

## Tiling a healthy home or office



*Tile used as floor covering, baseboard and trim around the door*

Tiles are the healthiest choice for covering floors and other surfaces in a home or office. Some people with multiple chemical sensitivity (MCS) also use tiles for walls, ceilings, window sills, countertops and baseboards. This article includes instructions and recipes for non-toxic installation of tiles, suitable for someone already experienced in tile work.

*Keywords: Healthy house, non-toxic home, office, chemical sensitivity, MCS, mold prevention, non-toxic, floor, wall, window sill, counter, baseboard, kitchen cabinets, tile, grout recipe, thinset recipe*

### **Healthy surfaces for a healthy home**

There are many square feet of floors, walls and ceilings in a house. With such a large area, the materials must be very non-toxic in order to create a healthy home. How stringent the requirements must be depends on how sensitive the people living there are.

## 2 *Tiling a healthy home or office*

The most common use of tile is for the floors, where there are few good options. The floor must be able to handle the wear, be odor free and not harbor mold and dirt.

Carpet is the most common floor covering in the United States. They are made with many kinds of toxic chemicals, which take several years to off-gas. Ditto any pad below the carpet. Some carpets are glued to the floor, adding more chemicals to the indoor air.

When the carpet gets older, it is a haven for dirt and mold. It is impossible to fully clean a carpet in place, even with the most powerful professional equipment. It has been tried, and still there was a lot of dirt once the carpet was pulled up.

Hardwood floors are a better option, but some people do not tolerate the wood terpenes or any waxes or sealers used to maintain the wood. Most of what is sold as “hardwood” is actually laminate that is glued together.

A tile floor offers several advantages:

- no off gassing of terpenes or chemicals
- easy to clean
- beautiful
- durable
- very low maintenance
- prevents mold

Tile floors have some possible downsides as well:

- cost
- weight
- hard surface
- poor acoustics
- cold surfaces

Tile floors cost much more to install, but they also last longer than cheaper flooring. If quality tiles are used, the floor may outlast the house itself.

A tile floor is very heavy and the house must be able to handle the weight. Sometimes the subfloor must be strengthened with cement boards, or the floor supports must be reinforced. If the subfloor is not firm enough, the tiles may come

loose or crack. If the floor cannot hold the weight, it may collapse. It may not be feasible to upgrade an existing house.

Things dropped on the hard surface are more likely to break. People have broken glasses and glass cooking pots on their floors. A heavy item dropped on the floor may also chip the tiles.

People can also fall and break. One elderly mobility-impaired woman with MCS fell on her tiled floor and broke her hip.

The hard surface can also be a problem to walk on for people with arthritis or other problems with their feet, legs or hips.

A tile floor is cool, which is why they are only common in warm climates, such as around the Mediterranean and the southern parts of the United States. If tiles are combined with an in-floor radiant heating system, a tile floor is extremely comfortable in any climate.

### **Tiling clinics and offices**



*Tile floor in a health clinic. The soft furniture helps absorb sounds.*

#### 4 *Tiling a healthy home or office*

Tiles can give a nice look to a professional office, whether they are on the floor or the walls. It is best to avoid white tiles, as that can produce the “institutional look”.

The fact that tiles do not trap dirt is a plus for health care facilities.

Tiled surfaces reflect sound, so people’s voices will carry much further than in a carpeted room. This can be a problem in shared offices and waiting rooms.

Soft furniture and other soft materials can help dampen the sound. It is best to use washable materials, so they can be detoxified. Special sound-deadening materials are available, but they are usually synthetic foams that are not suitable for healthy airspaces, unless they’ve been aired out for a long time first.

#### **Mold prevention**



*Wet ceiling after a shower, despite thick insulation (R-60) above the tiles.*

Mold is a problem for most environmentally sensitive people, even at levels that are not noticed by others. Mold grows where there is moisture, such as condensation on the walls and ceilings of a bathroom or around poorly insulated windows.

