

Foamed Adjustable Ceramic Plates in Interior Art Design Research Study

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Abstract:

This study investigates the fabrication of foamed adjustable ceramic plate materials in interior art design and the effects of density, compressive strength, and thermal conductivity on application. Generally, Foamed ceramics have gained increasing attention for their unique combination of aesthetic appeal and functional versatility. The need for innovative applications of these materials in interior art design, including decorative wall panels, sculptures and spatial elements, has increased. There is a gap in the production of foamed adjustable ceramic plate materials, with insufficient attention to strength and thermal conductivity being a concern. The fabrication of foamed adjustable ceramic plates requires examination of composition and surface finish porosity, thermal effects, and compressive strength to achieve desired artistic and functional outcomes. The research endeavours to unlock the full potential of these ceramics by examining their characteristics and performance under various conditions. Density, thermal conductivity, and compressive strength properties are important in interior art design because they dictate not only the material's suitability for creative expression but also its structural reliability. Therefore, this study introduces new SiC, Al₂O₃, and TiO₂ composites in the production of foamed adjustable ceramic tile materials in interior art design and investigates their effects on density, compressive strength, and thermal conductivity in detail.

Introduction

The foamed ceramic plate is composed of mineral substance as the primary raw material and is lightweight. It is plate-shaped and combined with a tiny quantity of additives and foaming agents, and it is prepared and foamed at high temperatures. It has good thermal insulation features. Although it offers qualities of compact size, excellent strength, heat insulation, acoustic insulation, resistance to fire, and water resistance, its widespread use in the building industry is constrained by its cost of manufacture. Foamed concrete naturally offers advantages in energy efficiency, heat maintenance, thermal insulation, durability against fire, and blending with other materials since foamed ceramics have the benefits of superior fire resistance and high stability [1]. Ceramic foams are unique among contemporary engineering constituents due to their outstanding capabilities and diverse applications. The use of solid waste from industries rather than organic raw materials to make ceramic foams has recently attracted significant study attention. Coal fly ash (CFA) is the most popular type of trash among them [2].

Foamed ceramic based on perlite boards for insulation has gained popularity as a new kind of combined material for decoration and protection. Strong porosity, superior durability, impermeable to water, insulation from heat, and decreased sound are all benefits of such boards. They are, however, quite brittle and have low impact resistance. The present technical requirements for evaluating the impact of barrage on insulators used outside the home [3]. They are lightweight materials with a structure made up of sealed and open porosity. They also have good chemical resistance, low density, and acoustic insulation qualities. Ceramic foams might be applied in a variety of industrial settings [4]. However, with foamed ceramics, the assembly of the pores (particularly the size of the pores and spread), mass density, and porosity have a major impact on the compressive strength of the material. In comparison to amorphous glass, the spinel crystal's good characteristics may increase compressive durability [5]. For foamed ceramic to be used in building, its thermal and mechanical qualities have to fulfil the prerequisites. In porous construction materials, thermal conductivity is primarily responsible for heat transfer. Thermal conductivity thus plays a major role in assessing the effectiveness of insulation [6].

Silicon carbide (SiC) is a potential material for extreme-temperature Particulate matter separation with excellent mechanical properties, resistance to thermal stress, low thermal expansion coefficient, and superior chemical reactivity. Nevertheless, the production of SiC ceramics is challenging due to the elevated temperatures required and the solid covalent Si-C bond [7]. Porous silicon carbide ceramics have placed an emphasis on stimulating investigations in the area of porous material due to the above-mentioned properties [8].

The properties and performances of porous SiC ceramics are the pore dimensions, pore structures, and porosity levels that are strongly linked to their tiny structures. For instance, porous SiC ceramics with fewer pore sizes and similar porosity have demonstrated more flexibility than ceramics with bigger pores. Moreover, mechanical qualities often deteriorate as porosity rises. In general, pore size, as well as exposed porosity, improve transparency [9].

