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Tile Patterns, bringing tile to life

eramic tile continues to reign as one of the most favored design staples in the floor-covering industry because of its performance, design versatility, color options and beauty. The range of design possibilities with ceramic tile is truly endless, which affords tile manufacturers the opportunity to meet the varying needs of residential and commercial audiences through extensive portfolios of stylish floor and wall tile options - but there's more to a tile installation than the tile itself.

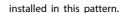
How tile is laid can change the look and feel of any space – and there are so many exciting tile patterns to choose from and ways to use them to a space's best advantage. No matter how you want to alter the appearance or scale of an installation, there's a tile pattern designed to work for you. Using any classic tile pattern can help transform a standard tile job into an extraordinary one. Considering the wide variety of tile and trim tiles available, the possibilities are limitless.

■ Trending tiles and patterns

Many of today's most popular tile patterns are inspired by the emerging trends driving modern design. These trends take some time to get seeded, but once a trend is identified, it tends to evolve and last for years. The most popular shapes right now are rectangular large formats and planks, which are often being used on both the floor and on the wall. This results in many more pattern options, which designers are utilizing more frequently to create unique designs. For larger format sizes, the most popular patterns are Running Bond, Straight Joint and Third Stagger.

Running Bond is a basic yet beautiful layout, also called a brick or offset pattern. In this pattern, the tiles are offset by half the width of the tile, offering a timeless look for almost

With each joint centered over the tile below, this pattern resembles classic brickwork. Larger formats (any side measuring over 18") require an offset of no more than 33% when



Straight Joint is one of the simplest tile patterns that showcases the beauty of every tile. The straight joint pattern offers a more contemporary, linear look.

Whether tile is installed vertically or horizontally, the pattern's clean lines make any space feel taller or wider.

Third Stagger is a variation of the Running Bond layout that features a stair-step pattern with each joint offset 1/3 from the row of tiles below it.

These larger format sizes (12"x24", 18"x36" and 24"x48") offer a more transitional, clean look and have less grout. Running Bond and Third Stagger provide a traditional spin on the modern cut tile, while the Straight Joint offers a more modern look.

■ Patterns for planks

For plank sizes, the most popular patterns are Chevron, Herringbone and Random Stagger. The rise in popularity of these layouts is due in part to wood-look tile, one of the hottest trends in the marketplace. What was first introduced as a traditional take on hardwood floors has evolved to include more colors and textures to choose from than ever before. There has also been a significant rise in the selection of natural stone planks due to the beautiful vein-cut natural stone options being offered today.

Chevron is an inverted V-shaped pattern. In this design, all planks are the same length and the pieces are installed at an angle to match up perfectly with one another.

This creates a perfectly straight line on both sides of the planks. Herringbone is very similar to Chevron, but instead of having the ends line up with one another, they overlap, creating an entirely different and unique look.

Mosaics are also "must-haves" right now, especially in kitchen backsplashes, shower walls and floor accents. The texture and color movement possible with these mosaics add a depth, sparkle and luminescence to any



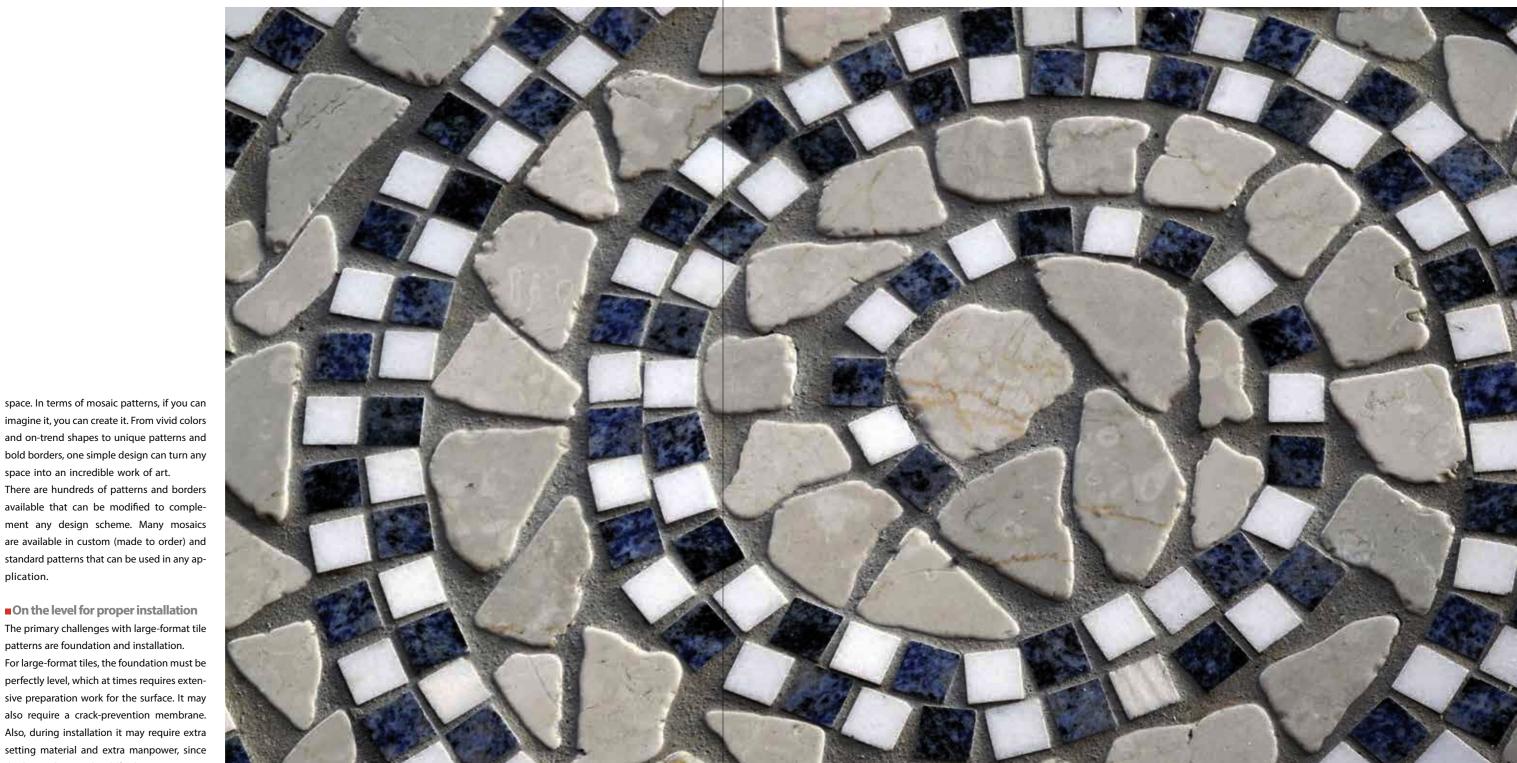






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space. In terms of mosaic patterns, if you can imagine it, you can create it. From vivid colors and on-trend shapes to unique patterns and bold borders, one simple design can turn any space into an incredible work of art.

There are hundreds of patterns and borders available that can be modified to complement any design scheme. Many mosaics are available in custom (made to order) and standard patterns that can be used in any application.

■On the level for proper installation

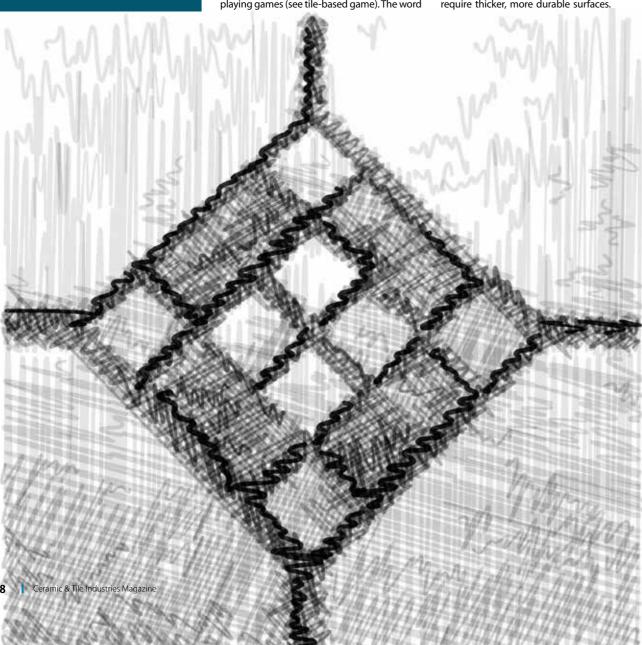
patterns are foundation and installation. For large-format tiles, the foundation must be perfectly level, which at times requires extensive preparation work for the surface. It may also require a crack-prevention membrane. Also, during installation it may require extra setting material and extra manpower, since the large tiles may be difficult to maneuver.

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What kind of tiles has been made?

is a manufactured piece of hard-wearing material such as ceramic, stone, metal, or even glass. Tiles are generally used for covering roofs, floors, walls, showers, or other objects such as tabletops. Alternatively, tile can sometimes refer to similar units made from lightweight materials such as perlite, wood, and mineral wool, typically used for wall and ceiling applications. In another sense, a tile is a construction tile or similar object, such as rectangular counters used in playing games (see tile-based game). The word

is derived from the French word tuile, which is, in turn, from the Latin word tegula, meaning a roof tile composed of fired clay. Tiles are often used to form wall and floor coverings, and can range from simple square tiles to complex mosaics. Tiles are most often made from porcelain, fired clay or ceramic with a hard glaze, but other materials are also commonly used, such as glass, metal, cork, and stone. Tiling stone is typically marble, onyx, granite or slate. Thinner tiles can be used on walls than on floors, which require thicker, more durable surfaces.



■ Floor tiles

These are commonly made of ceramic or stone, although recent technological advances have resulted in rubber or glass tiles for floors as well. Ceramic tiles may be painted and glazed. Small mosaic tiles may be laid in various patterns. Floor tiles are typically set into mortar consisting of sand, cement and often a latexadditive for extra adhesion. The spaces between the tiles are nowadays filled with sanded or unsanded floor grout, but traditionally mortar

Natural stone tiles can be beautiful but as a natural product they are less uniform in color and pattern, and require more planning for use and installation. Mass-produced stone tiles are uniform in width and length. Granite or marble tiles are sawn on both sides and then polished or finished on the facing up side, so that they have a uniform thickness. Other natural stone tiles such as slate are typically "riven" (split) on the facing up side so that the thickness of the tile varies slightly from one spot on the tile to another and from one tile to another. Variations in tile thickness can be handled by adjusting the amount of mortar under each part of the tile, by using wide grout lines that "ramp" between different thicknesses, or by using a cold chisel to knock off high spots.

Some stone tiles such as polished granite, marble, and travertine are very slippery when wet. Stone tiles with a riven (split) surface such as slate or with a sawn and then sandblasted or honed surface will be more slip resistant. Ceramic tiles for use in wet areas can be made more slip resistant either by using very small tiles so that the grout lines acts as grooves or by imprinting a contour pattern onto the face of the tile. The hardness of natural stone tiles varies such that some of the softer stone (e.g. limestone) tiles are not suitable for very heavy traffic floor areas. On the other hand, ceramic tiles typically have a glazed upper surface and when that becomes scratched or pitted the floor looks worn, whereas the same amount of wear on natural stone tiles will not show, or will be less noticeable. Natural stone tiles can be stained by spilled liquids; they must be sealed and periodically resealed with a sealant in contrast to ceramic tiles which only need their grout lines sealed. However, because of the complex, non repeating patterns in natural stone, small amounts of dirt on many natural stone floor tiles do not show. The tendency of floor tiles to stain depends not only on a sealant being applied, and periodically re-applied, but also on their porosity or how porous the stone is. Slate is an example of a less porous

stone while limestone is an example of a more porous stone. Different granites and marbles have different porosities with the less porous ones being more valued and more expensive. Most vendors of stone tiles emphasize that there will be variation in color and pattern from one batch of tiles to another of the same description and variation within the same batch. Stone floor tiles tend to be heavier than ceramic tiles and somewhat more prone to breakage during shipment.

