

Ceramic Tile Alternatives for Green Building St. Olaf College



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Introduction:

Ceramic tiles have been used for building and aesthetic purposes for millennia. Some of the earliest examples of tiles include the Great Pyramids in Egypt, as well as in ancient Babylon. The fact that some of the earliest mosaics and structures made from tile still exist and are in good condition show how durable ceramic tile can be if it is cared for properly [“Condensed”, n.d.]. Even a tile in an area with high traffic, such as a lobby in a college science building can last for the lifetime of the building. Furthermore, the materials to make ceramic tiles are easy to obtain. Different types of clays are found everywhere in the world. The ceramic tiles that are made from these can be very local, conveying the cultural sense of aesthetics as well as using local materials.

However, the production of tiles is very energy-intensive. In order to make tile out of raw materials, the clays must be fired at least once. The vast majority of decorative ceramic tile is glazed, which requires another firing. The firings can be up to 2700° F if glass-melting methods are used. A typical firing for clay-based tiles is about 2200° F [“Energy Saving Method”, 2001]. Furthermore, non-renewable energy from fossil fuels is typically used in production. Ceramic tiles cannot be used again in the same capacity, as fired ceramic materials are set in the same way thermoset plastics are. They cannot be melted down and reused in the same capacity, but they can be downcycled.

How then, can ceramic tiles be green? The green building movement, as well as the deepening concern for the environment that fueled it has brought some changes to the building industry. As demand for green buildings and LEED certification have rose, ceramic tile manufacturers have stepped up to the plate to supply builders with new products. Different manufacturers have different ways of making ceramic tiles “greener”,

but all of them make their greener tiles out of recycled materials. It is often impractical and might damage the tile's quality if these manufacturers tried to cut down energy usage. And furthermore, ceramic tiles do not emit VOCs [Aerias, 2001], as there are no chemical reactions or special chemicals needed to produce tiles, unless a producer without much concern for indoor air quality experimented with certain chemicals in the glaze. Low-VOC sealants can be used on ceramic tile, so toxicity is not a major concern in the manufacture of these products. Therefore, the only category of the Environmental Impact Questionnaire that these manufacturers can aim for improvement in is in the use of recycled materials.

Some tile manufacturers have used recycled glass in their ceramic products as a glaze. In the case of the Terra Green Company, the most visible manufacturer of recycled glass ceramic tiles, the individual tiles are made of 55% recycled post-industrial glass. Such glass is thus saved from the landfill that it would occupy otherwise [Terra Green, n.d.].

Porcelain tile differs from ceramic tile in its manufacture, absorption and breaking strength. It is typically composed of half feldspar and half firing ball clays. Porcelain is more dense than ceramic because it is pressed under higher pressure. It is also fired at a much higher temperature of 2200 °F. The absorption for porcelain is less than 0.5%. This factor allows for both interior and exterior use. The breaking strength of porcelain contributes to its extended lifespan and durability. Ceramic tiles typically fail at a force of approximately 250 psi, pounds per square inch; while porcelain tile's breaking strength is 390 to 400 psi. Though its function, manufacture and finishing look are similar to ceramic tile, porcelain tile is the superior product [Crossville, n.d.].

Terrazzo is a tile made out of a mixture of a binding matrix like cement and chips of a solid such as glass, stone, or concrete. It's been around since the 1450's, and was originally developed in Venice, Italy. The recycled materials in the case we're looking at originated as discarded glass, and they come from both post-consumer and post-industrial sources. Some manufacturers are Wausau Tile in Wausau, Wisconsin and EnviroGLAS in Texas. Wausau Tile's recycled terrazzo products are set in a cement-based matrix, while EnviroGLAS has an epoxy-based matrix, which can off-gas VOCs, so it isn't as benign from that standpoint.