One builder of MCS houses tried to save money by only tiling the window sills, while using drywall around the windows. After some years, those drywall strips became moldy due to condensation around the windows.

Mold grows on drywall and wood, while it is more difficult for it to grow on surfaces that offer no food for the mold, such as glass, tile and cement. Cement is highly alkaline and thus naturally mold resistant, but mold can still grow on cement grout.

Mold is an issue in all climates. There are many moldy houses in Arizona's desert, just as everywhere else.

### **Other uses of tile**

Tiles can be used to cover various surfaces in a healthy home, to avoid the use of wood or for protection against splashes. Common uses include:

- counter tops
- baseboards
- door trim
- window trim
- backsplashes

6 *Tiling a healthy home or office*



*Tiles used on the kitchen counter, window sill and as a backsplash.*







*Bedroom with tiled floor and walls.*

In some cases, all the surfaces of a home have been covered with tile, where someone with MCS didn't tolerate any cheaper material.

### **Choosing the subfloor or backing**

It is important to carefully choose the material under or behind the tiles. The tiles and especially the grout are porous, so fumes from the underlying material can come through enough to be a problem. Don't use any kind of manufactured wood product underneath. Cement boards, such as HardiBacker, work well.

Make sure any sub floor is so firm that it cannot flex, or the tiles will work themselves loose. This is extra important for the non-toxic thinsets, which are less flexible than the commercial types.

### **Choosing the tiles**

There are a great variety of tiles available, at widely different prices. What seems like a small price difference can really add up when multiplied by the many square feet of a house. For a 1000 sq ft home (100m<sup>2</sup>), a tile that is just 20 cents more will add \$200 to the cost of the floor. Some ceramic tiles cost more because they are better quality, but many are just "designer tiles." A store specializing in flooring may only have the expensive tiles, while the large building supply stores usually have a few bargain-priced tiles at much lower cost. It really pays to look around.

The basic tile materials are:

- natural stone (marble, etc.)
- terrazzo
- porcelain
- ceramic
- clay pavers

Natural stone can be very beautiful, but is generally costly. Some of the natural stones can contain low levels of radioactive materials, which can offgas radon gasses. This is particularly an issue with granite. Consider checking the batch with a Geiger counter before accepting delivery.

The clay pavers are also called Mexican pavers. They are essentially a clay brick, just thinner. The surface is unglazed and porous, which means spilled liquids can be absorbed into the tile. This can be prevented with a sealer (such as sodium silicate), though some people do not seal them. These tiles are the same color as the clay they are made of.

The most commonly used tile in MCS houses is the ceramic tile, which is sealed, cost effective and available in many colors.

Ceramic tiles have the pattern stamped on top of the tile and then covered with a glaze, before the tile is burned in an oven. This is as inert as the rest of the tile and generally not a problem. Be aware that some tiles manufactured outside the United States can contain lead or asbestos.

An uncommon issue is that the pattern can eventually wear off in a really high-traffic area. We have only seen this in one house out of a dozen.

More durable tiles could be used in just the high-traffic areas, such as next to the entrance door.

Porcelain tiles are of a higher quality than ceramic tiles and tend to be more evenly sized so they are easier to line up. They look very much the same and are often not clearly marked. This author has no experience with them.





*The edges of these low-cost floor tiles are starting to wear after six years in a high-traffic area.*

It is economical to choose larger tiles, i.e. 12 inches (30 cm) or larger, for floors. There is more labor cost with smaller tiles and there'll be more grout lines to look at.

There are special wall tiles available, which are thinner and usually a little smaller. It is easier to install the smaller and lighter wall tiles than using floor tiles, especially if using the additive-free non-toxic thinsets.

The ceiling tiles will be tugged at by gravity, so they need to be smaller. The six-by-six inch (15 x 15 cm) tiles are a common choice.

For counter tops, it is best to use the largest tiles available, to minimize the grout lines.

For window sills, baseboards and trim, simply use regular floor tiles that are cut to size.

