

Design and Production of Decorative Flower Pot from Plastic Wastes

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Abstract: In Ghana, plastic wastes have become social canker. Statistics indicate that more than 120 tones of plastic waste is collected daily and resold to recycling companies, yet the problem still persists. The quantity of plastic wastes generated on daily basis is very alarming and these plastic wastes caused by human activities litter the environment, thereby polluting water bodies, land and the air when the plastics are openly burned. It is against this backdrop, that the researcher seeks to recycle plastic wastes by designing and producing decorative flower pot from plastic wastes as raw materials, in complementing the efforts of the companies. The objective of the study was to find out whether plastic waste materials could be recycled into decorative flower pots. The methods employed were assemblage of plastics bottles, cut and join, and lastly, fold and paste. Samples of plastic waste bottles and sachets were collected from the campuses of Takoradi Technical University and its environs. The plastic sachets were used as linings for the pot and also for making artificial flower, while the plastic waste bottles were used to build the pot with carpenter's glue as a binding agent. The findings of the study revealed that the flower pot was very portable, non- breakable and stronger as compared with pots made with clay. It was recommended, among others that, visual artists and artisans could practice this mode of recycling plastic waste to foster creativity, self- expression and skills development.

Keywords: Plastic Wastes, Flower Pot, Sachets, Bottles

1. Introduction

The plastic industry within the manufacturing sector has developed tremendously since the invention of various routes for the production of polymers from petrochemical sources. Plastics have substantial benefits in terms of their durability, low weight and lower cost relative to many other material types [1]. The world is faced with environmental problems and Ghana is no exception. Between the years of 1980 and 1990, people were seen using cups to sell water and buying foods in leaves. This kind of lifestyle brought about the spread of many communicable and viral infectious diseases and illnesses. People then realized that the use of plastic was hygienic and safe way of transporting water, food, drugs, and other items and it was also cheap. On the contrary, this fine idea has caused a price to Ghana and that is the volume of waste generated by plastics. Of late, human societies including industrialized ones generate large quantities of

materials, which end up as waste. The nature of this waste has changed drastically over the last 30 to 40 years due to the introduction of synthetic materials such as plastics [2].

Plastic is one of the most common and useful materials in modern times. Its usage is about 20 times more than it was 50 years ago. Because plastics have been mass-produced for around 60 years, their longevity in the environment is not known with certainty. Most types of plastics are not biodegradable [3], and are durable, and as a result most of polymers manufactured nowadays will persist for at least decades if not centuries. Even degradable plastics may persist for quite a time depending on local environmental factors as rates of degradation depend on physical factors, such as levels of ultraviolet light exposure, oxygen and temperature [4], while biodegradable plastics need the presence of suitable micro-organisms. Therefore, degradation rates differ considerably between landfills, terrestrial and marine environments [5]. Human garbage, including synthetics and plastics, has inevitably found their way into the world's

oceans. This rubbish presence in the oceans and on beaches is called marine debris. It is a known fact that marine debris is one of the world's most pervasive pollution problems affecting the oceans [2]. Synthetics like plastics are the most problematic debris because they resist natural degradation processes and are danger to wildlife. According to Botwe [6], about 62% of plastic carry bags, takeaway bags, and other plastic products on the Ghanaian markets are imported mostly from China which not degradable. In Ghana, statistics indicate that more than 120 tones of plastic waste is collected on a daily bases and resold to recycling companies [7], and recently has increased to 320 tones of plastic waste as a result of 25 well-established plastic waste recycling companies [6].



Figure 1. Sample of various plastic wastes.

In spite of stakeholders' efforts to recycle plastic wastes, the problem still persists. Thus,

amount of plastic waste littering various parts of villages, towns and cities has been a crucial environmental problem. There has not been any legislative means of collecting plastic waste and it appears Ghanaians have not fully appreciated the danger that plastic wastes have on the environment, animals and humans. For instance, most people after using plastic containers drop them indiscriminately. Unfortunately, some of the plastic wastes dumped haphazardly find their ways in gutters thereby blocking drainage systems, which can cause flooding during raining seasons. In some instances, other plastic wastes make their way into water bodies affecting aquatic life [8]. This is because livestock and aquatic animals can mistake pieces of plastics for food and eventually choke them to death. It looks like certain sections of Ghanaians are not well-informed that plastic is not biodegradable and it takes very long period to degrade. According to a research scientist Gyamfi [9], nowadays certain percentage of deaths in Ghana is caused by hot food in plastics. This is because plastics in general are made of petrol-chemicals that are harmful to human system, leading to premature death, infertility, hypertension, prostate cancer and several others. However, Essel [10] disputed that fact but reiterated that it becomes harmful when it is abused or heated at a relatively high temperature. Consequently, plastic wastes make our