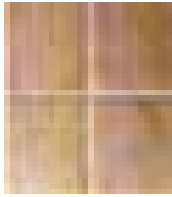
While all four of these tile manufacturers used different types of recycled material, all of these tiles are "green" products. However, one or more of these products may be more suitable for the St. Olaf project to build a new science building with the LEED rating of Gold. Like there is for all products, there are "shades of green", and one product might be more suitable for the tough requirements that must be filled if the building will receive a gold rating. All of the tiles in this study are tough, extra-durable tiles for heavily treaded areas like the common areas, as well as the entry areas and walkways in the floor plan for the new science building complex.

Terra Green Ceramics in Richmond, Indiana: Terra Traffic® Tile

Terra Green's website describes its products as the only SCS certified, truly recycled ceramic tile on the market. This company produces two lines of recycled glass ceramic tile, Terra Classic, for walls and bathroom interiors and Terra Traffic for high-traffic areas like the common areas and entryways of the new science building. What sets these two lines of tiles apart from the industry standard is the use of



55% post-industrial (pre-consumer) glass [“Terra Green Ceramics, LTD”, n.d.]. Unlike the Summitville Company’s website, which had not been updated in some time and did



not mention the green features of their tiles, the front page of Terra Green’s website mentioned that both their lines of tile are partially made of recycled glass. (We eventually decided not to include that company).

Terra Green’s name also shows their commitment to the protection of the environment.

Besides the recycled content, Terra Green also emphasized the durability of the tile and the domesticity of the products used. This manufacturer only uses American materials. While obviously in the market for green products and catering to those seeking LEED certification, Terra Green’s mission statement states that the company aims to: “continuously research, manufacture and market a high-quality, affordable commercial and residential ceramic product made domestically from recycled glass which is aesthetically pleasing, durable, unique and encompasses design trends and environmental concerns important to the survival and future of our mother earth” [“All About Terra Green”, n.d.]. Thus, the manufacturer mentions that their tile is also similar to a mid-budget tile, and the tiles are also made with aesthetic concerns in mind.

According to the Terra Green website, the idea to include some recycled glass in ceramic tiles was born in the late 1970s. After years of research, the company perfected its tile product [“Terra Green LTD”, n.d.]. This recycled content is the main reason why this tile is “green”. This post-industrial glass saves thousands of tons of glass a year from going to a landfill, ending its life cycle. This turns this glass, which would have been mere “waste” into another useful product. This glass is from the local area of Indiana, as well as Tennessee, the vast majority of which is within the 500-mile radius.

(Richmond, Indiana borders Ohio, so the furthest city in Tennessee from there is Memphis. Driving on major roads, it is about 537.85 miles from Richmond, which might still be in the radius) [Mapquest, 2006]. The company also emphasizes the aesthetic qualities of the unique glass, as no tile is the same as another tile.

The Terra Green Company has no production waste, as all scrap ceramic that did not get fired is reused until it makes a useful product. Furthermore, the product can be reused, but typically the product gets recycled (downcycled). The tile can be reused as mulch, but they cannot become ceramic tile again, as the firing process is irreversible. Thus, Terra Green cannot accept returns of the product after the tile's useful lifetime is over [Personal Communication, January 26, 2006]. While the product itself is made of recycled materials, the chemical properties of ceramics make it impossible to recycle again.

As mentioned in the introduction, ceramic tiles take massive amounts of heat energy to fire in kilns. This is the same with Terra Green's tiles, which are produced with the energy from natural gas. This non-renewable resource is the only source of energy used in the plant. It is impossible to reduce the amount of energy it takes to produce ceramic tile, as high-quality tiles with an aesthetically pleasing glaze need to be fired twice at high temperatures. Even "green" ceramic tile with recycled glass content cannot be green in the category of energy use. Furthermore, there is also more embodied energy in the tile from transportation to the job site [Personal Communication, January 26, 2006]. If the St. Olaf College design team for the new science building decided to use this product, it would be trucked from their facility in Richmond, which is outside the 500-mile radius from Northfield. We do not know how this is packaged, or if the

packaging is returnable. Unfortunately Tammy, the company only had time once to answer half of the questions for the EIQ. This is another weakness of this study of this product, as no one had enough time to answer all of the questions on the EIQ.