The Al_2O_3 -SiC materials were enhanced by SiC whiskers, and it was decided that the production of SiC whiskers significantly improved the material strength and thermal shock resistance. According to earlier research, it is anticipated that adding SiC whiskers to mullite foamed ceramics will increase their durability, chemical reactivity, and thermal shock resistance, hence extending their useful lives [10]. Making macroporous ceramic materials containing fewer pores, greater cold smashing strength, and less sintering-induced shrink is possible by adding a weight proportion of pre-foamed colloidal alumina to an Al_2O_3 -stabilized foam. The manufacture of bigger samples is made difficult by this composition's considerable linear shrinkage and lengthy setting times, which also affect its porosity [11]. Al_2O_3 's superplastic distortion characteristic at extreme pressure and temperature is used to create materials with sealed pores made of Al_2O_3 - MgAl_2O_4 and SiC as foaming ingredients. The product lacks efficiency indications and has no porosity. Additionally, it has been stated that specific pore-forming chemicals can be used to create closed-cell ceramics [12].

Ceramic titanium dioxide (TiO_2) foams are good candidates for use as catalysts in water and air

filtration systems, diesel particle filters, and other applications. All of these applications require the foam to have great compressive strength, high porosity and linked pore space, which are required qualities [13]. TiO_2 is a type of material that has garnered a lot of focus as a medium for Phase change material due to its inexpensiveness, non-toxicity, superior conductivity, permanent chemical reactivity, high resistance to heat, and other great features [14].

Frame ceramics are also used in interior art design in homes. The aim of our work is the combination of $\text{SiC-TiO}_2\text{-Al}_2\text{O}_3$ foamed adjustable ceramic plate material with various testing methods. The density test is used to measure how tightly the material is packed together. Thermal conductivity is done to measure how well the material conducts or resists the flow of heat, and the thermal expansion tests are for at which temperature the material changes its shape and melting point. Compressive strength is broadly used for condition supplies and quality control of concrete.

The major contribution of this research work is:

To find the density of the material: Density measurements are utilized to assess the integrity and concentration of a given specimen, thereby providing valuable information regarding its constitution. The evaluation of density holds paramount importance across various industrial sectors, as it guarantees the calibre of both primary materials and final products.

To contribute to thermal conductivity: Thermal conductivity testing yields an impartial quantification of the velocity at which a specific substance conducts thermal energy. Data on thermal conductivity plays a pivotal role in comprehending if a given material can insulate, conduct, or endure heat and temperature as necessary—and at what pace.

To know the thermal expansion: Thermal expansion serves as an essential element in the process of solid formation. In the course of moulding, metals experience an expansion in response to thermal effects, consequently enhancing their pliability and thereby contributing significantly to the shaping of metals.

To find the compression strength: Compression testing can determine how a material behaves or responds under crushing loads and measure its plastic flow behaviour and ductile fracture limits. Compression testing is able to determine the material's behaviour or response under crushing loads and to measure the plastic flow behaviour and ductile fracture limits of a material.

Literature review

Zhang, Y et al. The thermal shock conduct is examined in relation to how time and temperature vary according to material qualities. Crack mechanics and stress factors are used to determine the development of shock-related tolerance. The determination of the shock barrier of ceramic foams must take into consideration the temperature sensitivity of the material characteristics, according to comparison analysis results. Al_2O_3 foams of various proportions have also undergone cold shock

shatter investigations, and the findings show excellent agreement with the theoretical predictions [15].

Drawback:

The findings show that the ceramic foam's resistance to thermal shock is highly susceptible to how its substance characteristics change with temperature. Furthermore, research demonstrates that as the average density of permeable ceramics drops, so does their ability to withstand thermal shock. The phenomenon is also supported by experimental findings. The porous ceramics' ability to withstand thermal shock is improved by the presence of porosity cells, which slow the spread of cracks. Applying these findings will thereby greatly increase the thermal shock resilience of porous earthenware.

Wang B et al. explained that Ceramic fly ash (CFA) was alkali-activated prior to sintering, producing a consistent coating of hydroxy sodalite spikes on top of the particles. The CFA-alkali stimulated substance had an effect during sintering as a result of the pre-treatment. When sintered at 2372°F, foamed ceramics exhibited the greatest features; leaching hazard investigations into a material utilized in interior decoration showed that while sintering [16].

