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Cost-Effective and Eco-Friendly Sculptural Materials from Recyclable Waste Materials for the Teaching and Learning of Sculpture in Ghana

Juliana Asare[1], Dickson Adom[1], Joe Adu-Agyem[1], Lord Sam Ofori Addo-Danquah[2]

1 Kwame Nkrumah University of Science and Technology
2 Kibi Presbyterian College of Education

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Abstract

The global search for more eco-friendly, cost-effective and alternative sculpture materials to be used in the deployment of teaching and learning has been pursued by scholars in sculpture lately. This has been driven by the need to find alternative sculpture materials in the local environment of students, especially waste materials to replace the expensive conventional sculpture materials that cannot be purchased by majority of the students at the Senior School level in Ghana. Therefore, the purpose of this study was to experiment with various recyclable environmental waste materials such as styrofoam food containers, teak leaves and water sachets to find out if they could be potential cast materials for use during practical lessons in sculpture. The inquiry was carried out using the studio-based research design under the qualitative research methods. The material choice, binders used, recycling procedural steps and their casting processes. Moreover, the strengths and weaknesses in each of the recyclable waste materials as cast materials in comparison with the conventional sculpture materials such as Plaster of Paris, Cement, and resin were detailed. The results showed that aside from the cost-effectiveness and eco-friendly nature of the recyclable waste materials, they possessed significant properties similar to the conventional materials such as hardness, tensile strength, and natural textural qualities. The study contends that sculpture teachers must assist their students to be innovative in exploring the local waste materials as potential materials to be used for sculptural production for their sculpture practical lessons.

Juliana Asare[1], **Dickson Adom**[1*], **Joe Adu-Agyem**[1], **Lord Sam Ofori Addo-Danquah**[1]

[1] *Department of Educational Innovations in Science and Technology, Kwame Nkrumah University of Science and Technology, Ghana*

[*]**Corresponding author:** adomdick2@gmail.com, dickson.adom@knust.edu.gh

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Introduction

Sculpture is one of the subjects studied by Visual Art students in most of the Senior High Schools across the world. Sculpture has previously been considered purely decorative and now taken on a stronger significance as the representation of the gods in temples, various homes and other essential places with different types of traditional materials (Luo, 2017). Sculpture piece was mostly produced in stones (such as marble, limestone, granite, porphyry etc), metals (such as Bronze which was commonly used), wood (such as oak, ebony, mahogany, cedar etc.), clay (such as terracotta, primary and the secondary clay etc.), ivory which includes any animal tooth or tusk, and many other materials. These materials used in sculpting are now diverse, and changing throughout history, which has influenced most sculptors to produce works that are as permanent as possible, working in durable and frequently expensive materials. Early sculptors had minimal tools and materials but created majestic and gigantic sculptures that are still in great form and condition up to the present times. There are no limitations to the materials that can be used in sculpture, ranging from gold and silver to soap and butter in this 21st-century art era. It extend its branches to different range of activities involving new kinds of techniques and materials. These include the exploration of different types of techniques such as construction, gluing, sewing, bolting, and stamping. This has enlightened artists of today on the need to explore the use of different types of recyclable and non-recyclable materials in their environment. The art of sculpture can no longer be identified with any specific material or technique. Innovations with material choice, especially waste materials as possible artistic materials should be a creative step for artists (Adom et al., 2023). Some scholars in the field of sculpture in the Ghanaian context have pursued innovative ways of transforming waste materials into sculptural materials. Amissah et. al. (2022) successfully recycled palm kernel as an alternative sculptural material for the costly conventional materials and to ensure environmental sustainability. This study follows the drivers of Amissah et al. (2022) study which is based on the search for alternative and cost effective sculptural materials from environmental waste materials for regular practical lessons in Sculpture at the Senior High School level. The researchers of this study experimented with the possibility of obtaining a cost-effective and alternative sculptural material from styrofoam food containers, teak leaves, and water sachet plastics for students studying sculpture in the Kwabre East district of Ghana.

