

EXPLORING CEMENT-BASED COMPOSITES: INNOVATIVE APPLICATIONS IN VISUAL ARTS EDUCATION

Penerokaan Komposit Berasaskan Simen: Aplikasi Inovatif dalam Pendidikan Seni Visual

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ABSTRACT

This article explores the application of cement-based composites as an innovative crafting medium in pottery, 3D wall hangings, sculptures, and relief murals. This problem-solving visual arts pedagogy serves to provide insights to teachers and students on viewing cement-based composites as an alternative to clay and concrete. This new knowledge aims to inform innovative approaches to the role of the visual arts education. Cement-based composites involving the use of recycled paper, sawdust and Styrofoam, offer a platform for artistic expression and sustainability in the crafting realm. The article discusses the material composition, properties, crafting techniques, and artistic possibilities inherent in cement-based composites across each application. In the light of encouraging sustainable and eco-friendly projects, papercrete has been found to be a versatile and transformative crafting medium for various projects. This study has also uncovered an implicit interconnectivity between innovation and creativity, art practices and meaningful learning in classroom.

Keyword: cement-based composites, pottery, wall hanging, sculpture, relief mural

ABSTRAK

Artikel ini meneroka penggunaan komposit berasaskan simen sebagai medium kraf inovatif dalam penghasilan tembikar, hiasan dinding 3D, arca, dan mural relief. Pedagogi seni visual penyelesaian masalah ini berfungsi untuk memberikan pandangan kepada guru dan pelajar mengenai komposit berasaskan simen sebagai alternatif kepada tanah liat dan konkrit. Pengetahuan baru ini bertujuan untuk memaklumkan pendekatan inovatif kepada peranan pendidikan seni visual. Komposit berasaskan simen yang melibatkan penggunaan kertas kitar semula, habuk papan dan Styrofoam, menawarkan platform untuk ekspresi artistik dan kelestarian dalam alam kraf. Artikel ini membincangkan komposisi bahan, sifat, teknik kraf, dan kemungkinan artistik yang wujud dalam komposit berasaskan simen di setiap aplikasi. Memandangkan menggalakkan projek-projek yang mampan dan mesra alam, papercrete didapati sebagai medium kraf serba boleh dan transformatif untuk pelbagai projek. Kajian ini juga telah mendedahkan kesalinghubungan tersirat antara inovasi dan kreativiti, amalan seni dan pembelajaran bermakna di dalam bilik darjah.

Kata kunci: komposit berasaskan simen, tembikar, hiasan dinding, arca, relief mural

INTRODUCTION

This article proposes the use of cement-based composites as a novel creative medium in different artistic fields such as pottery, wall hanging, sculpture and relief mural. The reason for their use over traditional materials is because they improve the properties of their base materials and are applicable in many situations. The utilization of cement-based composites as a crafting medium has emerged as a compelling avenue for artistic expression, combining durability, moldability, and structural integrity across diverse applications. Traditionally reserved for construction, these composites, when applied innovatively, redefine the boundaries of creative expression in pottery, 3D wall hangings, sculptures, and relief murals. In pottery, artists can create unconventional forms and textures by experimenting with various ratios of cement to aggregates. Cement's durability allows for functional pieces that can endure outdoor elements and indoor display. For 3D wall hangings and sculptures, the material offers flexibility in design possibilities and intricate detailing not easily achievable with traditional materials. Cement-based composites also present an opportunity for crafting large-scale relief murals with detailed designs suitable for both interior and exterior applications due to its weather-resistant nature. This article will highlight and advocate the use of cement-based composites as a crafting medium in Visual Arts Education, while exploring the use of alternative materials such as papercrete, styrocrete, wood cement and concrete to expand their creativity across multiple disciplines.

BACKGROUND STUDY

Natural fibers and industrial and agricultural wastes, with their renewable and sustainable nature, are increasingly applied in construction to produce light weight concrete (Sandanayake,, Bouras, Haigh, & Vrcelj, 2020). It is also recognized by its low production cost, less health hazards, and accessible processing (Sheth, & Joshi, 2018).

This section will discuss the various cement-based composites which could be used as a crafting medium in the education sector. The selection of the composites is determined by their availability, sustainable quality and safety during usage. The suggested composites are papercrete, woodcrete or wood cement, styrocrete and concrete.

Cement-based composites are versatile materials used in various applications, including crafting. These composites are made by blending cement with other materials to enhance specific properties like strength, durability and workability, Sandanayake, et al., 2020). When used in crafting, they offer unique opportunities due to their mouldability and strength. The commonly used composites are concrete and papercrete. Styrocre and woodcrete are also gaining popularity as sustainable and eco-friendly crafting mediums.