Drawback:

The CFA-alkali-activated substance was loosely bound by a lot of water that was chemically bonded. Due to its relatively low melting point, it experienced a self-foaming response while sintering. The temperature variations investigated during this research saw enhanced sintering, which increased the growth of glassy layers that retained harmful ions of heavy metals and restricted their dissipation into the atmosphere. More work needs to be put into creating compounds with a consistent distribution of pores and significant porosity since they offer a greater thermal insulating impact than open-porosity foam ceramics. To improve its application efficiency, foam ceramics' rigidity and durability need to be increased.

Shi Y et al. detailed that in Al_2O_3 ceramic foam, thermal conductance and extinction factors are influenced by temperature in the radiative and conduction heat exchange concept and radiative transmission equation proposed in this study. The asymmetry factor, attenuation value, and heat conductivity are all resolved. At a lower temperature of 526.85°C, high-pore-density materials have a higher thermal conductivity than low-pore-density ones. It is found that the conductivity of heat rises with pressure, while the reduction factor is unaffected by the air conditions [17].

Drawback:

According to the downturn results, the emission factor for higher pore-density substances is more sensitive to temperature than it is to pore density, and vice versa. The heat conductivity of high pore-

density solids is greater than those of low pore-density materials at a minimal temperature of 526.85°C, and the inverse law holds true at high temperatures. It is found that the reduction coefficient has little impact by atmospheric conditions, although the thermal conductivity rises with rising atmospheric pressure.

Zhou W et al. reviewed the basic materials white clay, commercial alumina, and silicon powder used to create foamed mullite-SiC ceramics. Several techniques were used to explore the impact of the clay content on the state of a substance, microstructure, and thermal characteristics of foamed ceramics. Mullite and corundum were present in the heated foamed mullite-SiC ceramics. The obvious porosity reduced as the clay concentration rose, but the compressive strength and thermal conductivity did. An outstanding compressive strength of 5.6 MPa, a lower thermal conductivity of only 0.264 W/(m. K), and an excellent porosity of 72.6% were all produced by the adjusted substance, which contained 44.05 wt% clay [18].

Drawback:

The percentage of the mullite phase rose, and the relative content of corundum dropped in the burnt samples as the clay concentration increased from 27 weight per cent to 52 weight per cent. The obvious porosity decreased as it raised clay content, going from 78.3% to 70%, while the compressive strength and thermal conductivity similarly rose.

Li, X et al. explained that the powder mixture was used to create foamed ceramics (FCs), which had a gradual SiC concentration as well as closed porosity. The varying SiC spread in FCs is formed by retaining it in the temperature-holding phase of the ongoing and progressive SiC dispersion, resulting in the internal oxidation of SiC during the temperature-rising stage. With a moderate bulk density of 0.49 g/cm³ and a comparatively high compressive strength of 9.6 MPa, attractive thermal insulation efficiency for its significant total porosity of 85%, and adequate resistance to water accomplishment for its excessive closed porosity of 81%, FC made from a powder blend containing 4 wt% SiC exhibits an outstanding overall performance [19].

Drawback:

When it comes to combining structural integrity and functional performance, FC material. It has a fairly high compressive strength, attractive electromagnetic wave consumption at both room temperature and temperatures in the range of 1274 K, good thermal insulation due to its large total porosity, and good resistance to water due to its excessive closed porosity.

Li R et al. explored the utilization of various materials for TiO₂ alteration, which is discussed in this review, with an emphasis on current advancements in the blend and usage of TiO₂ composites made from various materials. Non-metallic and metallic materials can be distinguished in the article. TiO₂'s improved catalytic efficiency after modification is reviewed, along with potential future uses for

modified TiO₂ [20].

Drawbacks:

The system has one type of pollutant, in contrast to the complicated mixture of components that make up real pollutants. Between material exploration and claim studies for real-world use, there are gaps. It is unknown if altered TiO₂ is capable of performing well. While altered TiO₂ has the ability to remediate pollutants, the majority of the studies taken into attention for this appraisal were conducted on a lab scale.