All in all, this tile has some good green features to offset the amount of energy needed to make ceramic tile. The recycled content makes it so products like car windshields don't end up in the landfill. This reduces the need for new sand to be melted down into glass, which is also an energy-intensive process. The durability of this tile is common to all ceramic tiles. While Tammy did not have time to discuss the possible lifetime of the tile, tiles can last for a building's lifetime. This durability also makes it easy to clean. As tile is hard and keeps water and mold out (unless the flooring is poorly taken care of), the only cleaner required is soap and water, which do not have any problems with VOCs. Tiles generally do not emit VOCs, and even though Tammy was not able to get to that part of the interview, there is a very good chance that this tile also has no problems with toxic compounds. The Terra Traffic tiles, unlike the classic tiles, need to be sealed, but they can be sealed with a low VOC sealant that would do the job well [Personal Communication, January 26, 2006].



Of course there is the downside that this tile cannot be recycled, only downcycled. Even though this manufacturer does not accept its used tiles back [Personal Communication, January 26, 2006], an environmentally savvy building owner, including St. Olaf College, could find a way to send these used materials to someone who will downcycle it for them. There is no way to use old ceramic tiles in the same fashion again, and there is no way that a tile manufacturer could reduce the energy

used to make the tiles. Thus, while these are definite cons for this product, there are many green features. If a building team chooses ceramic tile, they accept these trade-offs. The weaknesses of this specific product are no different from those of other tile manufacturers, but there are more green features than the average tile. Thus, this product is worthy to be considered for a green building project such as the one St. Olaf College is in the planning stages for.

Crossville, Inc. in Crossville, Tennessee: EcoCycle Tile



Crossville, Inc., out of Crossville, Tennessee, is a porcelain stone company that began manufacturing porcelain tile in 1986. The company fosters a strong commitment to the environment and incorporates that ethic into the quality of its products and the usage of energy and materials required to make porcelain tile. The slogan “We take from the earth, we give back” sums it up [Crossville, n.d.]. In 1992, the company produced the EcoCycle series using unfired, reused raw material body. The EcoCycle tile is the researched product in the Environmental Impact Questionnaire. No representatives were available to answer questions (all executives were away for a conference) so the information is completely from their website. The section entitled “Crossville’s Commitment to the Environment” gives a very thorough overview of the company’s actions for a high degree of environmental responsibility. Included is a LEED certification document for the company. Though the detailed website is helpful to

consumers, I was only able to complete a small portion of the Environmental Impact Questionnaire with the information.

Crossville, Inc.'s resource management is very proactive for a company of its nature. The porcelain tile is generally 50 percent feldspar and 50 percent high-quality ball clays. These raw materials are extracted from Tennessee, Georgia and North Carolina; all within a 500 mile radius of the Crossville manufacturing plant. In the EcoCycle series, the recycled content measures at least 50 percent in post-industrial waste material. Though this is enough to classify the tile as "green," the company takes several other steps in its manufacturing, transporting and maintenance processes to ensure an overall "green" product [Crossville, n.d.].

The company is very conscious of energy-efficiency. It reduces energy in product transport by strategically locating plants and distributors along major U.S. shipping routes. A side note; the materials are



shipped in brown kraft paper cartons that are easily recyclable for use in other paper products. The production plants utilize a maximum amount of natural gas to maintain the highest level of energy-efficiency. The company facilitates programs to minimize waste products during manufacturing, such as stringent quality standards to help eliminate defective products and minimize wasteful firing. Crossville also boasts a responsible waste water system, twice earning them citations for effective waste-water management policies. Water used during production is returned clean to its natural habitat [Crossville, n.d.].