environment filthy, choke our drainage systems (gutters), and serve as breeding grounds for mosquitoes resulting in bad smell from choked gutters and diseases such as malaria and cholera from mosquitoes and flies respectively [11]. Again, in Ghana, current statistics indicate that poor sanitation including plastic wastes cost Ghana the equivalent of 290 million dollars annually, which is equal to 12 dollars per person in Ghana per year or 1.6 percent of the national gross domestic product (GDP) of the country [12]. It is also common to see burning of plastic waste in an open especially on refuse dumps, due to improper way of sorting out waste materials. The hazards of open burning of plastic waste are that the smoke and vapour from the burning contain many toxic chemicals that can be linked to adverse health problems on the polluted environment, including but not limited to asthma, lung cancer, and other respiratory ailments, kidney and liver damage, and nervous system, reproductive and developmental disorders [13].

In Ghana, plastic usage has gained popularity due to the fact that plastics are lightweight, strong, and cheap. Because of the cheap nature of plastics, they are gotten freely and therefore discarded haphazardly making it difficult to control the environment and also to adapt better ways of handling them [14].

Recycling implies taking materials from products that one has finished using and trying to make new products out of them. Thus, it involves processing used materials into products to prevent waste of potentially useful materials [15]. Recycling of plastic is one phenomenon of reducing environmental impact and resource depletion. It is in support of this that the researcher seeks to recycle plastic wastes by designing and constructing plastic flower pot for decorative purposes.

1.1. Sources of Plastic Wastes in Ghana

According to Abota [11], plastic wastes generations arise from different sources such as commercial waste, industrial waste, and metropolitan, municipal or district waste.

Commercial wastes deal with waste generated by hotels, restaurants, institutions, supermarkets and shops or kiosks during their operations or activities. These wastes involve some quantities of plastic wastes which find their way into the environment. There are no proper mechanisms of waste disposal. In some instances, people collect the plastic wastes and set fire on the wastes to burn the plastics wastes which pollute the air. Talking about industrial wastes, these are waste generated by the packaging, manufacturing, construction and assembling companies. For example, Coca-cola and Fan Milk Ghana Limited package their products in plastics, scraps from plastic companies like Ghana Plastic Manufacturers, and plastics used as packaging or wrapping of parts in construction and automobile industries. All these plastic wastes from companies contribute to waste problems in Ghana. The Metropolitan, Municipal and District Assemblies (MMDAs) work alongside with companies such as Zoomlion and others. They collect the wastes including plastics from streets, parks, residential areas and waste

collection points. Since the inception of drinking water packaged in the sachet and bottle, and the use of plastics as packaging materials when customer buys a product from the shops, supermarkets and markets, indiscriminate disposal of plastic waste has been increased in Ghana [11].

1.2. Hazardous Nature of Plastic Wastes

According to Antwi [8], plastic wastes have negative effects on the environment and affect the environment in three ways namely; water, land and air pollution. In affecting water, plastics wastes find their way into water bodies such as streams, rivers lagoons and lakes; and as a result pollute the water. The plastics float on the surface of the water bodies. This prevents direct sunlight for water organisms. Aquatic animals which mistakenly eat plastics as food are killed thereby affecting aquatic life.



Figure 2. *Plastics in a Stream.*

Explaining land pollution, Antwi [8] mentions that plastic wastes disposed on land from human activities also find their way in choking drains and gutters. The blocking of the drains and gutters by plastic wastes cause flooding whenever it rains, and the floods destroy properties and buildings, more especially, in towns and cities. This is because the rain water cannot get access to flow in the gutters and the stagnation of rain water created by plastics serve as breeding grounds for mosquitoes, which in the long run cause malaria and cholera to people. The plastic wastes affect not only the people but also livestock such as sheep, cows, goats, fowls and others. These animals die through mistakenly taking in plastic wastes along as they graze on the field. In addition, plastic wastes prevent crops from growing and also cover the top soil to deny air penetration into the soil. This kills soil organisms that help to fertile farmlands.

Lastly, plastic wastes as non-degradable substances are made up of toxic chemicals that pollute the air. Harmful substances such as toxins are released into the atmosphere when plastic wastes are openly burned. This can cause respiratory problems and cancer as they are inhaled [13].