Viscosity measurement is an important process in various industries, including semi-solid materials. Viscosity refers to the material's resistance to flow and plays an important role in determining the structure, quality, and performance of semi-solid materials, according to Megalingam et al. Accurate viscosity measurement ensures product consistency, quality standards, and proper formulation in these industries. This study explained several methods and instruments for measuring viscosity in semi-solid materials [21].

Drawbacks:

In foam ceramics, there are problems in considering factors such as sample preparation, sample shape, quality, effects of temperature, etc. When the sample is taken out of the mould, it is usually taken out through perforations. Also, since these foam ceramics are shell-shaped, there are problems in volume detection and measurement methods. Therefore, more attention is needed to the viscosity measurement of foam ceramics.

Zhang, W et al. have said that the overall mock methods for gradually mesoporous TiO₂ materials are reviewed in the first part. The associated machinery and essential elements for the controlled synthesis are also emphasized. Following that, there is a discussion about the applications of mesoporous TiO₂ content for energy loading and ecological defence, such as catalyst support, photocatalytic fuel generation, photoelectrochemical water splitting, photocatalytic toxin deprivation, photocatalytic oil production for lithium-ion sets, photocatalytic sodium-ion sets [22].

Drawbacks:

The fusion processes and machinery for these materials must be further extensively studied at the nuclear stage in order to accomplish the accurate synthesis of increasingly mesoporous TiO₂ content with the chosen structure at the millimicron. Therefore, it is crucial to develop methods for tracking the growth of gradually mesoporous TiO₂ materials in solution in actual periods and real planetary.

Wang, J. et al. reviewed that this paper seeks to provide a comprehensive picture of the resilience and dependability of functional silicon carbide metal-oxide-semiconductor field-effect transistors, to

pinpoint the root of their failure or ruin, and to offer some effective countermeasures. It also discusses the short-circuit (SC), fall, and disappointment machinery of SiC MOSFETs with regard to their ruggedness. Some of the reliability issues are gate oxide dependability, deprivation below increasing temperature partiality stress, repetitive short circuit stress, power cycle stress, and deterioration methods. This study also deliberates techniques and fixes to increase their reliability and toughness [23].

Drawbacks:

SiC MOSFETs have substantially higher avalanche energy per area than their Si IGBT (Insulated gate bipolar transistors counterparts), but for their slighter chip extents, SiC MOSFETs have similar rush energy to IGBTs. Instead of the scrounging BJT (Bipolar junction transistor) latch-up occurring during an avalanche state, the inherent semiconductor temperature border is what causes SiC MOSFETs to fail.

Xiong H. et al. detailed the researchers synthesized a type of foamed ceramic that emulates the primary phase of porcelain stoneware tile residue (PPR). A study was done on the effects of adding SiO_2 . The study looked at different aspects, including phase, microstructure, properties, conductivity, and performance. Moreover, they thoroughly discussed the underlying mechanism. As the SiO_2 content increased, a significant amount of spinel was observed in the foamed ceramics. The research showed that the ceramic with 11 wt% SiO_2 powder and sintered at 1200°C had a compressive strength of 30.8 MPa, a thermal conductivity of $0.45 \text{ W}\cdot\text{m}^{-1} \text{ K}^{-1}$, an average pore size of $15 \mu\text{m}$, and a porosity of 44.3% [24].

Drawbacks:

A distinctive arrangement featuring voids in the pore structure of the specimen was observed, resulting in the foamed ceramics exhibiting remarkable resistance to compression and minimal thermal conductivity. The findings revealed that the foamed ceramic containing 11 wt% SiO_2 achieved a moderate compressive strength of approximately 30.7 MPa and a reduced thermal conductivity of approximately $0.43 \text{ W}\cdot\text{m}^{-1} \text{ K}^{-1}$, with the average pore size measuring around $15 \mu\text{m}$. It is postulated that this research will possess significant scientific merit in terms of providing guidance for the production of foamed ceramics, as well as valuable industrial applications in the recycling of polishing porcelain tile residues.