Papercrete is a fascinating crafting medium that combines paper pulp with cement, creating a lightweight, versatile material. It is known for its eco-friendliness, as it utilizes recycled paper and requires less cement compared to traditional concrete (Cardinale, T. et al.,2021). Papercrete was rediscovered in the 1980s, independently by Eric Patterson and Mike McCain (they called it respectively “padobe” and “fibrous cement”). It is recognized as an environment-friendly material due to its significant recycled content (Shemale & Varma, 2005). There are numerous researches on papercrete as a sustainable building material (Zaki, Gorgis & Salih, 2018). The process of producing papercrete includes soaking waste paper in water overnight so that the fibers are softened and blending the soaked paper until a homogeneous pulp is obtained. Then Portland cement, sand

and water are added to the pulp and blended. Papercrete motivates recycling of waste paper, especially in communities with no recycling services. It saves landfill space and keeps paper processing and printing chemicals out of the water table.

Styrofoam or polysterene foam is a material formed from polysterene by blowing air on polysterene in a hot condition so as to produce a foam with an air content of up to 95% so that the unit weight of styrofoam is quite low ranging from 15-22 kg / m³ (Rahmi, Rinaldy & Shahrizal, 2018). In making light-weight concrete, one of the additional alternative materials used is Styrofoam. Styrofoam concrete or styrocon or styrocrete is one of the lightweight concrete formed by using light-weight materials in the form of styrofoam granules. Styrofoam added to the concrete mixture can be considered an air cavity. (Rahmi Karolina, 2019). Sawdust, collected from grinding, cutting, or pulverizing of hard and soft woods is an example of natural fiber. Sawdust has been used with concrete, but not widely, as fine aggregate in casting floors, roofs and walls for more than 50 years (El-Nadoury, 2021). Recently, several researchers investigated the applicability of using wood waste in concrete mixtures. However, these were related mainly to the building industry and its discussion is beyond the scope of this study. Concrete is a composite material (mixture) of several materials, whose main material consists of a mixture of cement, fine aggregates, coarse aggregates, water and or without other added ingredients with certain comparisons.

One of the most compelling aspects of cement-based composites in crafting is their environmental benefits. These materials often utilize recycled components or can be repurposed after use, aligning with sustainable practices. Additionally, their durability the need for frequent replacements, contributing to an eco-friendly approach in crafting.

MATERIALS

PAPERCRETE – is made by mixing recycled paper pulp with cement and water. Some variations might include additional aggregates such as sand, clay, or PVA glue for added strength. Superplasticizers like wall compounds and ball clay may be added to make the composite more malleable. The ratio of the materials will depend primarily on the type of project that is to be undertaken. Ratios vary depending on the desired consistency and strength. Commonly, the mixture comprises about 60-80% paper pulp and 20-40% cement by weight. In relation to properties, papercrete when dry is hard, durable, light, does not require firing and can be painted. It is also waterproof, and has a rough surface when hardened. The surface texture largely depends on the type of paper used. Egg trays and packaging boxes produce rough or course looking surfaces while recycled office paper, mahjong paper and tissue paper provide a smoother surface. Generally, newspaper composites fall between the above two.

STYROCRETE – is made by mixing Styrofoam granules or beads to cement and water. For added strength, sand and PVA glue is added. Again, the ratio of the materials will depend primarily on the type of project that is to be undertaken. For crafting purposes, a ratio of 20-30% Styrofoam granules 70- 80% cement is ideal. Styrocrete artefacts when dry, are lighter when compared to artefacts made from other composites. The surface texture of the hardened styrocrete largely depends on the ratio of styrofoam beads to cement used.

WOODCRETE/WOOD CEMENT - is made by mixing sawdust or wood pulp with cement and water. Fine sand may be added for a stronger and heavier composite. The texture of the mixture will vary according to the size of the saw dust. Fine sawdust will produce a delicate composite as

compared to bigger particles of sawdust or wood shavings. The ratio of 1:1 sawdust and cement is recommended for smaller artefacts. Woodcrete artefacts are lightweight, durable and strong.

CONCRETE – for crafting is made by mixing cement with fine or coarse sand and water. The consistency of the mixture will depend on the amount of water and also the project requirement. Of all the composites described above, concrete is the strongest, heaviest and most durable of the said composites. It is also water and fire resistant.