Figure 3. *Land polluted with Plastics.*



Figure 4. *Burning of plastic wastes to pollute the environment.*

2. Materials and Methods

2.1. Usage of Plastic Wastes

This is the aspect of the study where the researcher collected plastic waste materials that have been dumped haphazardly on the environs of Takoradi Technical University and made good use of them for aesthetic and creative purposes.

2.2. Tools Used

- (i) Working bench - it was used as a platform on which the plastic flower pot was constructed.
- (ii) Knife – it was used to cut the waste plastic bottles into required sizes.
- (iii) Brush – it was used to apply carpenter's glue for joining waste plastic materials.
- (iv) Rag – it was used to clean dirt and any unwanted materials.
- (v) Rubber bowl – it was used to keep the measured waste plastic materials.

2.3. Materials Used

- (i) Waste plastic bottles and sachet rubbers – they were the

major materials used to construct the flower pot.

(ii) Carpenter's glue – it was used to join various parts of the measured waste plastic materials.



Figure 5. Sample of plastic bottles.



Figure 6. Sample of sachets rubbers.



Figure 7. Sample of carpenter's glue.



Figure 8. Gluing of plastic bottles.

2.4. Methods Employed

Basic construction methods were adopted. These were;

1. Assemblages of plastic bottles – all plastic materials needed were gathered for construction.
2. Cut and join – various waste plastic bottles and sachet rubbers were measured, cut and joined with the aid of carpenter's glue.
3. Fold and paste – various parts of the plastic materials were folded and pasted to get the required shape of the pot.

2.5. Production Method

2.5.1. Preliminary Sketches

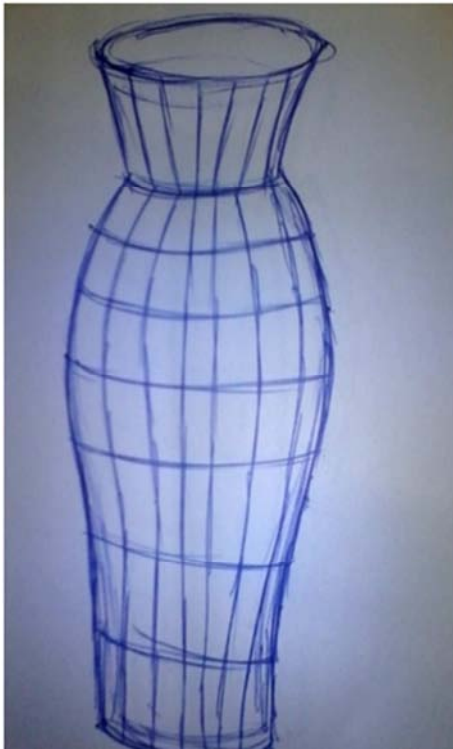
The researchers made several sketches before arriving at the final sketch. The sketches below demonstrated the initial drawings;



(i)



(ii)



(iii)



(iv)

Figure 9. (i): Thumb nails; (ii): Initial sketch; (iii): Working sketch; (iv): Final sketch.

2.5.2. Assemblage of Plastic Bottles

The plastic bottles were assembled and arranged uprightly in a circular form with the help of carpenter's glue serving as a binder to form the base as shown in figure 10. The inner part forming the base of the pot was also filled with plastic bottles to enhance its strength and stability. This was made possible with the aid of adhesive glue binding them together as illustrated in figure 11.



Figure 10. Circular arrangement of bottles.



Figure 11. Inner part filled with plastic bottles.

2.6. Formation of Belly of the Pot

Firstly, the base of the plastic bottles were cut off with a knife and the inner lower part of the bottles were glued. The upper parts of the circular base bottles close to the shoulder were also glued. The cut-off base bottles were then fixed on each other systematically and folded to form the belly as shown in figures 12 and 13.



Figure 12. Initial stage of pot's belly.



Figure 13. Base of pot's belly.

The cutting of the base of the bottles was done in such a way that it would fix on the neck of the bottles, bearing in mind the folding of the base in order to get the required shape as demonstrated in figure 14. It should also be noted that only the outer bottles of the base were fixed with other bottles to start forming the belly of the pot. The process was repeated until complete belly formation was achieved. This is shown in figure 15.



Figure 14. Formation of pot belly.



Figure 15. Progressive forming of pot belly.

To further ensure strength and stability of the pot, the inner part of the pot was lined with sachet rubbers cut-opened and glued with the help of carpenter's glue. The processes of lining were continued until the belly was fully lined as shown in figures 16 and 17.



Figure 16. Sample of glued sachet rubber.



Figure 17. Inner lining of pot.

It must be stated that, in building or forming the belly, the plastic bottles being arranged were pushed a little bit in and out in order to get the required shape of the belly. This is shown in figure 18.