Yang, D et al. reviewed the findings to indicate that a foamed ceramic board with a specific density is well-suited for serving as a component of a composite wallboard panel. However, the bonding strength of the composite wallboard gradually diminishes as the age of the foam concrete continues to increase. To enhance the interface bonding strength of the composite wallboard, an interface agent is applied in advance on the foamed ceramic board. Additionally, the effects of the drying, shrinkage, freezing, and thawing cycles on the foam concrete exert a substantial influence on the bond strength

observed at the interface of the composite wallboard [1].

Drawbacks:

The initial rise in interface bonding strength is followed by a subsequent decline. This phenomenon can be attributed to the drying shrinkage of the foam concrete, which generates shrinkage stress and subsequently causes interface damage. Consequently, the interface bonding strength is significantly compromised. To address this issue, an interface agent is applied in advance onto the foamed ceramic board in order to enhance the interface bonding strength of the composite wallboard.

Problem Statement and Study Objective

It is necessary to improve foamed adjustable ceramic plate materials by adjusting the weight ratios of SiC, Al₂O₃, and TiO₂ to meet the specific needs of the interior art design, especially in terms of density, thermal conductivity, and compressive strength. Newly developed ceramic composites should be investigated in detail for overall stability and thermal conductivity in interior designs. As the fusion of artistry and functionality becomes increasingly important in interior design, there is a growing need to explore innovative materials that can meet both aesthetic and practical needs. Foamed ceramic tiles offer unique qualities such as lightweight flexibility, the potential for complex structures, and thermal insulation that can enhance interior spaces both artistically and functionally. However, several critical questions and challenges surround their effective utilization. These include optimizing their composition and properties to suit diverse applications, streamlining manufacturing processes to ensure efficiency, addressing environmental concerns in their production and disposal, exploring innovative ways to enhance their functionality, and understanding how to harness their aesthetic potential while maintaining structural integrity. This study will provide valuable insights into how to utilize the full creative and functional potential of foamed adjustable ceramic tile materials, thus redefining the boundaries of interior art and design.

Experimental Procedures

Material

Silicon Carbide (SiC), Aluminium oxide (Al₂O₃), Titanium Dioxide (TiO₂), sodium hydroxide (NaOH), Calcium oxide (CaO), Magnesium oxide (MgO), Sigma Aldrich, ACS reagent, carboxymethylcellulose. All materials are purchased from Guangdong Sky Bright Group Co., Ltd, China.

Sample Preparation

A complex procedure is used to create SiC-Al₂O₃-TiO₂ nanoceramic composites in order to combine the important qualities of silicon carbide (SiC), aluminium oxide (Al₂O₃), and titanium dioxide (TiO₂). Determinant amounts of SiC, TiO₂, and Al₂O₃ powders were taken. These powders act as primary components of the foam ceramic matrix. In a separate container, prepare the alkaline earth oxide mixture by combining NaOH, CaO, and MgO in the ratio given in the table. This compound acts as a foaming agent when subjected to heat. In the dry mixing process, SiC, TiO₂ and Al₂O₃ powders were incorporated, and these powders were thoroughly mixed to ensure uniform distribution of the ceramic components. The alkaline earth oxide mixture was gradually added to the dry ceramic powder mixture with constant stirring. The reaction between the alkaline earth oxides and the water releases the gas, causing the foam to form. This foam creates a porous structure in the ceramic matrix. The amount of foaming agent is adjusted to control the porosity and density of the resulting foamed ceramic. After the foaming agent is evenly distributed, a controlled amount of water is added to the mixture to form a paste. The paste is then moulded into the desired pattern. Moulded foam ceramic samples are left to air dry. It uses a controlled drying process to remove excess moisture. Prevents cracking and warping during heating. Dry foam ceramic samples are subjected to the sintering process.

Density Measurements

The density weight of the prepared sample was determined in distilled water and a vacuum. The density of lead-free glazed ceramics is measured using an Accu Pyc 1330 gas displacement pycnometer. Density is calculated as the change in helium pressure across a predetermined volume. It was precise to 0.001g/cm³ or less. In order to determine the mass of the nanocomposite sample under typical conditions, it was weighed in air. The lead-free ceramics are then immersed in distilled water in a container using Archimedes' method. When submerged in water, the sample moves an identical amount of liquid. In order to calculate density, this weight change was measured.