METHODS

Crafting Techniques and Applications

A. Pottery

In the absence of clay, cement-based composites are excellent alternative materials for pottery. A variety of pottery techniques is possible with these composites. A slightly slurry form of the composite is required for casting or moulding technique. The slab and pinching methods require a much stiffer composite which will be able to hold its form. This can be achieved by reducing the amount of water in the paper pulp. However, it should be noted that the pinching and slab method cannot be used with styrocrete as the composite is unable to hold its shape. Beginners are encouraged to use the moulding technique as the process is relatively simple. The following steps will enable the production of a planter: (i) select and prepare a cement-based composite according to the ratio suggested (ii) then, a selected outer mould which is greased on the inside is then three quarters filled with the composite mixture. (iii) a smaller counter mould which is greased on the outside is filled with sand or small stones. (iv) this is then pressed it into the center of the outer mould in order to create a cavity. During this process, the composite will rise at the sides. (v) tap the mould gently to remove air bubbles present in the composite. (vi) leave to set in a cool dry place covered with a plastic bag for 4 -5 days. (vii) to un mould remove sand or stones, loosen sides and remove counter mould. Then gently turn over and press center of the bottom of outer mould to remove artefact.

When using stiffer consistencies the following technique may be used: (i) prepare a composite mixture to dough-like consistency (ii) line a mould of your choice with a plastic (iii) press small amounts of mixture into the mould (iv) press composite firmly to ensure uniformity in the thickness of wall (v) neaten edges of mould and place in plastic bag (vi) allow to set in a cool dry place for 4-5 days (vii) when set, remove from mould and slowly peel away the plastic sheet. (viii) turn the artefact over and allow to dry. The plastic sheet will have created an interesting texture on the external surface of the artefact.

Once the artefact is dry the next steps would be curing the artefacts. Immerse it in a container of water for 2-3 days. Then, wipe it with a cloth and let to dry. Once dry, the next steps will be to colour, texture and finish. There are two ways of colouring the artifact. One way is with pigments, dyes or acrylic paints which can be added to the mix to achieve different colours. However, the original colour of the composite will determine the colour of the end product. It is recommended white cement and recycled white paper/Styrofoam beads/lighter coloured sawdust be used during the mixing of the composite if lighter colours are to be used. If that is not possible, paint the artefact white. Allow to dry thoroughly then paint with required colour. Acrylic paints, spray paints, emulsion paints or enamel paints may be applied once the item is dry. Other than painting, another technique of colouring, marbling, is also possible with concrete artefacts with smooth surfaces.

Texturing refers to creating impressions, textures or patterns using tools or embedding materials like stones, glass or shells into the surface. In order to do this, remove the artefact from the mould before the cement dries completely. Alternatively, the embellishments may be glued on after the artefact is dry. Styrocrete artefacts on the other hand do not require embellishing. Melting away some of the surface Styrofoam beads with thinner in itself creates exceptional textures. Finishing refers to enhancing the appearance and durability of the artefact. This may be achieved by sanding, polishing or sealing the finished product. The process of sanding requires that the artefact be immersed in a basin of water while sanding.

Currently, the trend is to produce cement composite planters, bowls as well as other creative artefacts. In addition to the traditional method of casting and slab, the inflated balloon technique is gaining popularity. This is an easy way to introduce pottery making to beginners using cement-based composites. Pottery crafted from cement-based composites showcases a unique blend of strength and artistry. It allows a crafter to create vessels, pots and decorative items that boasts both functionality and aesthetic appeal. The versatility of these composites enables these crafters to experiment with textures, finishes and colours, resulting in distinct and personalized pieces. Below are some samples of cement-based composite pottery.



Figure 1: Papercrete



Figure 2: Concrete



Figure 3: Styrocrete

Source: Author



Figure 4: Papercrete
Technique: Embellishing



Figure 5: Concrete
Technique: marbling



Figure 6: Papercrete
Technique: painting

Source: Author

B. Wall Hanging

When it comes to creating 3-D wall hangings, cement-based composites offer an unparalleled opportunity for artists to push the boundaries of design. Their ability to hold intricate details and structural integrity allows for creation of captivating and unconventional art pieces that stand out in any place. The durability of these composites ensures the longevity of such wall hangings, making them a lasting addition to both indoor and outdoor environments. It is highly recommended that papercrete be used for small pieces. However other composites may be used depending on the intended artistic expression.

The materials required are a piece of plywood (the size of the intended wall hanging), a quantity of papercrete, PVA glue acrylic paints and clear varnish. The following steps will enable a crafter to produce a simple wall hanging using papercrete; (i) select a piece of plywood, (ii) draw the design on the plywood, (iii) next apply a thin layer of PVA glue to a small section of the design, (iv) apply papercrete to the design, a thin layer at a time, (v) add layers of papercrete to achieve the required thickness and effect. (vi) a thin layer may be applied to the background if necessary, (vii) when complete, leave to dry. (viii) when completely dry, paint with acrylic or mural paint. Finish off with 2 or 3 coats of varnish.