Rubber floor tiles have a variety of uses, both in residential and commercial settings. They are especially useful in situations where it is desired to have high-traction floors or protection for an easily breakable floor. Some common uses include flooring of garage, workshops, patios, swimming pool decks, sport courts, gyms, and dance floors.

Plastic floor tiles including interlocking floor tiles that can be installed without adhesive or glue are a recent innovation and are suitable for areas subject to heavy traffic, wet areas and floors that are subject to movement, damp or contamination from oil, grease or other substances that may prevent adhesion to the substrate. Common uses include old factory floors, garages, gyms and sports complexes, schools and shops.





■ Decorative tilework and coloured brick

Decorative tilework should be distinguished from mosaic, where forms are made of great numbers of tiny irregularly positioned tesserae in a single colour, usually of glass or sometimes ceramic.

The earliest evidence of glazed brick is the discovery of glazed bricks in the Elamite Temple at Chogha Zanbil, dated to the 13th century BC. Glazed and coloured bricks were used to make low reliefs in AncientMesopotamia, most famously the Ishtar Gate of Babylon (ca. 575

BC), now partly reconstructed in Berlin, with sections elsewhere. Mesopotamian craftsmen were imported for the palaces of the Persian Empire such asPersepolis.

Tiling was widespread in the time of the Sinhalese kings of ancient Sri Lanka, using smoothed and polished stone laid on floors and in swimming pools. Historians consider the techniques and tools for tiling as well advanced, evidenced by the fine workmanship and close fit of the tiles.[citation needed] Tiling from this period can be seen Ruwanwelisaya and Kuttam Pokuna in the city of Anuradhapura.



■ Islamic tiles

Early Islamic mosaics in Persia consist mainly of geometric decorations in mosques and mausoleums, made of glazed brick. Typical turquoise tiling becomes popular in 10th-11th century and is used mostly for Kuficinscriptions on mosque walls. Seyed Mosque in Isfahan (1122 AD), Dome of Marageh (1147 AD) and the Jame Mosque of Gonabad (1212 AD) are among the finest examples.[12] The dome of Jame' Atiq Mosque of Qazvin is also dated to this period. The golden age of Persian tilework began during the reign the Timurid Empire. Single color tiles were cut into small pieces and assembled by pouring liquid plaster between them. After hardening, these panels were assembled on the walls of buildings.

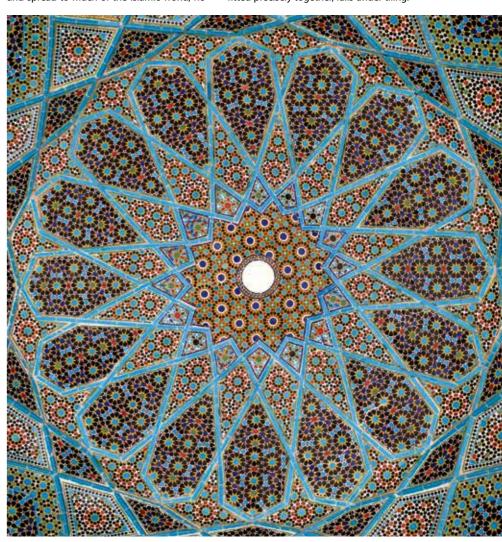
But the mosaic was not limited to flat areas. Jame Mosque in Yazd (1324-1365 AD) and Goharshad Mosque (1418 AD) are prominent examples of brick and tile mosaics of interiors and external surfaces of domes Islamic buildings in Bukhara (16th-17th century) also exhibit very sophisticated floral ornaments. Mihrabs, being focus points of mosques, were usually the places where most sophisticated tilework was placed.

The 14th century mihrab at Madrasa Imami in Isfahan is an outstanding example of aesthetic union between the Islamic calligrapher's art and abstract ornament. The pointed arch, framing the mihrab's niche, bears an inscription in Kufic script used in 9th-century Qur'an One of the best known architectural masterpieces of Iran is the Shah Mosque in Isfahan, from the 17th century. Its dome is a prime example of tile mosaic and its winter praying hall houses one of the finest ensembles of cuerda seca tiles in the world. Wide variety of tiles had to be manufactured in order to cover complex forms of the hall with consistent mo-

saic patterns. The result was a technological triumph as well as a dazzling display of abstract ornament. During the Safavid period mosaic ornaments vere often replaced by a haft rang (seven colors) technique.

Pictures were painted on plain rectangle tiles, glazed and fired afterwards. Besides economic reasons, the seven colors method gave more freedom to artists and was less time-consuming. It was popular until Qajar period when the palette of colors was extended by yellow and orange. The Persianate tradition continued and spread to much of the Islamic world, notably the İznik pottery of Turkey under the Ottoman Empire in the 16th and 17th centuries. Palaces, public buildings, mosques and türbe mausoleums were heavily decorated with large brightly coloured patterns, typically with floral motifs, and friezes of astonishing complexity, including floral motifs and calligraphy as well as geometric patterns.

The zellige tradition of Arabic North Africa uses small coloured tiles of various shapes to make very complex geometric patterns. It is halfway to mosaic, but as the different shapes must be fitted precisely together, falls under tiling.



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■ Ceiling tiles

Ceiling tiles are lightweight tiles used in the interior of buildings. They are placed in an aluminium grid and they provide little thermal insulation but are generally designed to improve the acoustics of a room. Mineral fibre tiles are fabricated from a range of products; wet felt tiles can be manufactured from perlite, mineral wool, and fibers from recycled paper, stonewool tiles are created by combining molten

stone and binders which is then spun to create the tile, or gypsum tiles which are based on the soft mineral and then finished with vinyl, paper or a decorative face. Ceiling tiles very often have patterns on the front face; these are there in most circumstances to aid with the tiles ability to improve acoustics.

Ceiling tiles, especially in old Mediterranean houses were made of terracotta and were placed on top of the wooden ceiling beams

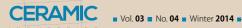
and upon those were placed the roof tiles. They were then plastered or painted, but nowadays are usually left bare for decorative purposes.

■ Diamond etched tiles

A new method for custom tile printing involving a diamond-tipped drill controlled by a special type of computer. Compared with the laser engravings, diamond etching is in almost every circumstance more permanent.







■ Western tile work

Medieval Europe made considerable use of painted tiles, sometimes producing very elaborate schemes, of which few have survived. Religious and secular stories were depicted. The imaginary tiles with Old testament scenes shown on the floor in Jan van Eyck's Annunciation in Washington are an example.

The 14th century "Tring tiles" in the British Museum show childhood scenes from the Life of Christ, possibly for a wall rather than a floor while their 13th century "Chertsey Tiles", though from an abbey, show scenes of Richard the Lionheart battling with Saladin in very high-quality workMedieval letter tiles were used to create Christian inscriptions on church floors

Transmitted via Islamic Spain, a new tradition of azulejos developed in Spain and especially Portugal, which by the Baroque period produced extremely large painted scenes on

tiles, usually in blue and white, for walls rather than floors. Delftware wall tiles, typically with a painted design covering only one (rather small) blue and white tile, were ubiquitous in Holland and widely exported over Northern Europe from the 16th century on, replacing many local industries.

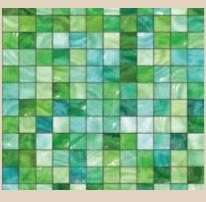
Several 18th century royal palaces had porcelain rooms with the walls entirely covered in porcelain in tiles or panels. Surviving examples include ones at Capodimonte, Naples, the Royal Palace of Madrid and the nearby Royal Palace of Aranjuez. There are several other types of traditional tiles that remain in manufacture, for example the small, almost mosaic, brightly coloured zellige tiles of Morocco and the surrounding countries. With exceptions, notably the Porcelain Tower of Nanjing, decorated tiles or glazed bricks do not feature largely in East Asian ceramics. The Victorian period saw a great revival in tilework, largely as part of the

Gothic Revival, but also the Arts and Crafts Movement. Patterned tiles, or tiles making up patterns, were now mass-produced by machine and reliably level for floors and cheap to produce, especially for churches, schools and public buildings, but also for domestic hallways and bathrooms. For many uses the tougher encaustic tile was used. Wall tiles in various styles also revived; the rise of the bathroom contributing greatly to this, as well as greater appreciation of the benefit of hygiene in kitchens. William De Morgan was the leading English designer working in tiles, strongly influenced by Islamic designs.

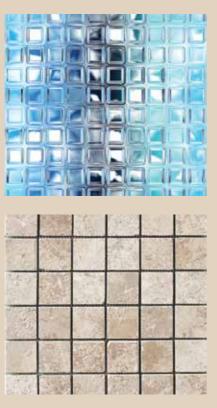
Since the Victorian period tiles have remained standard for kitchens and bathrooms, and many types of public area. Portugal and São Luís continue their tradition of azulejo tilework today. Notable among American tilemakers of the 1920s and 1930s were Ernest A. Batchelder and Pewabic Potterv.















Using Suspended Granilhas for **Porcelain**

Abstract

his paper details the wet application of the granilhas on porcelain tiles. This method has the advantage of cost savings due to decreased amount (about 50 to 70%) of material applied without compromising the technical characteristics required for these products. It also allows obtaining great variability aesthetics (color, texture, brightness, etc...) and can be marketed matt or polished. This method makes a layer thinner and more homogeneous, which requires less deep polishing, and adjusts the tendency of flooring and coating industry to produce increasingly finer. The curtain granilhas are applied by the bell on the glaze. The pieces arefired at temperatures between 1200-1220°C. We evaluated the layer resistance to the attack of stains, to chemical attack, abrasion, and measured hardness (Mohs). Conclude that this new granilhas application method produces surfaces that meet the requirements of the

■ Introduction

The need to develop differentiated ceramic products and aesthetically appealing emphasized in recent years. The search for new decorative effects led to development in the early 80's, in the form of glassy atomized, granilhas and "pellets".

Although it has been thought of giving the products greater variability aesthetics (color, texture, etc.), this type of application gave superior properties of glass surfaces techniques. The pieces with this type of finish present high resistance to abrasion and the granilhas exactly respond to these demands. These kinds of granilhas are fritsafter they undergo a grinding step and selected granulometrically (0.15 to 2 mm). The choice of this interval is made based on the effect to be obtained in the final product.

The granilhas can be transparent, matt, opaque or colored. The granilhas color is made during the step of melting frits or by





Figure 1. Application of granilha with wet method by campana

nilhas are used dry. After application of the glaze, those are applied onto the work piece using roller or screen machines and then coated with a second layer glazing with adhesive which is diluted by discs, increasing its adherence to the surface of decorated tile. In general, the application of granilhas in dry mode to polishing consumes from 1.0 to 1.5

kg per square meter granilha material. This work aims to study the application of gra-

nilhas by wet. For this purpose the granilhas which are used have sizes of less than those used by the dry (<0.3 mm) suspended in an organic binder.

The need to use smaller granilhas comes from need to ensure that they keep up scattered in the middle hanger. The application is made after enameling and decoration by screen printing or ROTOCOLOR and by using of bell (campana).

In Figure 1 you can see the application of suspended granilhas by campana.