Recycled Art

Recycled Art is a term used to describe creative artistic expressions made from discarded materials or objects that had served their original purpose (Asamoah, Adom & Kquofi, 2022). It involves repurposing and transforming waste or unwanted items into something aesthetically pleasing or meaningful from a wide range of mediums and techniques, including sculpture, collage, painting, and assemblage (Garnet, 2014). This approach to art-making is often used to raise awareness about environmental issues and to promote sustainable living (Yulianto, Yuliastuti & Sulistyo, 2017). Recycling helps artists to transform discarded materials into useful and functional products. It offers creative solutions for waste problems in organizations and communities (Yulianto & Sulistyo, 2019). Recycled art is creative work made from discarded materials that once had another purpose, and it includes anything from old plastic toys and vehicle tires to scraps of cloth and building supplies. The process for recycled art is sometimes also referred to as “creative reuse”, junk

art, etc. (Asamoah, Adom & Kquofi, 2022). Recycled artists essentially transform waste into art, creating unique and affordable products that are both creative and sustainable (New Mexico Recycling Coalition, 2015). The primary purpose of recycled art is to promote environmental awareness and encourage sustainable practices by demonstrating the potential beauty and value of materials that might otherwise be considered waste (Song, 2017).

Recycling offers a myriad of benefits including ensuring environmental sustainability and aesthetics. It aids in reducing and/or eradicating waste in the environment while promoting the ideals of sustainability through the giving on new life and purpose to discarded materials that would have been environmental nuisance (Yulianto, Yuliastuti & Sulistyo, 2017). Products from recycling of waste materials are often used in environmental sustainability awareness campaigns (Asamoah et al., 2022) and they do encourage people to ponder over their consumption behaviour and its negative implications on the environment (Adom et al., 2023). It incites members in the society to be environmental stewards (Song, 2017). Recycled art has been practiced by a lot of artists in diverse ways. Robert Bradford who creates life-sizes and above life-size sculptures of human and animals from waste or discard plastic items which includes toys, and colourful plastic bits and pieces (combs and buttons, brushes, and parts of clothes pegs) (Kothari, 2022). Some of Robert's sculpture piece contains piece of 3000 toys, saving them ending up in landfill (Kothari, 2022). Whereas, Aesthetica Magazine (2009) mentions Ramuald Hazoume as one of the famous recycled artists in Benin who produce his artworks with recycled jerry cans that have histories and are used for carrying gasoline accurately for creating masks and more significant artworks. Recycling of waste materials can be done by employing production techniques such as modelling, stitching, gluing, casting, carving, painting, assembling, and construction.

Methods

The study was pivoted in the qualitative research approach. It followed the rudiments in the descriptive and exploratory research strategies in the arts-based research design. Marshall's (2010) Double Helix of Praxis-Exergesis Model that consisted of exploration, production, and evaluation. The study explored various waste materials in the Kwabre East district of Ghana that could be recycled as raw materials for sculpture production. The exploration assisted in the manipulation of the identified recyclable waste materials and to compare it to the already existing to know the differences and similarities. The identified techniques were used to produce cast works instead of the conventional casting materials which are relatively expensive and not readily available such as Plaster of Paris, Resin, silicone, and cement. The practice used for the production of cast works were selection of materials, sculpting of models, and picking of moulds and casting of the final piece.

Selection of Materials

The discarded recyclable waste materials were selected from the environments of Kwabre East district. These materials include styrofoam food containers, teak dry leaves, and water sachet plastics.

Styrofoam Food Containers

Styrofoam food containers which is popularly known by Ghanaians as the takeaway bowls. These bowls are produced from an Expanded Polystyrene (EPS) which is a rigid and tough, closed-cell foam with an average density range of 11 to 32 kg/m3. These foam food containers are produced by injecting the EPS into a mould to give out a desirable shape and they are mostly used in packaging foods for buyers or visitors on various occasions. The waste foam food packs are regularly located at an entertainment site, gutters, refuse dumps and within the localities in the Kwabre East District but were mostly gathered from an entertainment site by the researchers, the Artist and other members who were willing to help in the study.

Teak Dry Leaves

Teak dry leaves as the name suggest are obtained from teak tree and are often brown or dark brown in colour then mostly found within our environment which makes its locality messy, especially during the dry seasons.

Water Sachet Plastics

This type of material is one of the cheapest and the most typical materials used by Ghanaians in our day to day activities. It is produced from high-density polyethylene (HDPE), which is often referred to as type two plastic and it is a non-biodegradable material. Water sachet plastics have become one of the most significant ways of packaging stuffs over the past several decades due to its favourable strength and existing properties as well as its relatively easy recyclability over other types of materials. The water sachet plastics used for the study were gathered by the researchers from house to house and from the immediate environment.

Sculpting and Picking of Moulds of Models

Four models depicting a torso of a pregnant woman was produced in three-dimensional. The production process adopted the additive and subtractive methods where clay was added and subtracted to achieve the desired shape. The size of the final model is 5 inches in height. Moulds were picked in silicon and plaster of Paris and was left for sometime before separating the moulds which came out well with less casualties.