Papercrete when dry will develop a textured surface. Therefore, if a smooth surface is required, apply a thin layer of cement paste or plaster of Paris to even out the roughness. Use a fine grade sand paper to smoothen out the surface. When using styrocrete, interesting textures can be created by dissolving the styrofoam parts with thinner using a cotton bud. Below are samples of wall hangings made with papercret.



Figure 4: papercrete
Technique: Embellishing

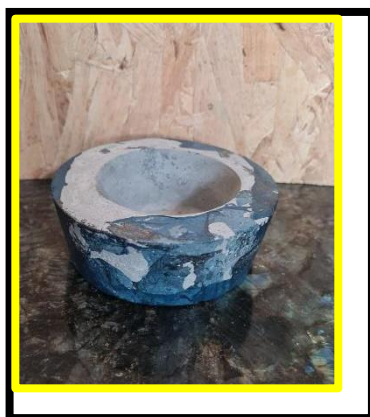


Figure 5: Concrete
Technique: marbling



Figure 6: Papercrete
Technique: painting

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Figure 7: Wall Hangings,
Medium: Papercrete

*Source: SPM Paper 3, Title: 'Hiasan Dinding' 2019.
SMK Assunta, Petaling Jaya, Selangor.*

Sculpture

As discussed previously, cement-based composites make excellent medium for sculptures. Sculpture is a three-dimensional visual art form. It can be created by carving, modelling, welding, or otherwise shaping materials such as stone, wood, clay, metal, or other materials. Sculptures can take various forms and sizes and serve different functions. Sculptors use a variety of techniques and methods to manipulate materials, expressing their artistic vision through the creation of tangible, often tactile, and spatial works of art. This section will discuss the use of papercrete and

woodcrete in making simple sculptures. Any one of them will work well. Sculptures using other materials is beyond the scope of this article.

Firstly, it is necessary to get the idea of the sculpture i.e. the design, on paper. Drawing the intended sculpture from a few angles, will provide a clearer picture of how the sculpture will look like. The techniques of sculpting using cement-based composites will be discussed below.

Sculpting Techniques Using Composite Materials

A. Modelling

(i) Firstly, prepare the amount of composite that is required. (ii) Next, create the form of the sculpture with crumpled paper. (iii) Then, secure the shape with string or very thin wire. (iv) Once this is done, wrap the entire form with cling wrap or use strips from a plastic bag and secure with tape. (v) it is important to ensure the form is stable and sits well on the table. (vi) The next step is to make the form stronger. Use a thin wire mesh to cover the entire form. (vii) Now apply the composite on the surface of the form a little at a time, layer by layer. Ensure that each layer is well-packed and that there is no air pockets (viii) Once this is done, while the composite is still wet, sculpt and carve to form shape, texture and the finer details. Use simple sculpting tools. (ix) Allow to dry. This will take a few days depending on the thickness of the composite and size of the sculpture. (x) When dry, seal with concrete sealer or apply waterproofing agent. (xi) Allow to dry. Paint with acrylic or mural paint and spray with a few coats of clear spray. Alternatively, if the natural effect is required, spray with clear varnish only. And allow to dry.



Figure 8: Papercrete sculpture
Technique: modelling
Source: Barbmaker



Figure 9: Papercrete sculpture
Technique: modelling
Source: Kimberly Duran



Figure 10: Papercrete sculpture
Technique: moulding
Source: Kimberly Duran



Figure 11: Papercrete sculpture
Technique: moulding
Source: Kimberly Duran

B. Carving

Carving sculptures from papercrete blocks involves working with a material that is relatively lightweight and versatile. The step by step instructions on how to carve sculptures from these composite blocks are provided below.

Materials:

(i) papercrete block, (ii) Carving tools (sculpting knives, chisels, rasps) (iii) Protective gear (gloves, safety glasses, mask) (iii) plastic sheet, (v) sandpaper, sealant and paint for finishing.

Process:

- i. Prepare papercrete blocks: Mix an amount of papercrete and set in a mould to form a block. Allow to dry completely or almost dry. If preference is to work with damp block, cover unused part with damp cloth.
- ii. Design the sculpture:
Sketch or plan the design of the sculpture on paper or draw directly on the block. This will serve as a guide while carving.
- (iii) Gradually shape and remove material from the papercrete block using the carving tools. Use broad strokes to get the general form of the sculpture. Then experiment with different tools to achieve various textures and details in your sculpture.
- (iv) if you require a smoother finish, use a sandpaper. Allow to dry completely.
- (v) Apply sealant and a few coats of varnish. Painting is also an option to add colour and enhance the visual appeal of the sculpture. The carving technique was used to produce the sculptures below.