Initial estimates indicate the need to consumeweightsper square meterbetween 0.6 to 0.7kg, which islower than required amount in the applicationby dry(reduction of about 50%) Apart from the decreaseof the quantityto be applied, the smaller grainyieldslayersthinnerandmore homogeneous.

Basically this method reduces the cost of productbecause oflowerconsumption of material and also subsequentpolishingstepscan be made atshallower depth. This kind ofend product providestransparentmatt appearancebefore polishingand afterpolishing gives a very brighttransparenttype.

Figure 2 representthe two possibilities of finishingproducts.

This advantagenot only increases the variabilityofaestheticpiecesproduced (matte textureand / orgloss), but also increases itsFieldof application (Zones of greater or lessertraffic

Studies conductedon theflooring industryin Europe, indicatethatfloorenamelingand finishing as oneof the majorcosts in construction(>25%). Havingconsidered this aspect, it is interesting to adoptmethodologiesthat reducethese costs.

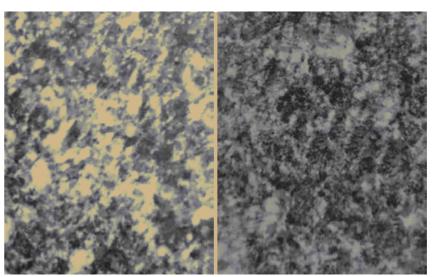


Figure 2. Possibilities of final product (picture on the left: before polish) (picture on the right: after polish)

■ Experimental Procedure

Characterized granilhas to be used in suspension, which we will call them "microgranilhas", have special distribution in particle size (measured by laser interference - Coulter). It was determined by the chemical composition X-ray fluorescence (XRF) and evaluated the thermal behavior (dilatometer, DTA /TG). Character of the glaze on which the granilha

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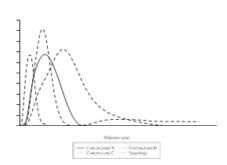
will be applied is matt glaze and consists of 40% frit-rich BaO / ZnO and BaO /CaO, the remaining 60% include raw materials (silica, feldspar,kaolin, zirconia, alumina, etc). The glaze was applied by bell, with a density between 1840 and 1860 gL-1 and with a viscosity of 40/45 seconds (Ford cup 4 mm diameter).

Themicrogranilhaswere added toan organic binderin a ratioby weight of70:30%respectively. The suspension was applied also with

The specimenswere firedbetweenthe maximum temperature1200-1220° C in acyclelasting 60minutes.

The samples were examined visually and evaluatedfor resistancelayerto attackstains, usingiodine, olive oil, red pasteFe,Crgreen pasteand alsoblue markerE3200accordingto standardISO10545-146.

The resistance tochemical etchingwas observedwipingsurface of thetest piecewith a solvent(acetone) and drying completely beforestarting the test. Test substancesused werehydrochloric acid 18%(V /V), citric acid100gL-1 lactic acid5% (V / V) and potassium hydroxide30and 100g.L-1.They



putupthepiecesof evidencein contactwith thetest substances for 24 hours (citric acidand lactic acid)and96 hours (Hydrochloric acid and potassium hydroxide) according to standard ISO10545-136. Abrasion resistance(PEI)was measured accordingto standardISO10545-76and hardness wasmeasured accordingresistance MOHS7 riskasscale.

Results

The results are explained in three sections that we will describe them below .These sections are characterization of materials like glaze and granilha used, application of granilha and finally the characterization of final product.

3.1. Characterization of Materials

Figure 3 shows the particle size distributions of the granilhas different compositions, milled in different conditions, for applying dry or in suspension.

The average particle size, for application of granilhas suspension is 87 microM and 90% (by volume) of the particles have size less than 150 microns. The maximum size is 300 microns. It observed that the size distribution for granilhas application in suspension is narrower than the particle size for application of



Figure 4. Micrograph of wet applied granilho

dry method (conventional A, B and C).

It was pointed in a scanning electron microscope (SEM) of granilhas in suspension, which confirms the size of particle, as seen in its irregular shape.

In Figure 4, once again it can be seen that the particles sizes are very small, below 300 mi-

Table 1 shows the chemical analysis of granilha for application wet obtained by X-ray fluorescence (XRF).

The X-ray diffraction (see Figure 5) confirmed the amorphous nature the material was not detecting any crystalline compound.

The granilha that we are speaking about does not contain opacifying agents, which generally correspond to the crystalline phases (e.g.,

It is the absence of these phases which gives a result after polishing without variation in hue in the final product.

Figure 6 shows the dilatometric behavior of granilha obtained on heating.

The absence of changes to linearity up to 700 ° C confirms the stability of the material expected to have suffered prior melt during sintering. It also confirms the absence of raw components.

The softening of the material occurs from this temperature (700 ° C), with a sharp decline. The coefficient of thermal expansion (COE), measured between 50 and 400 $^{\circ}$ C is 63.2 \times 10-7 ° C-1.

Figure 7 shows thermal analysis, differential and gravimetric (DTA / TG, respectively). So according toprevious observations, the thermal behavior of granilhais quite stable, notregistering decompositions.

Theapplying techniqueofwetgranilhaspre-

supposesapplying of the suspension on aglaze, whose behaviormustbe compatible. Therefore, the glaze which is selected and characterizedconsidered appropriate. It's chemical compositionshown in Table2. It can be seenthatit is amattglazeopaque .it containssignificant amounts ofopacifying agents like (zirconia, alumina, calcium oxideand zinc oxide).

Figure 8 showstheX-ray diffractionperformed on theglaze.

It is possible to observe the existence of crystalline phases. Theseare the raw elements forming part of the composition of the glaze.

It also appears that it is a matt glaze opaque by the presence of alumina and zirconia which are respectively matt and opacifying agents. The dilatometric behavior of glaze is very important and must have compatibility with microgranilhas which will be applied on it to avoid the emergence of tensions and risks of

Figure 9 shows the dilatometry curve of the

Up to about 750 °C there is a tendency expansive that is not too much significant(between 0.5 and 0.6%), whose linearity is disturbed especially the transition between α and β forms of quartz present the composition (to 573 ° C). From 750 ° C registers a sudden retraction reflecting material softening and loss of dimensionality. The coefficient of thermal expansion (COE), rated between 50 and 400 ° C, is 61.6 \times 10-7 ° C-1, so in the near of microgranilhas. The Softening also occurs in a region near, guaranteeing good compatibility between the two components.

Figure 10 shows the thermal analysis, differential and Thermo gravimetric of the glaze. The mass loss recorded at about 100 ° C (approximately 6%), accompanied by an endothermic reaction, results from decomposition





| Oxide | Percentage |
|-------|------------|
| Sio2 | 55.7 |
| Al2o3 | 18.1 |
| Cao | 10.3 |
| K2o | 1.1 |
| Na2o | 4.3 |
| Fe2o3 | 0.2 |
| Sro | 3.2 |
| Zno | 6.5 |

Chemical composition of granilha in wet method (XRF)

| Oxide | Percentage |
|---|------------|
| Sio2 | 47 |
| Al2o3 | 23.8 |
| Bao | 2.6 |
| Cao | 6.3 |
| K2o | 2.2 |
| Mgo | 1.2 |
| Na2o | 3.5 |
| Fe2o3 | 0.1 |
| Zno | 2.6 |
| Zro2 | 3.4 |
| habia?. Chemical composition of glaze (XRF) | |

of adsorbed water and confirms presence of calagents used. components in the composition of raw glaze. Because of using kaolin or clay as a suspending agent of the glaze so around 800 °C is ISO10545-136, which requiresnodetectionrecorded again endothermic peak accompanied by loss mass resulting from the decomposition of carbonates (dolomite

of glaze.

3.2.Application of granilha

Figure 11 illustrates the appearance of the suspension and microgranilhasin the compound. Theslurry densitywas optimizedfor applicationonbell. The density used was 1520qL-1 and applying high amount of granilha to obtain the viscositywas adjusted to 22/24 seconds in- a good result by dry method (we need 1.0 CLABORATORIES. Ford cup4 mmin diameter.

Optimizedthe amountof suspensionto be valuedrops toabout 0.46kg.m2, equivalent appliedper square meter product, and has to areduction of 55to 70%. This decreasecan achievedthe value of 0.66 kgsuspension. Whereas 70% suspension comprises by granilhas, it is estimated that the amount which re- ishing, because the layer is more homogeneou- Standard, 2006.

quired is 0.46 kgof this component per square sandless rough compared with dry application.

The pieceswere fired at a cycleof 60 minutes. Figure12represents the variation oftempera- It also allowsstoring thefinal product as amture againstlengthof the kiln.

surfacesandwithsmoothsurface appearance.

3.3.ProductCharacterization

tostain andresistance to attack

spectively.

The results of resistance to attack by aggressive variability areas of applicability. agents are shown in Table 3.

made withalcohol. This result gives the classiby regulations. fication5of the productin all cases.

Table 4 showsthe results ofresistance to chemical attack. The surfaceof the sampleshad a highresistance to attack of all chemi-

The classification GLA-GHA isthat indicatesany degradation, visible on the sample sur-Theabrasion resistancetest(PEI) according to ISO10545-76wasnotdonein apolishedplate. Thehardness testMOHSwas conducted in apolishedplatealready (see both results Table5).

Conclusions

Withthis new development, there is needto 1.5kg.m2 in dry method) ,while now the make cost reductions with these materials. The resulting productrequiresless deeppol-

Thissuitthecurrent industries produce parts thickness further reduced.

attand onlypolish it when necessaryaccord-Theapplication withcampanaachievesperfect ing to thecommercial application. Without beingpolishedthe piecesexhibitvalues of PEIIVwhich allowsits use intraffic areaseasily. Figures 13and 14,testsillustrate theresistance The application ofwet granilhaspresentsitself as aviable alternative to application by dry prochemicalpolished and non-polished tilesre- cessing offers the possibility two different finishes (polished and unpolished) and increases

These surfaceshave highresistance to chemi-Aboutstain, the stain removalis achieved- cal attackbeing classified asclass product GLA placing the tileinhot water (55 ° C)streamfor and GHA ISO10545-136. For these reasonsit is 5 minutes, for all elements used in the testex- concluded that the surfaces mattand shiny, by ceptthe marker. TheRemoval of themarkeris this methodmeet the requirements required

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Nano composite Ceramics, What are Nano composite Ceramics?

ver the past half century ceramics have received significant attention as candidate materials for use as structural materials under conditions of high loading rates, high temperature, wear, and chemical attack that are too severe for metals. However, inherent brittleness of the ceramics has prevented their wide use in different applications.

Significant scientific effort has been directed towards making ceramics more flaw-tolerant through design of their microstructures by incorporation of fibers or whiskers which bridge the crack faces just behind the crack tip; by designing microstructures with elongated grains which act as bridges between crack faces just behind the crack tip; by incorporating second phase particles which deflect the crack making it travel a more tortuous path; and by incorporating secondary phases which undergo stress induced volume expansion that forces the crack faces together. However, one of the most recent development has been the distribution of multiple phases in a ceramic composite at the nanoscopic length scale. Owing to prevalence of nanoscopic features, such composites are referred to as ceramic nanocomposites.

The definition of nanocomposite material has broadened significantly to encompass a large variety of systems such as one-dimensional, two-dimensional, three-dimensional and amorphous materials, made of distinctly dissimilar components and mixed at the nanometer scale. The general class of nanocomposite organic/inorganic materials is a fast growing area of research. Reducing the sizes of structural features in materials leads to a significant increase in the portion of surface/

The surface/interface energies essentially control the properties of a solid. Interfaces provide a means to introduce non-homogeneity in the material. This non-homogeneity acts as a significant modification of both thermal and mechanical properties of the composites. Selective mixing of materials in a highly tailored morphology with high percentage of interface area, leads to materials with enhanced properties.