Emissions from chemicals is a common problem with tiles and sealants, but Crossville takes extended measures to make certain that customers are aware of the superior care taken for non-VOC releasing products. There is a large section on the website devoted to information about Indoor Air Quality (IAQ). Crossville's porcelain tile is not an original source of contaminants, meaning it does not release contaminants during manufacturing, installation, the product's lifetime, cleaning or removal. This is possible through the use of environmentally sensitive raw materials and manufacturing processes and inert installation materials and procedures [Crossville, n.d.]. Porcelain tile will not absorb VOCs or other chemicals or hazards, such as cigarette smoke. Sealants are a typical producer of VOC emissions, but the recommendation is to use a low-VOC, water-based grout sealant to increase resistance to moisture and stain.

The tile installation itself is highly intensive largely due to the durability of the product, but luckily maintenance is not. Wet saws with continuous rim diamond tip blades are used to cut porcelain tile [Crossville, n.d.]. Diamond tipped blades are used to cut through only the toughest materials. Transportation for application in the St. Olaf science center would also embody much energy because the manufacturer is well outside of the school's 500-mile radius. Maintenance for the flooring is quite easy. It can be cared for with simple, water-based cleaning materials. Because of its durability, the product is expected to last the lifespan of the building with few or no need for repairs [Crossville, n.d.].

Crossville, Inc.'s EcoCycle porcelain tile is an excellent "green" material option because the company not only exemplifies its environmental mission in the final product, but in the entire process. From the extraction of raw materials from local

sources, to energy-efficient manufacturing, to recycled content, to zero emissions, to responsible delivery, this company covers all the bases of a sustainable product. In addition, the available colors (grey mingle, limestone and pompeii) are ideal for high-traffic areas like the science center hallways and entryways and its durability means it is made to last. Also, porcelain costs slightly more than ceramic, but makes up for it with its other attribute. This product receives a high recommendation as a flooring option for the St. Olaf science center.

Wausau Tile in Wausau, Wisconsin: Terrazzo Tile

The last “green” flooring material we are examining is a tile known as terrazzo, which essentially is a mixture of stone, masonry, concrete, tile, or glass chips bound together in a colored cement or epoxy matrix. Because of this, one could rightly call terrazzo the original recycled finish. Since our intention is to make this tile as environmentally friendly as possible however, we’ll be focusing only on terrazzo that has been manufactured out of recycled glass, since it finds a new use for the product and keeps less glass from ending up in landfills.



Originally developed in Italy, terrazzo can be used as flooring both in an interior environment, and an exterior area like a porch. Because glass is available in a fairly wide range of colors, recycled glass terrazzo is also suitable for all sorts of aesthetic purposes in addition to flooring. To that end, it can be a focal point to draw the eye, a soothing background surface, a way to improve on the blank, empty whiteness of restrooms, and installed to form pleasing geometric patterns in the flooring, among

other possibilities. Terrazzo also naturally possesses a smooth, beautiful finish to it, which makes it pleasing to both see and walk on.

Traditionally, terrazzo is produced by mixing marble chips into a matrix of either colored cement, or more often epoxy, as mentioned before. Being a latex-based setting material though, epoxy is a source of VOC emissions, which are produced as the terrazzo is walked on or “cures” after hardening. These emissions can pose a threat to people’s health if they are inhaled, especially if the individual has allergies or respiratory problems like asthma. To be fair though, most people do tolerate the cured product well enough. Because of this, cement--specifically Portland cement or polyacrylate modified cement, is a better material to use from an indoor air quality stance.

As for its manufacture, terrazzo can be produced either in the factory as pre-cast slabs or poured directly on site. In each case, terrazzo workers lay down a solid, level concrete foundation. After the forms are removed, another layer of sandy concrete is added. Then before it sets, workers partially embed metal divider strips in the concrete at places wherever there will be a joint or change in color. Finally, workers pour a mixture of aggregate, in this case recycled glass, and a binding matrix that may be Portland cement, polyacrylate modified cement, epoxy or polyester into each of the panels. While the mixture is still wet, a lightweight roller is then rolled over the entire surface to smooth it down.