Make sure to keep plenty of spare tiles. You may not be able to get the same color and pattern in ten years, when someone drops a heavy cooking pot on the floor and cracks a tile, or a crack develops across the floor from a shifting foundation.

### **Inspecting the tiles for contamination**

The tiles should be inspected for contamination when they are delivered to the work site. The non-glazed sides of a ceramic tile are porous and can readily absorb contaminants. Contamination can happen during transport, if something else on the truck or in a shipping container leaks, or perhaps by excessive fumigation. One MCS builder had to return a load of tile, which stunk like diesel fuel.

### **Commercial grout and thinset**

There are various adhesives available to install tiles with. These should all be avoided. You may hear the argument that the fumes will be sealed behind the tiles, but that is not correct. The tile itself *may* provide a good enough seal, but the grout is porous and will not fully seal in the fumes. It has been tried.

The only choice for a healthy house is to cement the tile in place with a thinset and then fill in the spaces between the tiles with grout.

There are various mixes of thinset and grout available. They all have chemical additives, which make them faster and easier to work with. But some people are not able to live in a newly tiled house for a year (sometimes longer) because of these additives. Some people can clearly smell them.

Some people do well with the Master Blend and Custom Blend products from Custom Building Products in California. These two products do seem to be the least toxic commercial options available in America, but some people still do not tolerate them. One contractor claimed that these products didn't have any chemical additives. As "proof" he produced their Materials Safety Data sheets (MSDS). However, the MSDS only lists ingredients comprising more than 1% of a product (0.1% for proven carcinogens). The additives are less than that, and thus not shown.

Another contractor, with extensive experience installing tiles, said he could tell the difference between the commercial mixes and the additive-free. The commercial mixes stick better, so they are faster to work with. The commercial mixes are easier (and thus cheaper) to use, but test for tolerance before committing to use them for a large project.



## **Using less-toxic thinset and grout**

Tile work is an ancient art from long before chemical additives. Well-preserved mosaics can still be seen in two-thousand-year-old Roman villas, for instance.

The homemade grout and thinset have much less of an odor, but they also take more effort to use. There is a good reason for those chemical additives. It is best to do some experiments first, to make sure which consistency works best.

We have not tried natural stone or clay pavers. We recommend using ceramic tiles.

## **Ingredients**

The recipes and methods described in this document each use some of the following ingredients, which are mixed on site:

- Portland cement
- extremely fine sand (120 grit, silica flour or marble dust)
- lime
- PVA glue (Elmer's glue, Weldbond)

Portland cement is used in all the recipes. It is usually a well-tolerated material once it is cured. It can occasionally be contaminated during the manufacturing or shipping, so it is a good idea to sniff the bags before using them.

Extremely fine sand is available in a variety of versions, such as 120-grit sand, silica flour or marble dust. These are specialty products that can be difficult to find, as few tilers make their own thinsets any more. The bags may have to be shipped long distance. Locate a masonry supply store in your region.

It is safest to buy the sand in bags. Sand sold by the truck load tends to be stored outside where it becomes wet. It may also have more contaminants.

Make sure to use a dust mask when mixing, as these sands are much finer than regular sand and can travel deep into the lungs.

Lime is sometimes added to make the thinset more workable. It also makes the thinset less strong, so it should be used sparingly or not at all. Some people with MCS do not do well with lime. Lime is the same as calcium carbonate.

Polyvinyl acetate (PVA) glue is used in some methods or recipes. This glue is tolerated by many people with MCS, but not everybody. In North America, PVA glues are commonly called “white glues” and are sold as the brand names Weldbond and Elmer’s Glue.

### **Wet curing**

The traditional thinsets were all wet cured and so are these. Wet curing means that the thinset must be kept moist while it cures.