The properties of nano-composite materials depend not only on the properties of their individual parents but also on their morphology and interfacial characteristics. The nanocomposites find their use in various applications because of the improvements in the properties over the simpler structures. Few of such advantages can be summarized as:

- · Improved Mechanical properties e.g. strength, modulus and dimensional stability
- Decreased permeability to gases, water and hydrocarbons
- Higher Thermal stability and heat distortion
- Higher Flame retardancy and reduced smoke
- Higher Chemical resistance
- Smoother Surface appearance
- Higher Electrical conductivity

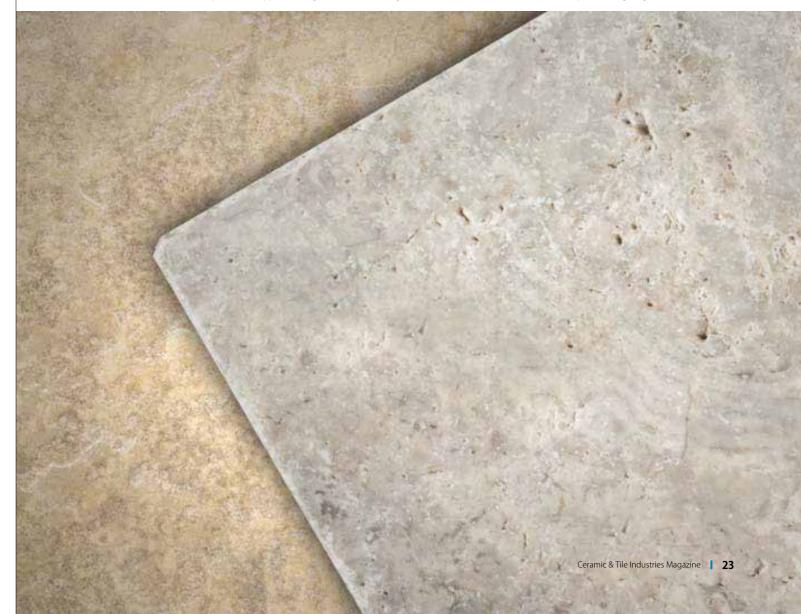
For components used in a gas turbine engine, a lifetime upto 10000 h and a retained strength of ~300 MPa at a temperature of 1400 °C have been postulated, together with negligible creep rate. Furthermore, at elevated temperatures, the material must exhibit high resistance to thermal shock, oxidation, and subcritical crack growth. Ceramic nanocomposites have been shown to be extremely

important for such future applications.

Advanced bulk ceramic composite materials that can withstand high temperatures (>1500 °C) without degradation or oxidation can also be used for applications such as structural parts of motor engines, catalytic heat exchangers, nuclear power plants, and combustion systems, besides their use in fossil energy conversion power plants. These hard, high-temperature stable, oxidation-resistant ceramic composites and coatings are also in demand for aircraft and spacecraft applica-

One such material system in this class of composites, Silicon Carbide/Silicon Nitride (SiC/Si3N4) composites, have been shown to perform very well under high temperature oxidizing conditions. Interest in such nanocomposites started with experiments of Niihara2 who reported large improvements in both the fracture toughness and the strength of materials by embedding nanometer range (20-300 nm) particles within a matrix of larger grains and at the grain boundaries. A 200% improvement in both strength and fracture toughness, better retention of strength at high temperatures, and better creep properties were observed.

An advanced nanocomposite microstructure such as that of polycrystalline Silicon Carbide (SiC)-Silicon Nitride (Si3N4) nanocomposites, Figure 1, contains multiple length scales with grain boundary (GB) thickness of the order of 50 nm, SiC particle sizes of the order of 200-300 nm and Si3N4 grain sizes of the order of 0.8 to 1.5 µm1. Designing the microstructure





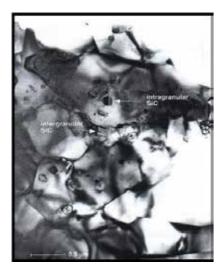


Figure 1. Actual microstructure of a SiC-Si3N4 nanocomposite1

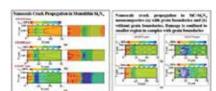


Figure 2. Snapshots of mesoscale crack propagation and damage propagation in the Si3N4 nanocom

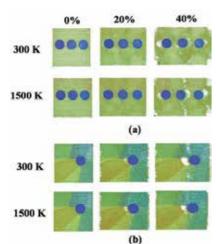


Figure 3. Snapshots of atomistic damage and failure propagation in two different SiC (particle) and Si3N4(matrix) nanocomposites at two different temperatures.

of such a composite (and similar others such as TiN-Si3N4, SiC-Al2O3, SiC-SiC, Graphene/ CNT+SiC, and Carbon Fiber+SiC nanocomposites) for a targeted set of material properties is, therefore, a daunting task. Since the microstructure involves multiple length scales, multiscale analyses based material design is an appropriate approach for such a task.

The ceramic nanocomposite work in Multiphysics Lab at Purdue focuses on (1) Understanding Performance of Carbide and Nitride Based High Temperature Ceramic Nanocomposites for Extreme Environments found in power generation cycles Including Nuclear Applications, (2) Multiscale Modeling and Characterization in Oxide Ceramic Materials and (3) Understanding thermal conduction and thermal issues in materials for thermoelectric power generation. A description of major areas of interest and contributions is as

•Understanding thermal conduction and thermal issues to develop materials with low thermal conductivity3-5: This work focuses on understanding atomistic mechanisms of operation of nanocomposites for thermoelectric power generation such that materials with low thermal conductivity could be developed. Explicit molecular simulations using molecular dynamics (MD) are performed to understand how morphology alterations can be used to reduce thermal conductivity in nanocomposites. We have found certain biomimetic arrangements that could achieve significant reduction in thermal conduction. We are in the process of making and testing such materials.

 Understanding Performance of Carbide and Nitride Based High Temperature Ce-

ramic Nanocomposites for Extreme Environments Including Nuclear Applications6-12: This research work focuses on understanding mechanisms of room temperature and high temperature operations of advanced nanocomposite ceramic materials that can enable power plant operation at temperatures in excess of 1750 K leading to efficiencies of almost 70% and significant reduction in the plant emissions. As an offshoot, this project also focuses on thermal properties of these materials for possible use as high temperature multifunctional materials, high temperature structural materials in nuclear applications or heat sensors in nucle-

Multiscale Modeling and Characterization in Oxide Ceramic Materials13-18: Focus during this work has been on understanding multiscale thermomechanical behavior of advanced composite materials such as multifunctional Al+Fe₃O₃ nanocrystalline composites and high-strength Al2O3/TiB2 ceramic armor composites. This research on atomistic deformation analyses of Al+Fe₂O₂ multifunctional nanocomposites using MD is one of the first in the area of atomistic deformation analyses of advanced ceramic composite nanomaterials. In this work large scale MD simulations of nanocrystalline Al+Fe₃O₃ multifunctional composites, of single crystalline Al, of single crystalline Fe₂O₃, and of various interfacial configurations of single crystalline Al and Fe₂O₂ are performed. In the case of Al2O3/TiB2 ceramic armor composites, we have developed and used a new cohesive finite element method (CFEM) for quantitative characterization of dynamic fracture.

The above contribution is strongly based on

a collaborative multiscale modeling-material design-experimental processing approach. A snapshot of the overall collaborative research approach on modeling, design, and fabrication highlights is provided below

· Multiscale Modeling of Ceramic Nanocomposites: An Example of Work in SiC-Si3N4 Ceramic Nanocomposites Our multiscale analvses (at nanometer and micrometer length and time scales) based on a combination of CFEM and MD based techniques have revealed that high strength and relatively small sized SiC particles act as stress concentration sites in Si3N4 matrix leading to inter-granular Si3N4 matrix cracking as a dominant failure mode. CFEM analyses have also revealed that due to a significant number of nano-sized SiC particles being present in micro-sized Si3N4matrix, the SiC particles invariantly fall in wake regions of micro-cracks leading to significant mechanical strength. This finding was confirmed in the MD analyses that revealed that particle clustering along the GBs significantly increases the strength of these nanocomposites. While some nanocomposite morphologies have sharply defined SiC-Si3N4 interfaces 19, other nanocomposite morphologies have diffusion of C, N, or Si atoms at the interfaces 20.

In the case of SiC-Si3N4 nanocomposites, MD analyses have also revealed that the second phase particles act as significant stress raisers in the case of single crystalline Si3N4 phase matrix affecting the strength significantly. However, the particle's presence does not have a significant effect on the mechanical strength of bicrystalline or nanocrystalline Si3N4 phase matrices. The strength of the SiC-Si3N4 nanocomposite structures showed an uncharacteristic correlation between the grain boundary (GB) thickness and tempera-

The strength showed decrease with increase in temperature for structures having thick GBs having diffusion of C, N, or Si atoms. However, for structures with no appreciable GB thickness (no diffusion of C, N, or Si atoms), due to the particle clustering and increase in SiC-Si3N4interfacial strength with temperature, the strength improved with increase in temperature. Figure 2 shows snapshots of fracture propagation analyses in such nanocomposites obtained using the CFEM.

Figure 3 displays snapshots obtained using MD. Current research work focuses on obtaining experimental images of the ceramic nanocomposites developed by collaborators, developing nanoscale CFEM meshes on such images, and performing failure analyses using the combination of MD and CFEM techniques.

■ Petascale Computing Based **Material Design**

Atomistic analyses at the nanoscale can impart important information about the effect of critical features such as a GB, an interface, or a triple junction, etc. on mechanical deformation behavior of a small nanoscale (~ few nm) sample. In multiscale modeling such information is used to formulate macroscale (>few µm) material models for understanding microstructure dependent deformation behavior of a material sample such as the one shown in Fig. 1.

Appropriate mathematical models of microstructure property relations allow to relate performances like fracture toughness, ulti-

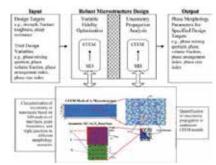


Figure 4. Schematic Petascale Material Design

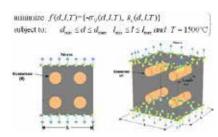


Figure 5. High and low fidelity models for the CFCC

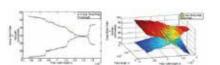


Figure 6. (left) Strenath and creep strain rate at 1500oC as a function of the design variable widthheight (d) for the 2-D low fidelity model. (right) Strength and creep strain rate at 1500°C as a function of the design variables width-height (d) and length of fibers (I) for the 3-D high fidelity model.

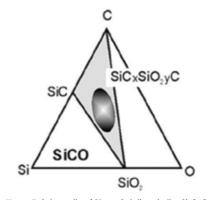


Figure 7. Schematic of Phase Relations in the Si-O-C System



mate strength, fatigue lifetime etc., to key material microstructure parameters like volume fraction, particle size, and phase composition. Since a typical nanoscale test sample is much smaller and is subjected to varied surroundings in a typical microstructure (e.g. Fig. 1), the incorporation of nanoscale information in macroscale models is subjected to statistical uncertainty.

If a complex microstructure is to be designed for a targeted set of properties, it is important that such uncertainties be correctly quantified and incorporated within a robust material design framework. We have pioneered the development of a variable fidelity model management framework that can incorporate material behavior analyses at multiple length scales in a design optimization framework21-24, (Collaboration with Prof. John Renaud's group at the University of Notre Dame).

Figure 4 details the process flow of a petascale multi-physics model management tool for multiscale material design. Deployed on a petascale machine, the design tool developed in this research, that integrates atomistic and mesoscale analyses using a variable fidelity model management framework, will facilitate a significant reduction in nanomaterials' development cost and time with a simultaneous increase in the possible different combinations of individual composite material phases to achieve desired material performance.