Once it has completely hardened, the divider strips are removed and the terrazzo is ground down even more smoothly by a terrazzo grinder, a machine something like a heavier version of a floor polisher, to both smooth and expose the marble chips. Any slight depressions left behind are then filled with a matching grout material and hand-

troweled to produce a smooth, uniform surface. At this point, the workers clean, polish, and seal the dried surface for a lustrous finish. Over the next few days or weeks, the material will then cure, aging as it sits.

Now that we've looked at what it is and how it's made, let's examine the advantages of terrazzo tile, keeping in mind that they apply to ones containing recycled



glass as well. The biggest one is that terrazzo is extremely durable. With the support the aggregate and matrix provide, it is very resistant to damage and cracking. It is also very resistant to any forms of erosion or decay, and generally lasts every bit as long as the building, or in other words a human lifetime.

Since it is nonporous, terrazzo doesn't absorb liquids and is stain-resistant, able to be cleaned quite easily with just water or a mild, neutral cleaning product.

And interestingly, a terrazzo floor is essentially self-cleaned by foot traffic, with nothing being able to clean it as well as shoe leather and rubber can!

Finally and most importantly for our purposes, terrazzo has many environmental virtues to it. Since it's nonporous it doesn't harbor mold or mildew that irritates the respiratory system, making it very useful for restrooms while sparing both allergy sufferers and asthmatics alike from attacks. It saves and reuses resources, making use of glass, stone, and other materials that would've just been thrown away to end up in a landfill, while also creating a market for what was once considered garbage. Finally, the

ease with which terrazzo can be cleaned means less toxic chemicals and VOCs are off-gassed into the building's enclosed environment, leading to better indoor air quality.

At the same time, we need to remember that building green isn't always a one-way street, and take an honest look at what kinds of disadvantages terrazzo has. One of the biggest and most immediate is that terrazzo is often quite expensive compared to other flooring options. Even a square foot can cost as much as \$20 or \$30!

This expense is mainly due to the fact that both terrazzo production and installation are labor intensive, take a fair amount of time, and require energy to transport /install. Add in custom or newly developed features, like additional pigments, acquiring and shipping the recycled glass, or what type of finish you want, and that naturally contributes quite a bit to the cost as well.

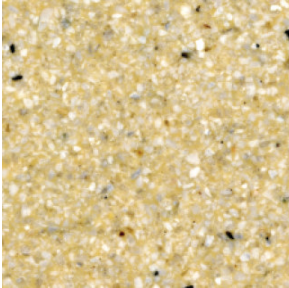
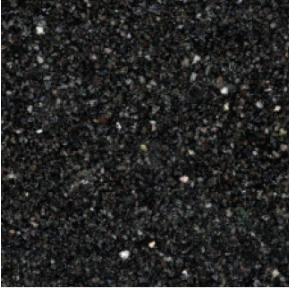
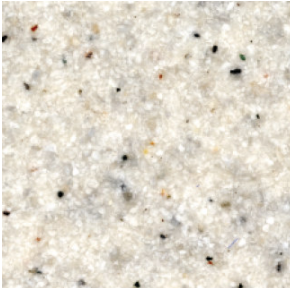
There are some environmental disadvantages too. The tile setting adhesives, latex mortar and grout are all made from petrochemicals, and their emissions can cause health problems sometimes, especially for sensitive people. The recycling process and transportation of both the glass and the finished, heavy tiles require petroleum and natural gas as power both of which are finite resources and produce greenhouse gases.