Figure 18. Completion of pot's belly.

2.7. Formations of Neck of the Pot

In building the neck of the pot, the final bottles of the belly were cut in such a way that bottles forming the neck could enter and lock. That was done by firstly cutting off the final bottles of the belly from the shoulder of the bottles at an angle of 90° and a diameter of 3.5cm. The top inner part of the cut off bottles were then glued as well as the lower part of the bottles forming the neck. These were then fixed together with the lower part glued bottles entering into the cut off glued bottles at an angle of 45° to form the neck as shown in figures 19 and 20.



Figure 19. Building the neck of pot.



Figure 20. Completion of neck of pot.

2.8. Decorations

As a form of decoration, the joints of the belly and the neck were decorated with folded sachet rubbers in a form of triangle and caps of the plastic bottles as demonstrated in figure 21. The belly of the flower pot was also decorated with the caps to enhance its beauty as seen in figure 22.



Figure 21. Decorated pot with sachets and caps.



Figure 22. Completion of flower pot.

2.9. Formation of Artificial Flower

Plastic bottles were arranged in a circular form and glued together to form the base. The bottles were arranged and glued in a conical shape. Sachet rubbers were also shaped in conical shapes and glued along the bottles to form artificial flower as shown in figure 23.



Figure 23. Artificial flower made from sachet rubbers.

3. Results and Discussion

It was found out that the designed flower pot was strong and also light. Hence, the pot was portable. It also came to light that the pot was durable and could not be broken down easily as compared to pots made with clay. It was also revealed that the plastic waste bottles were malleable and could be folded to suit most designs. Again, no matter the size and shape of the bottles, they could either be used alone or mixed together.



Figure 24. Final pot with artificial flower.

The research has also demonstrated that there could be mass production of plastic flower pots by ceramic artists and artisans through the systematical procedures that have been tabulated below;

Table 1. Systematic Approach for Mass-Production of Plastic flower Pots.

Step	Procedures
1	Base of Pot - Assemble and arrange plastic bottles of equal sizes in circular form with the aid of carpenter's glue.
2	Fill the inner parts with plastic bottles and glue them together to enhance the strength. Belly of Pot - The base of the plastic bottles is cut off with a knife and the inner lower part of the bottles is glued. The upper parts of the circular base bottles close to the shoulder are also glued.
3	The cut-off base bottles are then fixed on each other systematically and folded to form the belly
4	Lining of Pot - To further ensure strength and stability of the pot, the inner part of the pot is lined with sachet rubbers cut-opened and glued with the help of carpenter's glue
5	Completion of Pot Belly - In building or forming the belly, the plastic bottles being arranged are pushed a little bit in and out in order to get the required shape of the belly Neck of Pot - In building the neck of the pot, the final bottles of the belly are cut in such a way that bottles forming the neck can enter and lock. This is done by firstly cutting off the final bottles of the belly from the shoulder of the bottles at an angle of 90° and a diameter of 3.5cm. The top inner part of the cut off bottles are then glued as well as the lower part of the bottles forming the neck. These are then fixed together with the lower part glued bottles entering into the cut off glued bottles at an angle of 45° to form the neck.
6	Decoration of Pot - As a form of decoration, the joints of the belly and the neck are decorated with folded sachet rubbers in a form of triangle and caps of the plastic bottles. The belly of the flower pot can also be decorated with the caps to enhance its beauty.
7	Artificial flowers - Plastic bottles are arranged in a circular form and glued together to form the base in a conical shape. Sachet rubbers are also shaped in conical shapes and glued along the bottles to form artificial flower.
8	

4. Conclusions and Recommendations

The study concludes that unwanted plastic waste bottles and sachet rubbers that thrown everywhere to litter the environment have been utilized into aesthetic, durable and environmentally- friendly decorative flower pot and to a larger extent provide other alternative materials to clay for making pots and vases. This would go a long way to minimize clay mining thus saving the soil and plastic waste pollution in the environment.

The following recommendations have been made by the researcher:

(i) There could be further study to ascertain the entire life span of the pot and the extent of recycling the materials again.

(ii) The ceramic artists and artisans should embark on mass- production by adopting the systematical procedures that have been outlined in table 1. This would foster creativity, self- expression and skills development.

(iii) It is proposed that producers of plastic products should be made to pay a weighted proportion of levy for the pollution that the plastic may cause in the environment in a

levy system termed as the plastic polluter pay fund or polluter pay principle fund (PPPF), to pay for people who collect the plastic bottles and sachets for recycling.

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