The model management framework21,22, besides managing the models and scales, is also well suited to control hierarchical parallelism. The natural hierarchy is MD within CFEM within design under uncertainty, using a mixed programming model SHMEMTM by

SGI for CFEM and MPI for MD and the uncertainty modeling. Both MD and the uncertainty quantification (via quasi-Monte Carlo integration) can use 1000 processors, and CFEM 10, so 1000 uncertainty quantification groups of 10 CFEM groups of 1000 HMC processors is 107 processors, nearing exascale.

Preliminary material design analyses of the model system have been performed to understand the morphology related parameters that must be controlled for optimal targeted set of properties. The application of design tool is focusing on the continuous fiber ceramic composite (CFCCs) models of SiC-Si3N4 nanocomposites, Fig. 5. The second phase (circles and cylinders) are the SiC fibers that have higher elastic modulus and higher creep resistance (E) but lower yield stress and fracture toughness, than that of the primary Si3N4 phase. The problem is to design the most suitable CFCC, with maximum strength and creep resistance for a set of external temperatures T, where the number of design variables will depend on whether the simulation tests are run on the 2-dimensional (2-D) or 3-dimensional (3-D) model. The design variables to be considered in the nanocomposite design optimization problem, for the 2-D model, are the fibers diameter (d) and the external temperature (T). And for the 3-D model the design variables to be considered are the fibers diameter (d), the length of fibers (l) and the external temperature (T). The problem definition in standard form is given below: Figure 6 illustrates normalized (0-100) function values for the strength and creep strain rate as a function of design variables for the high fidelity model (3-D) and low fidelity model (2-D). Figure 6 (left) shows an increase in the

CFCC strength and a corresponding decrease in the creep strain rate as the design variable d increases. Similarly for the high fidelity model, Fig. 6 (right) shows an increase in the CFCC strength and a corresponding decrease in the creep strain rate as the design variables d and I increase.

■ Fabrication

Focus during this activity is on forming a collaborative modeling-deign-processing framework where complex ceramic nanocomposites for targeted set of mechanical and non-mechanical properties could be produced without wasting significant trial-and-error time and money. We are collaborating with Prof. Rajendra K Bordia's group at the University of Washington-Seattle. Polymer derived ceramics (PDCs) are an attractive approach to make material design predicted morphology of ceramic nanocomposites. First Niihara and his coworkers and then others used this approach to make high performance nanoscale reinforced composites25-27. Continued research in this area has led to the development of a range of nanostructures. One particularly interesting class of materials have predominantly amorphous Si-O-C nanodomains containing nanoscale SiC and C reinforcements. These materials have the desired characteristics for a broad range of high-temperature applications while offering greater control over processing, compositions and nanostructure. PDCs are produced by pyrolyzing preceramic polymers and are typically amorphous up to very high temperature but provide very intriguing ceramic-like properties, such as good creep and oxidation resistance28.29





Technology pushes trends in Ceramic tile

hat could be new about something that has been around more than 4,000 years? When it comes to tile, a lot. During coverings 2014, the largest tile-and-stone trade expo in the country, the buzz was about baking technology, science and great design into modern ceramic

"Technology has been one of the tile industry's inspirations," said Ryan Fasan, tile-andstone consultant for Tiles of Spain.

Innovations over the past several years have included super-thin, extremely light tile that can be applied to cabinets or counters, very thick and anti-slip tile that can be used on uneven outdoor surfaces and tile that can resist wide temperature fluctuations. Antibacterial tile is a smart option for bathrooms, hospitals, schools or any public place. Some tile even cleans the air and itself.

American-based Crossville teamed up with Japanese company Toto to create ceramic tile that purifies the air and destroys stains. A special coating that is baked onto the surface of the tile is activated by light. Crossville uses recycled content in its products.

Italian company Casagrande Padana is turning out its own self-cleaning ceramic that works like trees, removing nitrogen oxide produced by car exhaust from the atmosphere. This is tile and technology at its best.

Digital inkjet printing revolutionized the manufacturing of ceramic and porcelain tile.

"One of the great things about this process is we can reproduce the look of stones that are extinct or which are not environmentally responsible to harvest," Fasan explained.

Tile makers in Spain, Italy, Mexico and beyond are embracing environmentally friendly practices and adopting the Tile Council of North America's Green Squared certification for porcelain tile as the industry's watermark for sustainable practices. Since tile is a natural prod-

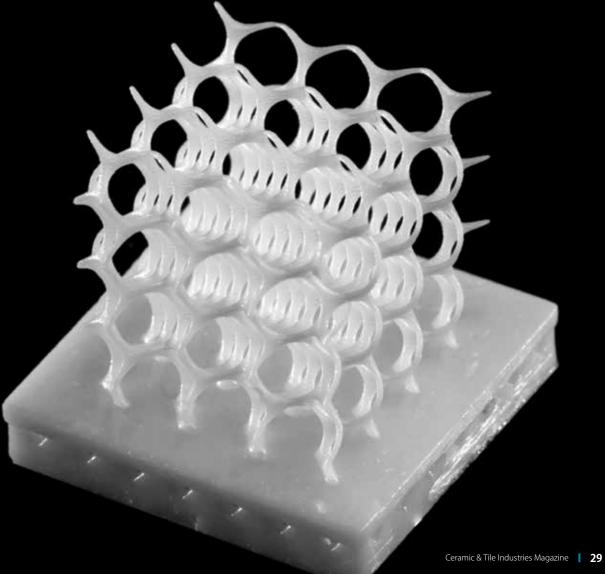
uct made of pyrolized red or white clay, it's the grout, sealants, adhesives and manufacturing and installation processes that are constantly being evaluated in terms of the environment. The biggest style trend now is the look of wood, with reclaimed wood being a favorite for wall and floor tiles. Like pre-washed jeans, it's not enough to imitate natural materials such as cement, stone and wood. They must also have a time-worn patina.

Florida Tiles showed Magnolia, a printed wood look that comes in a variety of colors. Fioranese's Old Wood series is nearly indistinguishable from the real thing; even wood's texture is replicated. Aparici, which does great inkjet designs, showed several of its Sonar collection of ceramic wood-flooring options together for an impressive display. Viva Made's Street collection of ceramic planks was an urban-inspired design. For a very dramatic effect, Over by Cerdomus combines black and white wood-style tile planking. The Maderia Collection by Keraben was another example of tile imitating wood that would be perfect for mudrooms and kitchens.

Del Conca and Cisa Ceramiche are just two companies that have re-created the look of petrified wood on tile. Del Conca, an Italian manufacturer, is building a plant in Tennessee to produce porcelain stoneware tile. Del Conca Fast is a high-tech tile installed without joints, adhesives or grout. It's basically a floating ceramic floor.

Fiandre's large-format, manmade Precious Stone collection uses the best of inkjet printing to create porcelain wall panels that are as artistic as they are architectural. And Emil Ceramica introduced Stone Box. Each box has 36 tiles representing different stones such as marble, granite, onyx, etc., but the color pal-

"We are seeing large tiles trending in both matte and polished finishes," said David Lang,





The continuing evolution of quartz surfacing



quartz surfacing — especially for countertops — has been on the rise. For those seeking a durable and consistent look, quartz surfacing products offer an alternative to natural stone or other surfacing materials. And due to its evolving popularity, quartz surfacing manufacturers are expanding their selections — providing solutions for both consumers and the de-

"Quartz surfacing continues to be very popular for countertop applications be-

istics — mainly durability — and ease of maintenance," said Michele Caneva of the Italian-based company Santa Margherita. "The residential market has not significantly changed, and the quartz surfacing is still promoted and sold mainly for kitchen countertop applications. We have seen an increased interest coming from designers working on commercial projects — mainly for flooring and bathroom area applications. Again, I think the interest toward quartz surfacing is mainly due to its out-

maintenance and, when it comes to designers, the possibility to have custom colors." And while custom colors are appealing, Caneva finds that several basics remain favorites. "Some colors simply never go out of fashion — white and gray in different shades and black," he said. "We see a trend for beige in sales, and the consumer has learned of the 'cold' hues and taupe colors."

Maggie Amir, Brand Manager for Caesarstone bility and color consistency." of Van Nuys, CA, confirms the color trends. "White is definitely a hot color when it comes to quartz surfaces," she said. "In the A&D com-

beige and browns are popular with consumers. "Quartz has definitely grown in popularity, but mainly on the coasts," Amir went on to explain. "Middle America is still learning about the product. In the last five years, quartz has become more readily available at point of great benefits of the product, including dura-

■ Marketing approaches

The increased interest in quartz surfacing can

of the leading quartz manufacturers. "With consumers, we focus on advertising both online and in print, and we try to educate them about the benefits of quartz," said Amir. "With architects and designers, Caesarstone takes a direct approach. Our reps are out in the field meeting with the A&D community and building strong partnerships with them." Santa Margherita also takes a solid approach to marketing its products and educating its consumers. "All technical data, including instruction for maintenance and certifications,

Michel Kornmann and CTTB

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are available on our Web site and in all our published literature," explained Caneva. "For the A&D community, we have developed an iPhone/iPad application, a CEU online course for AIA members (hosted by www.aecdaily. com) and a 'lunch & learn' presentation valid for both AIA and ASID members."

■ Environmental benefits

In addition to strong marketing campaigns, the environmental benefits of quartz surfacing are alluring in this day and age of green building and sustainability. "Caesarstone surfaces are non-porous and prevent the growth of surface mold and bacteria due to the use of quartz as a key ingredient," said Amir. "In addition, our product is in compliance with ISO 14001: 2004 to intensify environmental protection activities both in the manufacturing facilities and the outside world."

Caneva agrees that quartz surfacing offers environmental benefits. "Most quartz surfaces to be found on the U.S. market, and Santa Margherita is among them, are Greenguard certified," he explained. "This means that the level of VOC emission is very low. In addition to

that, quartz surfacing shows a long life cycle. Today, many quartz surfaces can be manufactured using recycled raw materials, such as glass, mirrors, feldspar, granite and porcelain. Santa Margherita has developed a special line called Second Life, manufactured with 89% certified recycled content."

Chris Carlson, Vice President of Sales and Marketing at QuintessenzaTM Stoneworks, states that his company's line of quartz surfacing also is made with the environment in mind. "Quintessenza Stonework's quartz materials are environmentally friendly, and fit right into our commitment to provide safe products for our customers and for the planet," he said, adding that the company's factory in China, CXUN, has 14 active production lines, with two more being added. "All of our products are continually tested beyond the industry standards for bisphenol A (BPA), phthalates and lead content to ensure our stone is completely safe for direct food contact."

When speaking more on the environmental er is involved. We benefits of quartz, Carlson cites that it is radon and radiation free, and it has no harmful effects on indoor air quality. "[Also], the man-

ufacturing of quartz surfacing uses materials that could otherwise be wasted and just go directly into landfills. The quartz engineered stone manufacturing process results in a very durable material, which is highly resistant to damages from scratching and warping, thus you can truly rely on having this 'green' countertop last for a very long time."

■ Surface finishes

While quartz products present a wide selection of color options, various finishes are also available. However, a polished surface remains popular in the U.S. market.