Wausau Tile uses 100% recycled glass from both consumer and industrial sources, with their New Thin Tile containing 60% recycled content by weight! Also uses a special process developed at Columbia University to protect the cement and glass from the alkali-silica reaction that leads to the erosion of the cement matrix. New Thin Tile is also pre-sealed in the factory, and can be set and grouted with cement. It comes in blue, green, clear, brown, amber, and red colors, among others, so presents a good

selection. Since the nature of terrazzo is its recycled content, this product would also be suitable for St. Olaf new science facility.

Fritz Tile in Mesquite, Texas: Fritz Green Tile

Fritz Tile, a branch of Fritz Industries, manufactures terrazzo tile out of Mesquite, Texas. The company began using recycled materials in terrazzo products 45 years ago and today has taken the initiative a step further with a “green” line of products. The goal was to produce a product that would meet strict LEED standards for certification as an environmentally safe product. After trying to contact the local representative out of Lino Lakes, Minnesota, we contacted the company again and was given another reference, John Blanton. We exchanged correspondence with Mr. Blanton via email; unfortunately he did not return the questionnaire as he indicated. The information for this product is from the company’s website. The website is not as helpful as other companies’ as far as environmental issues are concerned. The evidence the company does produce is more often than not in terms of cost over environmental impact. Still, it provided some useful information for Fritz Tile’s efforts towards sustainable tile.



The primary “green” feature identified on the website is the 70 percent recycled-content. The recycled materials include post-industrial waste raw materials, marble and granite rubble and fly ash. It also boasts no VOC emitting from using inorganic materials. To supplement this quality, there is a pitch for the VOC free adhesives Fritz FA-88 and Fritz FA1100. One of the LEED credits is for reuse application, but this is due to the extended lifecycle of the product due to its durability. The main elements that the manufacturer highlights are “reduces maintenance/replacement cost over the life of the building, energy conserving, improved occupant health and productivity and lower costs associated with changing space configurations” [“Fritz Green Tile”]. The product line also offers 15 colors and a 20 year warranty.

The only information concerning the sustainability of the manufacturing plant was a brief excerpt about their wastewater management. They are LEED certified for 20 percent water use reduction. The location of the plant is not ideal for sustainable use in Northfield building projects. The manufacturer is well outside the 500-mile radius of St. Olaf campus. It would require a large amount of energy to transport the products the entire distance.

From the information obtained, Fritz Tile seems like a moderate choice for a flooring option. Some of the other producers seem to be better options. Nonetheless, this manufacturer has taken several admirable steps towards creating an environmentally safe building material. Successful marketing as an eco-product could make this terrazzo tile very profitable for the company.

Conclusion:

The greatest conclusion we can come to with this project is that obtaining information for the Environmental Impact Questionnaire is a difficult task. All of the EIQ materials we researched produced very little of the requested information. There were several frustrations in dealing with company representatives. In most cases, they either did not have the time or did not make the time to attempt to answer our questions. Most likely, none of the companies even have this sort of information compiled and easily accessible to its employees. It serves as a point of fact that though companies are taking big initiatives to create “green” products, the overall process has a long way to go to reach its potential!

Considering the products, we decided that Crossville Inc.’s EcoCycle Tile is most suitable for the St. Olaf science center building project. Porcelain tile appears to be superior to ceramic tile in terms of durability, longevity and quality. It also exceeds terrazzo in terms of cost and quality. Additionally, Crossville, Inc. respects the environment in every step of its production process. The company produces porcelain tile considering each aspect with environmental concerns. This dedication shows advanced development as a “green” building material producer that the other companies lack in the evidence we have uncovered. We conclude that Crossville Inc.’s EcoCycle Tile is the best “green” tile flooring alternative for St. Olaf College’s science center.

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The document reads too much like each of you wrote a section and pieced it together. You need to edit it in a way that makes the transition between authors appear seamless. Overall, you provided some good information on a very important product. It is a little surprising that the companies did not provide more about their environmental philosophy on their web pages since they are targeting the LEED crowd.

SCORE = 83%