*Wet curing floor tiles under plastic sheeting.*

It is extremely important to thoroughly saturate the floor, wall or ceiling well before putting up the tile (use a mop). The back side of the tile must also be wetted, before sticking it on, otherwise the moisture is wicked away too quickly. If the thinset is too dry, or the surfaces are not wetted down enough, the tiles will tend to work themselves loose after a while. A good way to keep the tiles

sufficiently wet is to keep them in a 5-gallon bucket of water. If they sit vertically, that is a handy way to serve them to the tile setter.

Be careful not to work when it is too cold, otherwise it will not harden up well. It is best if the room temperature is above 50° F (10° C).

If it is hot and dry, consider using an evaporative cooler to moisturize the air, so the thinset and grout does not dry too fast. The tile setter may also appreciate the comfort.

When doing wall and ceiling tiles, it is important to keep the room very humid so the thinset and grout does not dry too fast and become brittle. The room should be closed up for at least 24 hours after the tiles are set. Perhaps place some buckets of water to add moisture to the air. Another method is to hang plastic sheets against the walls with painter's tape.

With floor tiles, it is sufficient to cover them with plastic for at least 24 hours.

### **Method 1: thinset with PVA glue**

This method is the easiest one to use. The thinset is more flexible and is used like the commercial types so there is less labor cost and contractors like it better. This thinset can work well if attaching tiles to a less-rigid subfloor, and it allows the contractor to reposition a tile.

The downside is that a lot of PVA glue is used and it takes a couple of years for it to fully cure behind the tiles. The smell of the glue will migrate through the tiled walls (tile and grout is porous) and the house will have an odor for the first couple of years. Many people with severe MCS will object to this odor. Make sure the person living there will be okay with this odor before proceeding.

PVA thinset recipe:

- 10 – 30% PVA glue
- 50/50 mix of Portland cement and extremely fine sand

Vary the amount of PVA glue according to how flexible the thinset needs to be. The 30% glue is needed if the subfloor is not fully rigid.

The thinset is wet cured.

## **Method 2: priming with PVA glue**

This method uses little PVA glue, which is allowed to fully cure right away, so there should be no odor issue. This method will only work with a cement board underneath.

Mix a solution of:

- 3 parts PVA glue
- 1 part water

Apply in a thin coat using a brush. Let dry and cure thoroughly for at least a few days before continuing.

To mount the tiles, use an additive-free thinset, such as:

- 1 part Portland cement
- 1.5 – 2 parts extremely fine sand

Use a ¼” (5 mm) notched trowel to apply the thinset on the subsurface for 6-8 tiles at a time. Make sure the tiles are thoroughly soaked before they are mounted.

The thinset is wet cured.

## **Method 3: the additive-free thinset**

This method uses no glue at all, but it is also the most labor-intensive. It should only be used if Method 2 is not acceptable.

The thinset must be “battered” onto the back side of each tile, using a notched trowel. Then the tile must immediately be attached to the surface and held in place for about ten seconds. It is not possible to reposition the tile.

It is essential that both the tiles and the subsurface are thoroughly wetted before mounting the tiles. Follow the instructions in the section about wet curing.



*A tile worker testing the additive-free thinset recipe with a wall tile in the bathroom. The tile had to be chiseled off.*

Additive-free thinset recipe:

- 5-1/2 cups extremely fine sand
- 4 cups Portland cement
- 1/2 cup lime (optional)

Increase the cement content for ceiling tiles.



## **The grout**

The grout is placed between the tiles once the thinset has cured.

Less-toxic grout for 1/4-inch (1/2 cm) grout line:

- 2 parts extremely fine sand
- 1 part portland cement

Less-toxic grout for 1/8-inch (1/4 cm) grout line:

- 1 part extremely fine sand
- 1 part portland cement

Only an experienced tile-setter should attempt doing the 1/8-inch grout lines.

Grout can be made with coarser sand (down to 60-grit), but it will be more rough looking, and may only work for 1/4-inch (1/2 cm) grout lines. Thinset cannot be made with coarser sand.