"In Europe, honed, brushed and textured finishes have been popular for at least the past five years," explained Caneva. "The North American market has always preferred a polished finish — mainly because of its ease of maintenance. We are seeing a slight change to the market with an increased interest in textured finish — especially when a designer is involved. We offer a textured finish line called Wave that recalls the look of slate, and Concreto that is reminiscent of a polished

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A couple's retreat built with native stone

areful consideration to all of her client's requests had to be taken when architect Katheryn Lott, AIA, RID, LEED AP BD+C, set out to design a private residence on a small golf course in Austin, TX. Lott, who owns her own Austin-based firm, Katheryn Lott Architects, had to incorporate the homeowners' love for entertaining, along with a desire for rustic charm and low-maintenance building materials, into the design of their

The answer was to build the structure with regional sandstone and limestone.

"[My client was] an executive from an international firm and his wife who dreamed of living on a small golf course lot in Austin," the architect explained.

"They wanted to achieve a comfortable feel — a balance of wood and stone with the use

Among the design objectives for the new residence was the importance that the building materials required little maintenance. "Llano sandstone from the nearby Highland Lakes area, aluminum clad windows and a clay tile roof were chosen as the exterior building materials," said Lott. "Wood plantation shutters were installed for privacy along the golf course."

The home's entire exterior facade is constructed with Llano sandstone. The golden and rust-colored hues of the stone give the residence a warm and welcoming effect. Moreover, the rough-cut solid look of the stone provides a sense of permanence and nicely complements the natural surroundings.

Because the Llano sandstone has a lot of natural color variation to it, mock-ups were done prior to installation for the owners and architect to approve.

In addition to exterior walls, the local sandstone forms a series of archways on the veranda, where the homeowners and their guests can sit, relax and dine. "The veranda sandstone arches are repeated in the dining room - creating an intimate dining experience," explained Lott. "Flagstone-shaped Lueders limestone flooring flows from the interior out to the veranda and down the stairs — eliminating the boundaries between indoors and

The interior also features a fireplace wall built of Llano sandstone, which is paired with wooden beams and the flagstone flooring. The combination of materials — along with the open floor plan — creates an inviting atmosphere with country elegance that is ideal for entertaining.

"The client's reaction was fabulous after the house was completed," said Lott, adding that construction time took between 14 to 16 months.



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Digital technology creating new possibilities for ceramic tiles

all know that digital technology has transformed photography and the music

It has also transformed the ceramic tile industry, creating new and intriguing possibilities for home interiors.

Digital technology's most obvious impact has been the change in the appearance of the tiles. Adapting inkjet printing techniques, ceramic tile manufacturers can now make tiles that so closely resemble natural materials like marble and wood, even the tile professionals can't tell the difference. "Once the tile is installed, unless I touch it and I'm six inches away, I can be fooled," said Vancouver-based tile designer Ryan Fasan, in a recent interview.

Another plus with the new technology: It is almost impossible to discern a repeated pattern because the tile makers now create "pattern areas" that are 30-by-30feet square. In the old days, you could easily spot identical tiles within about two or three feet of where you were standing. Not anymore, Fasan pointed

Of even greater interest to tile designers, the new technology allows them to design tiles with unusual three-dimensional qualities, Fasan said.

In the past, a raised pattern could not project more than 1/16th of an inch from the tile surface. The effect was subtle and only visible at close range. Today, a tile pattern can project as much as a half-inch, creating effects that are visible

from across a room, and a look that can change in the course of a day, depending on how sunlight hits it.

The sizes of these distinctly different-looking tiles have also changed; tile manufacturers can now produce tiles that are very large and very thin — 3-by-10-feet in area and 3 millimeters (about

What does all this mean for homeowners? You can make dramatic changes to your entire interior with a material that you probably thought best suited to bathrooms and kitchens.

Whether you're going for a more decorative, turn-of-the-last-century look, a spare, midcentury modern look or a more eclectic contemporary "I'll create my own aesthetic" look, there's a tile out there for every household and every room.

The choices number in the thousands; these are a few of the standouts that I saw in April at Coverings, the annual international trade show in Atlanta for the ceramics and stone industry. Reflecting the fact that nearly 70 percent of the ceramic tiles used in the United States are imported, four of these five standouts are produced by foreign companies.

The most dramatic possibilities for a new look with tile are the look-alikes. If you've always hankered for marble but resisted it for practical reasons — real marble is a soft stone that cracks and scratches easily — here's your chance.

You can install ceramic porcelain tiles that look exactly like the real deal, combine the look of several real stones, or

ones that evoke a long ago time and place. Grespania, a Spanish tile manufacturer, makes a red-clay-colored Palace Alicante tile that is a dead ringer for Rojo Alicante, a very common Spanish marble that will look familiar to many Americans. If you want to wow your visitors as they step over the threshold into your foyer, this would be a good flooring choice.

Knoxville-based Crossville's brand-new Virtue looks like white marble, but not a specific stone, because it's a combination of three classics — Carrara, Calacatta and Statuario. With subtle veining and a soft satin finish that imbues it with a calming ambience, Virtue would be perfect flooring for a sitting area where you want to unwind after a long day. Marble is not the only stone that tile makers are mimicking. Lamosa, a Mexican firm, makes Piedra Terraza. It looks like real river stones — stones with a rounded surface after eons of contact with running water in rivers or streams. Moreover, each individual stone on each tile is raised, a detail that becomes obvious when you walk on it barefoot.

The porcelain ceramic wood look-alikes are made to resemble individual floor planks or parquet flooring with multiple wood pieces on each tile.

Lamosa's Firenze collection includes American standards like Cherry and tropical hardwoods like Ipe and Zebra wood.

Aparici's Sonar displays a distressed or worn, weathered look that does not resemble real flooring; it's actually more interesting. The wood "wannabes" can be used in any room but are especially well suited to wet areas such as kitchens and bathrooms or outside as a pool deck.



Joseph W. Shaw, John C. Overbeck,



پروپیلن است. فریت بهعلاوه رنگدانه پایه اصلی که

در حدود ۵۰ تـا ۷۰ درصـد تركيـب خميـر چـاپ را تشـكيل

میدهند، ساییده شده تا به دانهبندی مناسب

برای روتوکالر برسند. همچنین میبایست فریت و

رنگدانه به طور مناسبی در روغن چاپ پخش شود.

ميـزان پخـش شـدن، روش اسـتفاده بـراى مخلـوط كـردن

و سایش متفاوت میباشد. برای کنترل میزان پخش

شدن مى توان از روش آناليز عكس استفاده نهود.

در روش چاپ تخت، روغن چاپ برپایه پلی اتیلن

گلیکول با وزن مولکولی کم است که مزیت آن

پلاستی سایزر و روانساز بودن آن است و اشکال آن

قدرت اتصال كم آن است كه با اضافه كردن بايندر به

تصحیح مشکل ذکر شده میپردازند. فیکساتیو مورد

استفاده برپایه پلیوینیل استات و یا پلیوینیل الکل

است که اشکال آن چسبندگی براساس سرعت خشك

شـدن آن اسـت. در عملیـات دکوراسـیون، رفتـار خمیـر

چاپ براساس رفتار رئولوژی آن تعریف میگردد که به

صورت ایده آل عبارت است از اینکه، ویسکوزیته بالا

به هنگام سکون داشته که از جداشدن آن جلوگیری

میکند و به هنگام جنبش و حرکت ویسکوزیته کم

بوده که موجب بهتر شدن خاصیت عبور می شود. در

روش دکوراسیون روتوکالر انتخاب روغن چاپ بستگی

به نوع تولید اعم از تك پخت یا دوپخت بودن

تكنولوژي روتوكالر

یکی از مشکلات موجود در صنعت کاشیهای دیواری و کف تنوع در تنالیته و شید رنگی است. معمولاً این مشکل بر اثر وجود تنوع در ترکیبات رنگی لعاب بهوجود نمیآید، بلکه اغلب بر اثر فرآیندهای بعدی تولید، مثل عملیات

مورد شید رنگی مؤثر باشد.

۱- شدت رنگ مورد نیاز بیشتر (مخصوصاً این مورد با استفاده از سیلندرهای نرم امکان پذیر است.

۲- نزدیك بودن طرح به لبههای سیلندر (مخصوصاً در سیلندرهای نرم به کمک این کار میتوان مشکلات را رفع

٣- تفاوت كم در چاپ نقاط كوچك

دكوراسيون است.

امروزه در صنعت تولید کاشی، استفاده از روش دکوراسیون رولـری، بـه ویـژه روتوکالـر کـه متعلـق بـه شرکـت «سیسـتم (System) »است بسیار رایج شده است. در این روش چاپ، خمیر چاپ که محتوی رنگدانه سرامیکی است به وسیله غلتکی که طرح مورد نظر بر روی آن و با استفاده از سیستم لیزر حکاکی شده است بر سطح کاشی نشانده میشود. بسته به عمق و نوع حکاکی غلتک یا سیلندر، شدت رنگ ایجاد شده بر روی کاشی میتواند متفاوت باشد. بسته به تعدد رنگهای مورد استفاده در یک طرح تعداد سیلندرها نیز متغیر است. تنوع در رنگ علاوه بر شرايط و فرآيند توليد مى تواند ناشى از تركيب لعاب و خمیر چاپ باشد که میبایست از نظر تنوع رنگی مد نظر قرار گیرد. بنابراین بررسی تأثیر مواد بر روی خمیر چاپ، مشخصات رئولوژیك روغن چاپ و همچنین مشخصات بدنـه و لعـاب هماننـد روش چـاپ میتوانـد در

■ ارتفاع سیلندر و مشخصات تیغه

یکی از فاکتورهای مهم بر شید رنگی با کاهش فاصله و در نتیجـه افزایش فشـار شـاهد افزایـش dE هسـتیم. هرچقدر فشار بیشتر باشد (ارتفاع کمتر باشد) به دلیل تخلیه بیشتر خمير توسط حفرههاي سيلندر شاهد تيرهتر شدن كاشي خواهیم بود. فشار بیشتر موجب کاهش کیفیت سطح میگردد. هـم چنیـن بـا افزایـش فشـار، شـاهد کاهـش عمـر سیلندر و ایجاد اثـر کاشـی بـر روی سیلندر در درازمـدت خواهیــم بــود. در صورتــی کــه ناگزیــر بــه کاهــش ارتفــاع سیلندر باشیم، معمولاً افزایش فشار به دلایل زیر صورت

۵- در سیلندرهای فوق نرم جدید امکان چاپ جتی در برجستگی ها وجود دارد و در نتیجه مشکلات قبلی نظیر چاپ نخوردن کاشی ها در گوشه ها و یا سایر قسمتهای طرح رفع شده است و این سیلندرها هم چنیـن قابلیـت اجـرای طـرح را در کاشـی هـای اسـتراکچر و یا برجسته را دارند که در نتیجه مشکلات پیشین تاحدودی رفع شده است.