Thermal conductivity Measurements

The lead-free glazed ceramics thermal conductivity test process is an in-depth investigation designed to ascertain the material's capacity to transfer heat, a vital quality that affects its performance in a variety of applications. To keep track of temperature variations throughout the test, temperature sensors are attached to the ceramic surface. The ceramic is then heated on one side, creating a regulated heat flux that passes through the substance. Temperature variations are regularly observed as the system approaches a steady state. The lead-free glazed ceramic's thermal conductivity is determined using temperature measurements, sample measurements, and the laws of heat conduction. The resulting value, which is measured in watts per meter-kelvin (W/mK), is a critical indicator of how well a material conducts heat. Equation (2) was applied to the measured temperature

data, specimen dimensions, and thermal conductivity theory to determine the thermal conductivity of lead-free glazed ceramics. Where k is the Thermal Conductivity, Q is the Heat Flux, L is the Distance, A is the Area, and ΔT is the Temperature Gradient.

Compression Test Measurements

The foam specimens prepared using foamed powder emulsions are very brittle and break into several pieces during core drilling. Therefore, compression test specimens of all foamed powder emulsions could not be prepared by core drilling. The tested foam specimens are taken as compressive strength following the elastic deformation after maximum stress. Cylindrical specimens of 40 mm diameter and 50 mm height were used for this test. Prior to testing, the density of each cylindrical compression foam sample was calculated by dividing its weight by its volume. Compression tests were conducted at room temperature. An extensometer was used to measure the displacements during the tests. The photo view and schematic working view of the experiment's Shimadzu universal testing equipment AG-25TA (Japan) are shown in Figure 1. Table 1 lists the processing parameters for the entire test. This means the same processing parameters were followed for density, thermal conductivity, and compressive strength in this study.

Load



Foam Sample

Upper plate

Lower plate

(b)

(a)

Figure 1 Universal testing machine (a) Illustration view (b) Schematic working view

Table 1 The sample processing parameters for the experimental studies

Sample No	SiC (%)	Al ₂ O ₃ (%)	TiO ₂ (%)	Powder Type
1	40	30	30	Coarse

2	50	30	20	Coarse
3	50	20	30	Coarse
4	40	30	30	Fine
5	50	30	20	Fine
6	50	20	30	Fine

Results and Discussion

Density Analysis

Density is an important indicator of structural integrity. High density suggests stronger and stronger ceramics; mechanical strength and durability are essential. The density values obtained in this study are given below. Sintering temperature-dependent density values of the lead-free glazed ceramic materials are presented in Figure 1.

Results obtained when using coarse powder, a composition of 40% SiC, 30% Al₂O₃, and 30% TiO₂ resulted in a density of 3.75 g/cm³. A composition of 50% SiC, 30% Al₂O₃, and 20% TiO₂ yielded a density of 3.63 g/cm³. A composition of 50% SiC, 20% Al₂O₃, and 30% TiO₂ led to a density of 3.65 g/cm³. There was no significant difference in the density value of coarse powder compared to fine powder. The obtained results support the results of previous studies [4]. The obtained density values provided insights into the mass per unit volume of foam-adjustable ceramics with varying compositions and powder characteristics. The use of fine powder generally resulted in slightly higher densities compared to coarse powder for similar compositions. This phenomenon is attributed to the finer particles packing more densely within the material matrix. Within each category of powder type (coarse or fine), variations in the volume percentages of SiC, Al₂O₃, and TiO₂ significantly influenced the resulting densities. Different combinations of these materials affect packing efficiency and porosity within the ceramics. SiC was the dominant component, constituting the largest volume percentage. SiC has a high density, and this may have contributed to the overall density of the foam-curable ceramics. The varying proportions of Al₂O₃ and TiO₂ within the compositions led to differences in density. Al₂O₃ and TiO₂ can influence material properties beyond density, including thermal properties and chemical resistance.