Figure 12: Papercrete blocks



Figure 13: Papercrete sculpture

Technique: Carving



Figure 14: Papercrete sculpture

Technique: Carving

Source: Kimberly Duran

C. Reliefs/Murals

Normally reliefs are done with concrete but it is also possible to create reliefs with the use of papercrete and other cement composites. It is almost similar to the production of wall hangings. However, there are a few things that need to be taken into account before beginning. Firstly, for beginners, select a small wall or a small portion of a wall. Walls are vertical, therefore, work with thin layers. Apply one layer at a time achieve the intended thickness. Allow the layer to dry slightly, before applying the next layer. This is to avoid slumping of the papercrete to the bottom of the wall.

Materials:

(i) select a suitable wall/area of a wall. (ii) Carving tools (sculpting knives, wooden spatula etc.) (iii) Protective gear (gloves, safety glasses, mask) (iii) plastic sheet, (v) sealant and paint for finishing.

Process:

(i) select and draw on paper, a suitable design for the wall. Duplicate the design and select the colour scheme that is going to be used. Prepare two or three colour schemes for selection

(ii) prepare the amount of papercrete required for the area of work. It should be fairly stiff. Next, prepare a thick papercrete slurry with papercrete, PVA glue and water to be used when layering.

(iii) Transfer the design on to the wall.

This can be done by several techniques. If the area is relatively small, the design may be drawn on a piece of paper as large as the area and transferred by using carbon paper. For those with expertise, may project the image on to the wall and trace the image. In larger areas, enlarging using corresponding squares on paper and wall, will provide an almost identical design. On the other hand, if using free hand technique, step back now and again to check the accuracy of the drawing.

(iv) prepare the tools necessary for work.

(v) Line the floor area with plastic or cloth to collect the drips.

(vi) wear protective gear; mask, gloves, apron, shower cap, shoe protector.

(vii) apply bonding adhesive to a small area of the design. Next apply a layer of papercrete. Move over to the area beside and continue; apply the adhesive then the papercrete. Apply papercrete to areas which are to be worked on that day. When partially dried, spread a small amount of slurry and add the next layer. The slurry acts as the bonding agent between the layers. Its best to work with two layers at a time, allowing time for drying in between. Remember the wall is vertical and the weight of a very thick layer will make the papercrete slump to the floor. When completed for

the day, secure a piece of plastic on the wall over the relief with tape, to prevent it from drying too quickly. Resume work by spraying a bit of water on surface before continuing. Layers may be added as long as each layer is partially dried before the next is added on. When the relief is completed, cover with plastic and leave to dry slowly. This may take about a week or more depending on the size and thickness of the relief.

(viii) when completely dry, protect the relief with two or three coats of waterproof sealant.

(ix) when dry, paint or leave in natural state. Spray with two or three coats of clear varnish.

Papercrete reliefs are suitable for indoors and outdoors. However, avoid working on walls that are constantly exposed to rain or hot sun. Papercrete reliefs can be worked upon by a small group of people each working on their individual area. It encourages communication, critical appreciation of another's work and team building.

CONCLUSION

Crafting pottery, wall hangings, sculptures and wall reliefs offer a unique avenue for artistic expression, allowing individuals to explore their creativity through various materials and techniques. While traditional mediums like clay, wood and cement have long been favoured for these crafts, the utilization of alternative materials such as papercrete, woodcrete, and styrocrete presents exciting opportunities for innovation and sustainability. The versatility of papercrete, allows for intricate detailing and sculptural forms, while its eco-friendly nature aligns with contemporary concerns for environmental conservation. Woodcrete, on the other hand offers a natural aesthetic with the structural integrity of traditional concrete. Its malleability when wet allows for carving intricate designs and textures, making it an ideal choice for both functional pottery and decorative wall pieces. Styrocrete is suitable for crafting wall hangings and reliefs. Its ability expands the possibilities for artistic expression while promoting sustainability through the repurposing of waste materials. By embracing these alternative materials in crafting pottery, wall hangings, sculptures and wall reliefs, crafters can push the boundaries of their creativity while contributing to a more sustainable future. Whether exploring the tactile qualities of papercrete, the organic beauty of woodcrete, or the innovative potential of styrocrete, the possibilities for artistic expression is endless, inviting individuals to experiment, innovate, and create with newfound materials and techniques.

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