Figure 1. Final models of torso in clay

Figure 2. Moulds of the models in silicon and reinforced with POP

Figure 3. Final mould of the pregnant torso models

Figure 4. Separated version of all the four pregnant torso moulds

Casting Process

The designed models were cast with the identified recyclable materials in different sections. Below are the casting processes used for production.

Styrofoam food container (SFC)

This category of recyclable waste material adopted the melting technique produced with the use of petrol. The SFCs were cut into pieces in a plastic container in which the petrol (dissolving agent) was poured. It was then pressed and stirred for some time until the entire cut SFCs dissolved (see Figure 2). The dissolved SFCs was mixed with sand and pressed into the designed mould bit by bit until a desirable amount and form was achieved.

Figure 5. Pieces of cut Styrofoam Food Containers

Figure 6. Melting process of the STCs

Figure 7. Complete melted version

Figure 8. A mixture of SFCs and sawdust

Figure 9. Filling of the mould with the mixture of SFCs and sawdust

Teak leaves (dried)

The type of leave used was explicitly from the teak tree. These leaves were first crushed into pieces and blended into powdered form with the help of an electric blender. The powered teak leaves were carefully mixed with carpenters' glue

until a solid mixture was achieved (see Figure 12). The mixture was repeatedly and carefully placed onto the designed mould for casting.

Figure 10. Crushing and blending of teak leaves litters

Figure 11. Mixing of the powdered teak leaves and carpenter's glue

Figure 12. A mixture of the teak leaves and carpenter's glue

Credit photo: Artist Studio

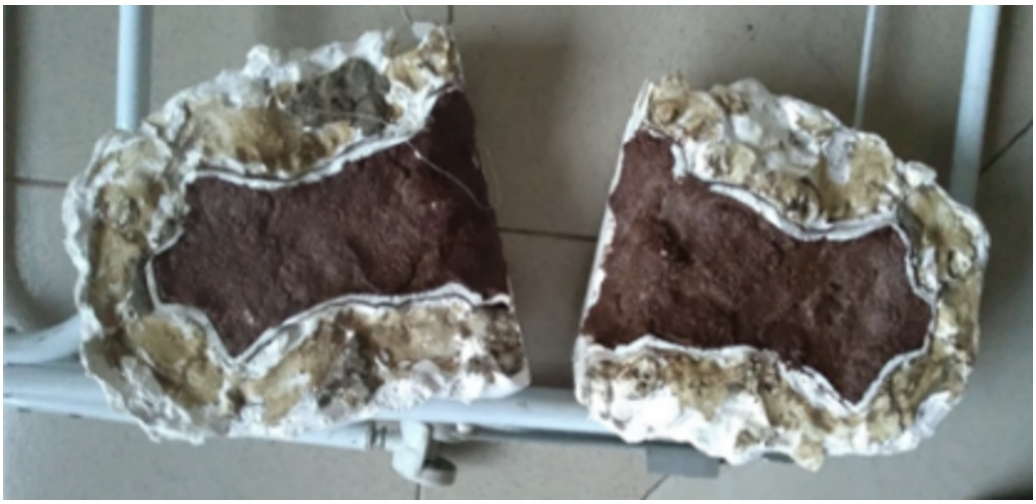

Figure 13. Complete filled of two-piece mould with dried teak leaves

Water sachet plastics/rubbers

The identified waste Water sachet plastics were tested in two (2) different types named Type A and Type B. The first sample called Type A was produced with only the melted rubbers. The second sample titled as TYPE B was produced with the melted rubbers mixed with sand for the production. The study adopted the melting technique for production. These rubbers were placed on a saucepan and set on fire for 40 – 50 minutes as shown in Figure 6, 7 and 8 until a liquid mixture was attained.

Melting Stage

Figure 14. Melting process of Water sachet rubber.

Type "A" sample

Figure 15. Filling of mould with only

Figure 16. Complete filled of mould with only melted sachet s plastics water sachet plastics

Type “B” sample

Figure 17. Mixture of melted water sachet plastic and sand

Results and Discussion

Teak leaves (Dried)

Casting completed from dried teak leaves was very easy with no harmful effect since the teak leaf was carefully changed to powdered form which made it less stressful when mixing with PVA glue as a binder. This mixture was made very thick to prevent the mixture from flowing out of the designed mould during casting.

