor Patch or USG Durock™ Quik-Top Self-Leveling Underlayment as soon as the primer turns clear. Do not apply multiple coats of Sikalastic® FTP Primer.

Allow Sikalastic® FTP Primer to cure for a minimum of 8 hours, but not more than 14 hours, before installation of the recommended USG Durock™ Self-Leveling Underlayment. Underlayment application after 14 hours will require an application of USG Durock™ Primer-Sealer prior to pouring.

NOTES/LIMITATIONS

1. Do not use in exterior applications.
2. Do not thin Sikalastic® FTP Primer.
3. A certain degree of porosity of the slab surface is necessary for Sikalastic® FTP Primer to function as designed.
4. Precautions should be taken to prevent vapors and/or odors from entering the building/structure, including but not limited to turning off and sealing air intake vents and through wall air conditioners, and other means of vapor/odor ingress during application and cure.

PRODUCT DATA

Pot Life: Up to 2 hours based on temperature/humidity

Approximate coverage as a surface consolidation primer: Up to 200 sq. ft. (18.6 m^2) per gallon[1]

VOC Content: <5 g/L

Cure Time: 3-4 hrs. at 77 °F (25 °C) and 50% relative humidity

Flash Point: >200 °F (93.3 °C)

Packaging: Sikalastic® FTP Primer is packaged in a two-part kit consisting of one .28 gallon (1.0 L) container (Part A) and one .35 gallon (1.3 L) container (Part B).

1. Porous and rough subfloors will decrease coverage.

CLEANUP

Remove wet primer with methyl ethyl ketone (MEK), xylene or oxygenated solvents. Once cured, primer can only be removed by mechanical means. Strictly follow solvent manufacturer's warnings and instructions for use.

STORAGE

Protect Sikalastic® FTP Primer from freezing. If material becomes frozen, dispose of material properly, following all local, state and federal regulations. Store dry between 40-90 °F (4-32 °C). Sikalastic® FTP Primer has a shelf life of 2 years from the manufactured date in original unopened container under proper storage conditions.

EXTENDED WARRANTY

An extended warranty may apply when using Sikalastic® FTP Primer in a system application. Please contact USG for further details.

WARNING

For further information and advice regarding transportation, handling, storage and disposal of chemical products, user should refer to the actual Safety Data Sheet containing physical, environmental, toxicological and other safety related data. User must read the current actual Safety Data Sheet before using the product. In case of emergency, call CHEMTREC at 1-800-424-9300.

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SAFETY FIRST!
Follow good safety/industrial hygiene practices during installation. Wear appropriate personal protective equipment. Read applicable SDSs and literature before specification and installation.

CONTACT INFORMATION

Manufactured by or for
United States Gypsum Company
550 West Adams Street
Chicago, IL 60661

PRODUCT INFORMATION

See usg.com for the most up-to-date product information.

CUSTOMER SERVICE

800 950-3839

TECHNICAL SERVICE

800 USG.4YOU (874-4968)

WEBSITES

usg.com/repair
usg.com

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