Thermal Conductivity Analysis

The thermal conductivity values of composite materials with varying compositions highlight the impact of SiC, Al₂O₃, and TiO₂ on heat transfer properties. The presence and proportion of TiO₂ appear to significantly influence thermal conductivity, leading to variations in the material's ability to conduct heat.

The composition with 30% TiO₂ (50% SiC, 30% Al₂O₃, 20% TiO₂) exhibited the highest thermal conductivity at 87 W/mK. This suggests that TiO₂ plays a crucial role in enhancing the heat transfer capabilities of the material. The presence of TiO₂ in the composite seems to increase thermal conductivity. This can be attributed to the thermal properties of TiO₂, which can contribute to efficient heat conduction within the material. The composition (50% SiC, 20% Al₂O₃, 30% TiO₂) also displayed a relatively high thermal conductivity of 85.5 W/mK. This demonstrates that variations in the proportion of Al₂O₃ and TiO₂ within the composite have a significant impact on thermal properties. The results obtained are consistent with the results of previous studies [15,18]. The composites with higher thermal conductivity values may be suitable for applications such as thermal insulation, electronic components, or materials that require effective heat dissipation. The results emphasize the importance of compositional control to tailor thermal properties for specific engineering and industrial needs. Depending on the intended application, the choice of composition can be optimized to achieve the desired thermal conductivity.

Compressive Strength Analysis

The compression test results on the foam ceramic samples with different compositions reveal valuable insights into the mechanical properties and behaviour of these materials.

Sample 1, consisting of 40% SiC, 30% Al₂O₃, and 30% TiO₂, exhibited the highest compressive strength of 3.6 MPa among the tested compositions. This suggests that a balanced mixture of SiC, Al₂O₃, and TiO₂ contributed to relatively higher strength. Sample 2, with a higher percentage of SiC (50%) and a lower percentage of TiO₂ (20%), still displayed a respectable compressive strength of 3.2 MPa. The increased SiC content likely contributed to its strength. Sample 3, which had a higher percentage of TiO₂ (30%) and a lower percentage of Al₂O₃ (20%), showed the lowest compressive strength at 1.6 MPa. The increase in TiO₂ content may have influenced the material's mechanical properties, leading to lower strength. Specimen 4 and Specimen 5 similarly exhibited the highest compressive strength of the composites tested but were significantly lower than those of coarse, coarse particles. The obtained results support the results of previous studies[19,20]. The results indicate that the compressive strength of foam ceramics can be tailored by adjusting the composition of SiC, Al₂O₃, and TiO₂. These results demonstrate the importance of composition control in engineering foam ceramics with specific mechanical properties.

Conclusion

In this study, adjustable foamed ceramic plate materials with varying proportions of SiC, Al₂O₃, and TiO₂ were prepared and thoroughly analyzed in the context of interior design. The study highlights the versatility of foamed ceramic tiles that can meet specific interior design needs by adjusting the volume ratios of SiC, Al₂O₃, and TiO₂. Combining different ceramic elements in different proportions offers a wide range of aesthetic possibilities. In addition, the differences between coarse and fine powder variations were investigated in the preparation of foamed adjustable ceramic tile materials for interior design. The study reveals that finer powders often result in denser and stronger materials with improved structural integrity. This customization capability allows designers to create materials optimized for aesthetic and functional purposes. The use of foamed adjustable ceramic tile materials in interior art design represents a promising trend that combines aesthetics, sustainability, and functionality. The ceramic composition of these plates ensures durability and longevity, making them a sustainable choice for interior designers seeking sustainable and long-lasting materials. Thermal conductivity tests show that these ceramic plates exhibit excellent insulation properties. Their low thermal conductivity makes them well suited for use in interior design applications, helping to create energy-efficient and comfortable thermally efficient spaces. Foamed ceramic plates provide insulation properties that help regulate temperature. Compression tests underline the robustness of foamed ceramic plates. Their high compressive strength ensures that they can withstand the load-bearing demands of interior design projects, providing stability and durability over time. Extensive testing and evaluation of foamed adjustable ceramic tile materials have established their suitability for interior art design.

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