Figure 18. Final Cast of the Pregnant torso from dried teak leaf mixture

Observation(s) on teak leaves casting

- The cast piece looks compact with less shiny surface, but can only be used indoors because of the white glue added.
- The cast work was able to depict the design of the mould perfectly and successfully.
- The mixture took five to seven days to dry up completely depending on the depth of the mould and also change from a tint of brown to a very dark - brown colour.
- The cast work came out well with fewer casualties which can easily be worked on.
- The cast work came out with a smooth surface since the mixture was well done and gently poured to fill the designed mould.
- The cast work is very light in weight depending on the type of mould used.
- Cast works produced from the teak leaves' mixture works perfectly with Plaster of Paris mould used by the researchers and other mould form different materials.
- The cast work shrinks very fast during the drying process

Similarities and differences between casting with Teak leave mixture and other already existing casting materials.

Similarities

- Cast work produced from teak leaves hardened as the final cast works produced from sawdust.
- Cast work produced from teak leaves, sawdust, and paper, use PVA glue (white glue) as their binder for casting.
- The cast works produced from teak leaves, sawdust and paper, works perfectly with plaster of Paris and other moulds.

Differences

- Cast piece from teak leaves cannot be used outdoors as compared to cast works produced from resin, cement, and silicone.
- The cast works produced from teak leaves come out with fewer casualties as compared to cast piece created from plaster of Paris and cement.
- The cast works from cement, metals, and plaster of Paris are heavier in weight as compared to works cast from teak leaves.

Styrofoam food containers (SFCs)

The second tested cast work was produced from SFCs (melted SFCs). The cast work tested from the melted foam food container was mixed with an amount of sawdust and was cast with plaster of Paris's mould.

Figure 19. Three - quarter view of the final torso cast piece produced from melted Styrofoam food container and sawdust

Observation (s) on SFCs casting

- Melted SFCs appear very soft and much malleable for perfect and easy casting.
- Cast works from melted Styrofoam food containers took weeks to dry up completely depending on the thickness of the cast.
- It has a strong scent, which makes it very dangerous.
- Cast works produced from melted SFCs comes out with less casualties and can easily be worked on after casting.
- Casting produced from melted SFCs does not work with oils as releasing agents, especially when working with plaster of Paris moulds.

- SFCs casts processes do not work perfectly with plaster of Paris moulds but works perfectly with rubber moulds.
- Melted SFCs cast works appears very strong in nature and has smooth surface after casting.
- Cast works from melted SFCs can easily burn to ashes when exposed to fire.
- It takes a week to dry up completely when mixed with other materials.

Similarities and differences between casting with melted Styrofoam food containers (SFCs) and other already existing casting materials

Similarities

- Cast works produced from melted SFCs and other casting materials such as Plaster of Paris, cement and resin shrink at their drying stage.
- Cast works from melted SFCs, and other casting material give smooth finishing after casting.
- All casting materials take different shapes easily and can be used for decorative purposes.
- Cast from plaster of Paris and melted Styrofoam food containers become hard and resistant to temperature and water.

Differences

- Casting produced from melted SFCs is less expensive while casting produced from other casting materials such as Plaster of Paris (POP), cement, silicone, and resin are more expensive.
- Casting from melted SFCs takes weeks to dry up completely while casting done with other casting materials such as plaster of Paris and resin take two to three hours to dry up completely.
- Cast works produced from SFCs are less stressful since the materials are very accessible as compared with POP, cement, and resin, which are regularly scarce since they are mostly imported from another country.
- Casting with melted SFCs are harmful to all artists due to the unpleasant scent that is associated with it while casting produced from POP and cement are not harmful and virtually has no scent during production.
- Cast works produced from melted Styrofoam food containers are very light in weight and portable as compared to cast works produced from POP, cement, and metals.
- Cast works from melted SFCs has less chance of breaking when not handled with care, but POP and cement works can break easily when not handled well.
- Casting with melted SFCs comes out with less causalities as compared to POP and cement cast works.
- Cast works produced from melted SFCs works perfectly with only rubber moulds while casting produced from POP, resin and cement work perfectly with all moulds.
- Melted SFCs cast works cannot be soaked in water easily as compared to plaster of Paris cast works which can easily be soaked in water.

Water Sachet Plastics

The last recyclable waste material tested was produced from water sachets (Plastics). The melted plastics becomes liquid

after heating with fire but maintain its plastic nature back after drying. Casting with these plastics were explored in two different ways where the first sample was cast with only the melted plastics and was classified as Type A, the second sample titled as Type B was produced from the molten plastics and sand.

Figure 20. Frontal view of the final Type A torso cast model with only the melted water sachet rubbers.