در این بخش موارد زیر مورد بررسی قرار می گیرد:

- شرایط اجزای خمیر چاپ
- روغن چاپ و شرايط آن
- فرآیند دکوراسیون و متغیرهای آن
- مشخصات بدنه دكور شده و تغييرات آن
- تغییرات تجهیزات دکور (ماشین و رولر)

مشکلاتی که در هنگام استفاده از سیستم روتوکالر ممكن است ايجاد شود عبارتند از:

- شید رنگی
- چاپ بد در اطراف کاشی
- چاپ بد در لبه های کاشی
- تفاوت در شدت رنگ کاشی
- قسمتهایی که بد چاپ خورده باشد
- سخت بودن کار با رنگهای تیره

■ خمیر چاپ در سیستم چاپ روتاری سیستم روتوکالـر براسـاس اعـمال رنـگ در قسـمتهای

مشخص به وسیله سیستم چرخشی - رولسری و با استفاده از تیغه و سیلندر جهت دکور کاشی و انتقال طرح بـه کاشـی عمـل می نمایـد. طـرح براسـاس نحـوه

توزیع شکافها (حفرههای حکاکی شده روی سیلندر) در سطح غلتك است. براثر هم پوشاني و بهكار بردن چاپهای پی در پی در نهایت شاهد ایجاد طرح مورد

خمیــر چــاپ مــورد اســتفاده در سیســتم روتوکالــر از دو

بخش اصلی تشکیل شده است:

۱- بخش پایه و یا Base که شامل فاز جامد یعنی فریـت (پـودر چـاپ)، اکسـیدهای رنگـی و مـواد رسـی

۲- بخـش مایـع یعنـی روغـن چـاپ یـا Medium کـه شامل ترکیبی از اتیلن، دی و پلیاتیلنگلیکولها و

محصـول دارد. مشخصه های مورد نیاز برای خمیر چاپ عبارت است

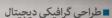
- قدرت تعليق
- قدرت ترکنندگی
- یایداری در تولید
- کشش سطحی کم برای قدرتترکنندگی بالا
 - قدرت بالای تصحیح

نکات و متغیرهایی که میبایست مد نظر قرار گیرد:

پارامترهایی که قبل از روتوکالر میبایست کنترل شوند عبارتند از: مشخصات بدنه، یرس، دمای کاشی، اسپری آب اعمالی، انگوب و لعاب و خط لعابکاری. پارامترهایی که در حین استفاده از روتوکالر تأثیرگذار هستند عبارتند از: خمیر، یـودر چـاپ و مشـخصات مكانيكي روتوكالر



تکنولوژی پرینت دیجیتالی در صنعت سرامیک که هماکنون جهانی شده است، اگر موجب انقلاب در صنعت کاشی نشده باشد حداقل به میزان بسیار زیادی موجب بهبود دکوراسیون شد و راههای دکوراسیون را تغییر داد و تکنولوژی Inkjetباعث بالا بردن کارایی پروژههای سرامیکی شد. به گفته آقای Penna رییس تولید شرکت Imolaکه هفت ماشین دیجیتالی را راهاندازی غوده است، اهمیت نوآوری دکوراسیون دیجیتالی در صنعت کاشی به اندازه تغییر کورههای تونلی به کورههای رولری است. به گفته وی فرآیند چاپ دیجیتالی مشکلات موجود از تنوع در رنگ گرفته تا محصولات نامنطبق در صنعت چاپ را رفع میکند و قطعات یدکی انبار را کاهش میدهد. این تکنولوژی همچنین قادر است که ارزش افزوده کاشیها را نیز افزایش دهد. همچنین با این روش زمان تولید طرحها و قرار گرفتن ان در خط تولید نیز کم میشود.

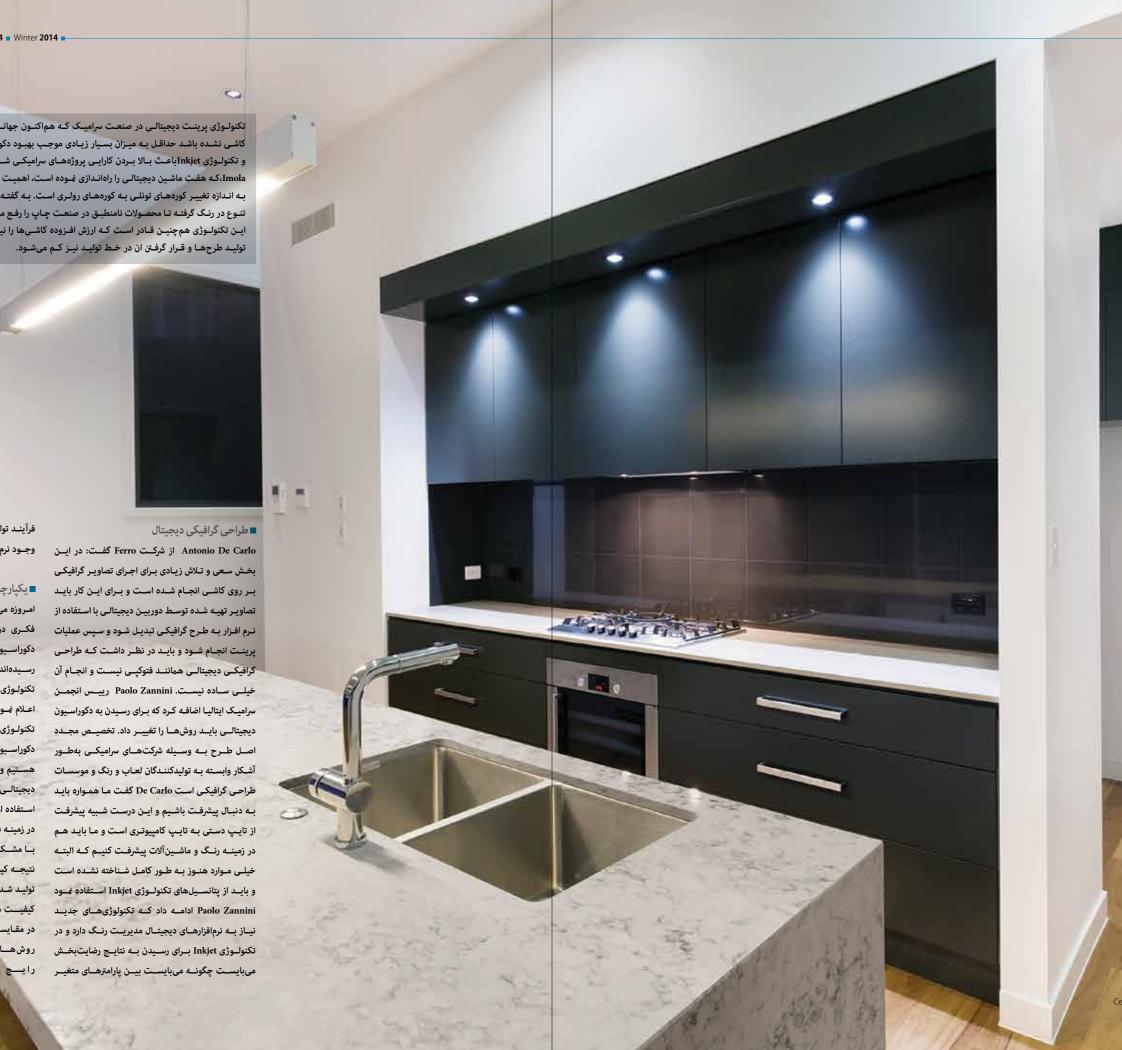


Antonio De Carlo از شرکت Ferro گفت: در ایسن بخش سعی و تلاش زیادی برای اجرای تصاویر گرافیکی بر روی کاشی انجام شده است و برای این کار باید تصاویر تهیه شده توسط دوربین دیجیتالی با استفاده از نرم افزار به طرح گرافیکی تبدیل شود و سیس عملیات پرینت انجام شود و باید در نظر داشت که طراحی گرافیکی دیجیتالی همانند فتوکیی نیست و انجام آن خيلي ساده نيست. Paolo Zannini رييس انجمن سرامیک ایتالیا اضافه کرد که برای رسیدن به دکوراسیون دیجیتالی باید روشها را تغییر داد. تخصیص مجدد اصل طرح به وسیله شرکتهای سرامیکی بهطور آشکار وابسته به تولیدکنندگان لعاب و رنگ و موسسات طراحی گرافیکی است De Carlo گفت ما همواره باید به دنبال پیشرفت باشیم و این درست شبیه پیشرفت از تایپ دستی به تایپ کامپیوتری است و ما باید هم در زمینه رنگ و ماشین آلات پیشرفت کنیم که البته خیلی موارد هنوز به طور کامل شناخته نشده است و باید از پتانسیلهای تکنولوژی Inkjet استفاده ضود Paolo Zannini ادامه داد که تکنولوژیهای جدید نیاز به نرمافزارهای دیجیتال مدیریت رنگ دارد و در تکنولوژی Inkjet برای رسیدن به نتایج رضایتبخش روشهای

فرآیند تولید هماهنگی ایجاد نمود که این کار نیازمند وجـود نرمافزارهای کامپیوتـری مناسـب اسـت.

پکیارچگی بین تکنولوژیهای موجود

امروزه میتوان گفت در جهان به یک نوع یکپارچگی فكرى درخصوص تكنولوژىهاى موجود در زمينه دکوراسیون سرامیک با استفاده از تکنولوژی Inkjet رسیدهاند و همگان باور دارند که میبایست این تكنولوژی تقویت شود.Paolo Monari از شرکت سیستم اعلام فهود به عنوان مثال امروزه مشکلی که در این تکنولوژی وجود دارد این است که برای اعمال مواد دکوراسیون با ضخامت زیاد با مشکل مواجه هستیم و هماکنون اعمال لعاب به صورت دیجیتالی هنوز غیر قابل تصور است. استفاده از این روش برای دکوراسیون در زمینه فاصله بین رنگها هنوز با مشکل مواجه است و در نتيجه كيفيت محصولات تولید شده در این روش كيفيت مناسبي در مقایسه با







فعلی وجود ندارد و با استفاده از روش حکاکی سیلندر کیفیت مناسبتری در مقایسه با تکنولوژی دیجیتال موجـود می تــوان حاصــل نمــود Marco Ferrari از شرکــت Colorobbia اضافه نمود باید در نظر داشت که میبایست در ادامه روشهای فعلی سعی در بهبود آن با استفاده از روشهای جدید داشت.

پتانسیلهای زیبایی شناختی

Zannini افـزود مزيـت اسـتفاده از روشهـای جديـد ايـن است کے لبہ ہای کاشی سطح مورد نظر و ہے چنین نقوش برجسته موجود در سطح نیز میتواند با استفاده از این روش دکور شود. در حالی که به عنوان مثال در روش دکوراسیون روتوکالر که از سیلندرهای حکاکی برای اعــمال رنـگ اسـتفاده میکنــد ایــن امــکان وجــود نــدارد AlbertoGhisellini از شرکت Kerajet افـزود بــا اسـتفاده از روش دکوراسیون Inkjet میتوان به افکتهای مشابه پـرس دوبـل و یـا کاشـیهای رگهرگـه دسـت یافـت. ایـن روش میتواند بر روی بدنه پرس شده به صورت مستقیم بکار رود و یا اینکه در کاشیهای دوپخت از این تکنولـوژی اسـتفاده نمـود.

■ جوهر و رنگ

Warren Green از شرکت Jettable گفت با وجود اینکه در سالهای اخیر تلاش زیادی برای ساخت رنگ مناسب انجام شده است، ولیکن هنوز نیاز به تلاش بیشتر در زمینه رنگ وجود دارد. تولید تمامیرنگها با استفاده از سـه، چهـار و یـا شـش رنـگ اصلـی هنـوز بـه صـورت کامـل قابـل دسترسـی نیسـت و اسـتفاده از روشهـای مـورد استفاده در صنایع دیگر در صنعت سرامیک به صورت کاملاً مشابه در صنعت سرامیک قابل اجرا نیست زیرا در صنعت تکنولوژی دیجیتال عوامل دیگر فرآیند تولید نظیر پخت، واکنش با یکدیگر از جمله واکنش بین رنگ، لعاب و بدنه نیز تاثیرگذارند.

از شرکت Colorstore عنــوان Alessandro Giudice نه فردار آزمایشات انجام شده با استفاده از چهار رنگ سرامیکی می توان ۸۰ تا۹۰ درصد تولیدات را از نظر رنگبنـدی تولیـد نمـود و در برخـی مـوارد حتـی سـه رنـگ

در مـورد هزینههای تولیدی در دکوراسیون بـه روش دیجیتال اشاره شد که هنوز برای ارایه هزینه هر واحد از کالا زود است. Ghisellini اشاره کرد که هزینه سفارش، ماشين آلات ديجيتال بالا است و اين قيمت بالا به دليل تجهيزات الكترونيك مربوط به دستگاه است.