## **A cost-saving tip**

A lot of labor time can be saved if the tiles are mounted so they are staggered (called a “running bond”). With staggered tiles, there are not the long straight grout lines which must be absolutely straight to look good. Such straight lines take a lot of precision when mounting each tile, especially when the tiles vary slightly in size. It also takes more time when a crooked tile has to be chiseled off again. Labor-savings of 30% have been reported with staggered tiles.

An example of staggered tiles can be seen on the wall of the bedroom on page 6.

## **Tiled countertops**

Some cabinets can be purchased without the counter top. One can be put in using three layers of HardiBacker cement board with tiles mounted on top using thinset and grout. Use the largest tiles available to minimize dirt-collecting grout lines, and place the grout lines as far from the edge as possible.



*Bathroom cabinet with tiled counter on top of HardiBacker cement boards.*



*Detail of tiled kitchen counter;  
with three layers of HardiBacker cement boards underneath.*

We recommend *not* sealing below the countertop, such as with aluminum foil. Spills may migrate through or around the cement board and get trapped by the foil, resulting in mold growth.

## **Backsplashes**



*Backsplashes around a stove.*

Healthy houses sometimes use clay paints, which cannot be washed. These houses usually have large backsplashes in the kitchen to protect the walls.

## **Trim around doors and windows**

Wood is sometimes avoided in healthy homes, as the terpenes and paint can be bothersome. Tile can be used instead.



*Setting the tile around door and baseboard, using steel mesh (1/2 inch hardware cloth) for extra strength in these areas. The drywall is sealed with an aluminum foil that is attached with wallpaper wheat paste.*



*Spackling thinset on the steel hardware cloth.*







*Tile work around a window, with HardiBacker cement board underneath.*

### **Tile over aluminum foil**

Some MCS houses are built with drywall that is sealed with aluminum foil. The foil is typically attached with regular wallpaper wheat paste. Tiles can be installed on top of the aluminum foil, such as for backsplashes, baseboards and trim around doors. The thinset does not attach well enough to the foil, so a lathe is needed. Steel hardware cloth can be attached to the wall using staples and galvanized roofing nails. The tile can then be installed over that.

In our use, the mortar cured fine, even though the moisture could only travel out through the grout lines. This was in Arizona; we are not aware of anyone attempting this in a humid climate.



In one MCS house, wall tiles were mounted over aluminum foil using a lime casein glue. The casein was soaked for 20 minutes, then lime and a tiny amount of water were added until the glue was stiff as icing for a cake. It was applied sparingly to the back of each tile, using an icing bag. This has worked well and no tiles have come loose after five years. The casein glue sometimes produces a faint odor of milk and lime, which can be smelled on a hot day with the windows closed.

The casein glue method should not be used in wet areas, such as for shower and sink areas.

### **Tile over wood**

Lathe is also used on a wood surface, such as wood frames around doors.

### **Sealing the grout**

The grout is porous and some people prefer to seal it to avoid stains or mold. If used in a bathroom, especially inside the shower area, it is generally a good idea to use a sealer. Counter tops should also be sealed.

The AFM grout sealer product has been used successfully by many people. It basically consists of sodium silicate (“water glass”). Some people simply used pure sodium silicate, which they got from a chemical supply store.

### **An alternative to the tile floor**

If building a new house, a cheaper alternative is to have a concrete slab floor. It can be tinted with various concrete colorings, and even scored in patterns, if desired. Such a floor must be sealed with sodium silicate. Otherwise dirt will eventually give the floor a dark gray color. The sealer should be applied annually, as it will wear off.

### **Hiring a tile setter**

It may be difficult to find a tile setter willing to use these methods. Contractors often shy away from new methods, as it is difficult to estimate how long a job will take. It works better to pay the tile setter by the hour and encourage him to use a little time to experiment up front.

**Other healthy-house articles**

See [www.eiwellspring.org/saferhousing.html](http://www.eiwellspring.org/saferhousing.html) for more articles about less-toxic construction and renovation methods.

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