Figure 21. Side view of the final Type A torso cast model with only the melted water sachet rubbers.

Figure 22. Final Cast work of the melted sachet plastics and sand mixture

General Observations for Type A, and B

Melting of plastics by fire is very harmful depending on how it is completed. The colour of the plastics changed to black after melting to its liquid state. Melted plastics used for the production dried up very fast and looks strong after drying with no harmful scent. Melting of the water sachet is relatively difficult depending on the selected procedure. They are poor resistance to oils when used as releasing agent. Melting of the water sachet has a strong scent which is harmful to all humans. The melted water sachets need to be worked on as soon as possible since it dries up faster when moved away from the fire.

Table 1. Presentation of observation on sample Type A, and B in a tabular form

Type A (Cast with only melted water sachet plastics)	Type B (cast with melted water sachet plastics and sand)
The final cast work dried up completely in 12 hours.	The final cast work dried up completely in 5 hours since the sand added to the melted water sachet makes it very thick for fast drying.
The final cast work appears to be very light in weight.	The final work became very heavy in weight.
It came out with less casualties which can easily be restored or worked on.	It came out with more casualties which can be worked with much care.
It looks very black.	It appeared in dark grey because of the addition of the sand.
Casting from melted water sachet does not work perfectly with Plaster of Paris moulds.	Cast works from this mixture work with Plaster of Paris moulds.

Similarities and differences between casting with melted Water Sachet and other already existing casting materials

Similarities

- Cast works from melted water sachet plastics, and resin has the same plastic nature.
- The shape of a melted water sachet plastics works behaves as cast works from resin.
- Cast works bent from melted water sachet plastics dries up easily as works produced from plaster of Paris and resin.
- Melted water sachet cast works are very strong just as cast works from resin.
- Cast works produced from melted water sachets and resin are all good water resistance when completely dried.

Differences

- Works produced from melted water sachet plastic come with its colour (black) which do not allow any addition of colours as compared to the resin cast works where colours can be added to make it more beautiful and attractive.
- Melted water sachet plastic hardens when separated from fire while resins harden with the help of hardener.
- Cast works produced from melted water sachet plastics are relatively less costly while works produced from resin, Plaster of Paris, cement, and metals are relatively expensive.
- Casting from melted water sachets involves the applications of fire or melting equipment while casting produced from resin deals with the application of fiberglass, accelerator, and hardener whereas Plaster of Paris and cement deals with application of water as a solvent.
- Casting with melted water sachets do not work perfectly with plaster of Paris moulds as compared to cast works produced from cement, plaster of Paris and resin.

Importance of the Recyclable Waste Materials for the Study

The materials used which included dried teak leaves, water sachets, and styrofoam food containers are readily accessible since they are waste materials in the environment. The use of these waste materials as potential cast materials in sculpture could help in the management of hefty heaps of garbage in the environment. Recycling of these materials by artists for their works reduce the cost burden in the procurement of conventional cast materials for sculpture. Also, the efforts exerted by artists to be innovative in their exploration as potential cast materials for sculpture heightens their creativity prowess. More so, it was evident from the series of studio experiments that the cast works from the melted styrofoam food containers appeared very strong and had smooth surface after casting. Works produced with the recyclable waste have distinctive natural texture as well as its colours adds aesthetic worth to the finished piece.

Disadvantages of the Recyclable Waste Materials

The study detected that, produced cast works from the melted water sachet dries and hardens up faster and do not work faultlessly with plaster of Paris moulds. Cast works from the Styrofoam food container also take a very period of time (a week or two) to dry up completely, and it is also harmful to all artists due to the unpleasant scent of the dissolving agent used. Cast works from melted styrofoam food containers can easily burn to ashes when exposed to fire.

Conclusion

Waste materials can not only be scattered or deposited in trash cans for dumping but can be used for other purposes, especially in the field of art. This study has revealed that waste materials that are mostly thrown away can be used by Sculpture students for the production of cast works. Exploring these recyclable waste materials would lead to a decrease in cost, stress, and shortage of casting materials. It also leads to the art of exercising students' creative abilities in producing pleasing works from waste materials in the environment. The study found out that waste materials such as teak leaves, water sachets, and waste Styrofoam food containers are recyclable and can be used as an alternative casting material in sculpture in the Senior High Schools (SHS). The use of these identified waste materials works with the already existing techniques in casting which includes the foundry or the melting method, the crushing and the mixing method. Future researchers can explore the use of local waste materials in their environment or locality as sculptural materials as alternatives to the conventional sculpture materials sold at higher prices in the market.

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