نیـز بـرای رسـیدن بـه محدودههـای رنگـی کافـی اسـت.

MarcoFerrari افـزود نسـخه جديــد نرمافـزار فتوشــاپ

خصوصیات مربوط به رنگها را در خود جای داده

است و برنامههای دیگر جهت استفاده پیچیده هستند

و بـه تازگـی نسـخههای برنامههـای مربـوط بـه صنعـت

سرامیک ارائه شده است. امروزه تولیدکنندگان رنگ

به طور ویش به روی استفاده از سه رنگ [اصلی] بهعلاوه رنگ مشکی تمرکز کردهاند. برای فایق آمدن

بـر مشـکل عـدم حضـور رنـگ واقعـی Magneta، سـختی

کار در ایجاد رنگ زرد مناسب، قهوهای و سبز مربوط

ترکیبات ایجادکننده رنگ سیاه است که تحقیقات برای ایجاد ترکیبات ارگانومتالیک (Organometallic) جدیـد و

همچنین محدودههای وسیعی از رنگدانههای بسیار

ريـز (SuperFine) در حـال انجـام اسـت. امـروزه تقريبـاً

تمام تولیدکنندگان پایدار بوده و شدت رنگ خود را طی

فرآیند تولید از دست نمیدهند.

Claudio Ricci از شرکت ساکمی اشاره کرد که برای ارزیابی هزینه ها می بایست تمام مراحل را از هزینه های مربوط به پرسنل طراح گرفیک تا اپراتورهای ماشین آلات را محاسبه نمود زيرا ماشين آلات فعلى پيچيدهتر عمل

Chisellini افـزود البتـه ايـن نكتـه را نبايـد فرامـوش كنيـم که در تکنولوژی Inkjet تنوع رنگی ایجاد شده و شید کمتر است و همچنین میزان مصرف و مواد مصرف شده و کالیبراسیونهای مکانیکی که در روشهای فعلی وجود دارد در اینجا حذف میگردد و همچنین فضای اشـغال شـده در ايـن روش كمـتر اسـت. Norbert von Aufschnaiter از شرکت Durst گفت: بـرای تولیـدات در محدوده وسيع روشهاى رايج به نسبت دكوراسيون دیجیتال هزینه بیشتری ایجاد میکند.

(Roller Kiln)



کوره های مداوم رولری جدیدترین و اقتصادی ترین کوره، جهت پخت سریع محصولات سرامیکی هستند. مطالعات و تجربیات حاضر نشان میدهد که هزینه تولید محصولات سرامیکی(کاشی، ظروف، چینی، بهداشتی) در این کورهها کمتر از کورههای دیگر است. البته این بدان معنا نیست که سایر کورههای متناوب و یا مداوم مورد استفاده قرار نمى گيرند، البته هـم اكنون بـراي پخـت سـاير قطعـات كـه دارای محتویات مواد فرار بالا، یا شکل پیچیده و بزرگ و یا دمای پخت بالایی باشند، کورههای غیر رولری مناسب هستند. از آنجا که کورههای رولری دارای ابعاد مشخص و همچنین زمان پخت کمی هستند، امکان پخت قطعات بـزرگ (از نظر ارتفاع) و همچنیـن پخـت قطعاتـی با فرمول های متنوع (بدنه و لعاب) درآنها وجود ندارد. این کوره ها در دو نوع تک پخت و دو پخت بکار می روند. نوع تک پخت اغلب برای تولید کاشی کف و نوع دو پخت آن برای کاشی دیواری و چینی مظروف و چینی بهداشتی مورد استفاده قرار میگیرند.

ساختمان کورههای رولری بصورت یک تونل (محفظه) طویل بوده که بصورت پیش ساخته بر اساس نیاز مشتری با استفاده از نسوزهای سبک به ابعاد (۱۰۰۰×۱۰۰۰ تا طبقه) ساخته میشوند.

کورههای رولری یک طبقه بر اساس نیاز موجود و پیشرفت فناوری، به کورههای رولری دو طبقه تبدیل شده که در بعضی جهات در مقایسه با کورههای یک طبقه دارای مـزا عبارتنـد از:

الف- كاهش مصرف انرژی ، بخاطر كاهش اتلاف حرارتی ساختمان كوره.

ب- کاهش مساحت تاسیسات به نصف، با ظرفیت تولید مشابه، وجود سیستمهایی که اجازه کنترل و کار مجزای هـر دو کانـال کـوره را هماننـد دو کـوره مجـزا میدهنـد. این کورهها با واحدهای پیش ساخته دیرگداز و عایق، با منطقههایی مشابه کوره یک کاناله تقسیم بندی

دارا بودن دو کانال اجازه تولید دو نوع محصول مختلف با سیکلهای مختلف پخت در یک زمان مشابه را فراهم مى آورد. علاوه بر داشتن كنترل كاملاً مجزا، تفاوت هاى عملکرد دو کانال نیز میتواند بیشتر از ۱۵۰ درجه سانتیگراد باشد. در این حال کوره رولسری تک کاناله

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مطمئن تريـن كـوره بـراى پخـت سريـع محصـولات اسـت. در این کوره ها قطعات توسط دوران رولرهای نسوز ، از یک سمت وارده كوره شده و در طول مسير از مراحل مختلف کـوره میگذرنـد. بالاتریـن درجـه حـرارت در وسـط کـوره بوده و عمل پخت نهایی در آن منطقه انجام میشود. درست در خلاف جهت حرکت رولرها (قطعات) هوای خنـک دمیـده میشـود و سـبب سرد شـدن قطعـات پـس از پخت، در شرایط کنترل شده می شود. بنابراین قطعات خروجی، با دمای محیط تفاوت اندکی دارند که مانع از ایجاد شوک در قطعات میشود. این کورهها معمولاً با اغلب سـوختها ، نظیـرگاز طبیعـی، گاز شـهری و سـوخت مایع سبک (نفت سفید) کار میکنند. کوره های ((رولری الکتریکی)) نیز از انواع کورههای رولری هستند اما به دليـل بـالا بـودن هزينـه بـرق و مشـكلات تهيـه المنتهـاي حرارتی که قادر به تحمل تغییرات مداوم درجه حرارت بیش از ۱۲۰۰ درجه سانتیگراد نیستند، فقط برای پخت تزیینی(دکور) استفاده می شوند.

به علت اهمیت زیاد کورههای رولـری و مراحـل پخـت آن 💮 خ - عدم نیاز به پی ریزی و فوندانسیون قوی

ایـن کورههـا بـه سیسـتم کنـترل خـودکاری بـرای تنظیـم درجـه حرارت، تنظیم سرعت ، دوران رولرها، میـزان هـوای احـتراق، تنظیم فشار و ... مجهز شده اند. مزایای ومعایب کوره های رولری نسبت به کوره های دیگر در ذیل ذکر شده است.

■ مزایای و معایب کوره های رولری الف- صرفه جویی در مصرف سوخت و کاهش هزینه پخت ب - کاهش اتلاف حرارتی در نتیجه عایق بندی مناسب پ - یکنواختی پخت در طول کوره ، به دلیل استفاده از مشعل های ویـژه بـا اختـلاط مناسـب هـوا و گاز ت - دارا بـودن حداکثر بـازده پـس گازهـای احـتراق ، بـع علت داشتن ظرفیت حرارتی مختلف ث - مقدار ثابت فشار نسبت به زمان در شرایط مختلف

بارگـذاری (مقادیـر مختلـف مـواد پخت شـونده) ج - سهولت کنترل و تنظیم سیستم در طول کوره چ – پایین بودن هزینه تعمیر و نگهداری ح - استفاده از گرمای اتلافی جهت پیش گرم کردن هوای ثانویه

د - نیاز به حجم و فضای کم ذ - حذف استفاده و مصرف ساگار

ر - کاهش احتمال ورود ناخالصی های حاصل از ساختمان کوره ز- سبک بودن تجهیزات کوره

ژ- افزایش سرعت و حجم تولید

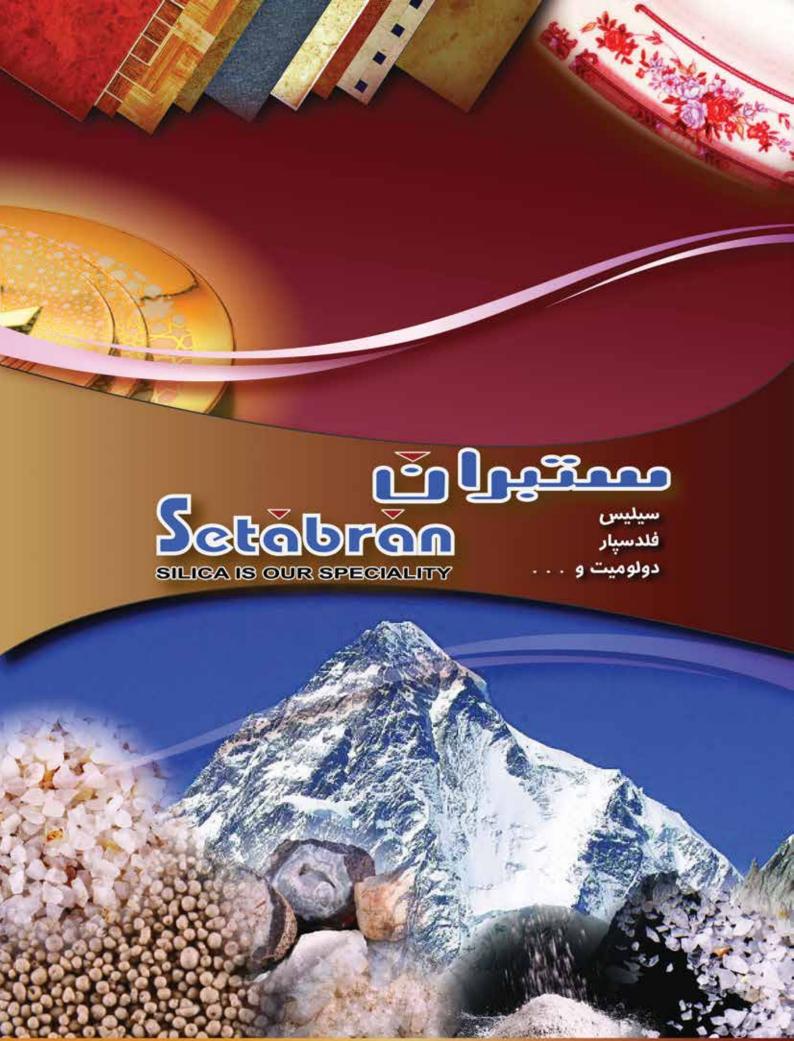
س- تشخيص و برطرف كردن سريع عيوب فرمولايسون محصول به علاوه مکانیزم دستگاه ها به گونه ای است که احتمال ایجاد خطر و تنش برای رولر بسیار کم است و در شرایط سنگین (سخت) کاری عملکرد خوبی را از خود نشان داده انـد. بـا ایـن وجـود کـوره هـای رولیـری دارای معیـاب و محدودیت هایی نیز به شرح زیر هستند:

محدودیت ها و معایب کورههای رولری الف-توقفناگهانی کوره در صورت عدم چرخش رولرها در حین کار ب - وابستگی کار کـوره و شرایـط پخـت بـه انـواع رولـری مـورد اسـتفاده

پ – چسبیدن احتمالی قطعات به رولرها ت - هزينه بر بودن تعويض رولرها



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