PROJECT TITLE:

CONVERTING WASTE PLASTICS INTO COMPOSITE FLOOR/WALL TILES

A project conducted by the students of Government Science Technical College,

Area 3, Garki, Abuja

CONTENTS

ABSTRACT

The role of plastics in human lives ranging from use as household appliances, packaging materials, polyethene bags, pure water sachets and products of plastics which are widely used in communities for various purposes. The open burning of these waste plastics releases toxic gases like carbon monoxide, dioxin, furans, mercury, polychlorinated biphenyls and bromine, in form of smokes and soot into the air posing threat to vegetation, human and animal, its impact is climate change and diseases. The need then arises to convert this waste plastics into composite floor/wall tiles. Method used involves; collection of the waste plastics from our school dumpsite. These were sorted out, washed, shredded, then melting of the already shredded and weighed plastics, mixing with a specified quantity of local red clay and pouring into a dimensioned pre-designed metallic mould. Finally, a heavy weight is lowered on the flat cover of the mould for 3- 5 minutes, then, the mould is immersed into a basin of water for easy removal of the tile. The tile is removed from the water and allowed to set for 40 minutes and the composite floor/wall tile is ready for use.

The principle behind this procedures include; melting, chemical bonding, moulding technique, compression and solidification processes.

From our result, melting of 300g of plastic wastes and mixing with 100g of red clay produced one piece of composite floor/wall tile of dimension 35cm by 25cm.

In conclusion, open burning of waste plastics should be discouraged by converting this wastes into composite floor/wall tiles.

RESEARCH PROBLEM/STATEMENT OF THE PROBLEM

The role of plastic materials in human lives cannot be over emphasized ranging from use as household appliances, packaging materials and many more which are widely used in our communities. But the improper disposal of this waste plastics after use such as burning in open air is a major source of air pollution. Since it releases dioxins, furans, mercury, and polychlorinated biphenyl into the atmosphere. Also, burning of polyvinylchloride liberate hazardous halogens and pollute the air and the impact is climate change and diseases. (https://www.unep.org).

The toxic substances that are released are posing threats to vegetation, human and animal health and also the environment as a whole. According to airquality.news.com, burning of waste plastic is a serious health concern because smoke from the fire emits black carbon and other particulate matter emission which can have a significant impact on health causing respiratory problems, health diseases and brain cancer.

According to World Health organization (WHO 2016) data, air pollution kills about 7 million people worldwide yearly. Also, 4.2 million death every year occurs as a result of exposure to ambient (outdoor) air pollution.

According to Mynewsdesk.com, waste plastics when burnt causes air pollution which release toxins such as chlorine and bromine that destroys ozone layers which in turn leads to global warming. All these legion of problems posed by this improper disposal of waste plastics led us to this research of converting waste plastics into innovative composite floor/wall tiles.

The fundamental importance of these research lies in the fact that these waste plastic materials not reusable are cost effectively converted into innovative composite floor/wall tiles with a

considerable reduction in the problem of air and environmental pollution caused by open burning of waste plastics. This research will also encourage hiring of more people into the business of waste recycling thereby making a living. Employment will be created for that woman in the street who will be collecting waste plastics for production. Jobs will also be created for labourers in the factory- retailers/wholesalers who will deliver the products (affordable composite floor/wall tiles) to Nigerian builders. And the high cost of building materials such as floor/wall tiles will drastically reduce as our composite floor/wall tile penetrates into the building industry. This would also increase the economic growth of the country. The unemployed youths both in the urban and rural communities will also be taught the skill as a means of gainful/self-employment.

This research is also tied to some of the Sustainable Development Goals (SDGs), such as goal number 3 – Good health and well-being, goal number 8- Decent work and Economic growth, goal number 9- Industry, Innovation and Infrastructure, goal number 11- Sustainable Cities and Communities and goal number 13- Climate Action.

The background Technology of our research:

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Title of the Technology: A Pilot Recycling of plastic pure water sachets/bottles into composite floor Tiles

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In the above technology, the method the researchers used involves the collection of the waste plastics from trenches, drainages, streets, dump sites and from eateries around Oshogbo Metropolis. These was sorted and washed before shredding process was carried out, then melting of the shredded plastic, mixing with saw dust and poured into a dimension wooden mould and cured for some days and the tile is ready.

In the above technology, the researchers made use of saw dust as their loosed particles during mixing of the molten plastic before pouring into the wooden mould. Saw dust is usually gotten from trees and this method could encourage failing of trees instead of planting more trees to preserve our environment from global warming. Another observation is that saw dust is not flame /fire retardant, so the tiles produced by the method may have restricted areas it could be used in case of fire issues.

From the above technology (research), we innovated the use of local red clay as the loose particles instead of using saw dust, because, from our research we found out that local red clay is a good fire retardant since our tiles will also be used in both sitting room, kitchen, bathroom and every

other interior part of a building. The red clay gives the tile fine and smooth finishing and also, to discourage falling of trees. We decided to use metallic mould in place of wooden mould, since with metallic mould we can obtain smoother and sharper edges in our tiles and the mould is not exposed to wear and tear.

We decided to apply this our innovation in our community in form of waste management initiative that has potential to impact on the global plastic waste crisis because it can transform waste low density polyethylene (LDPE) and other readily available types of plastics into a valuable building material (Composite floor/wall tiles).

The composite floor/wall tiles is cheaper to produce (availability of raw materials), affordable, durable, water and termite resistant, best for water logged areas, non-brittle, eco-friendly, can be moulded into different designs, shapes and a better alternative to the conventional tiles.

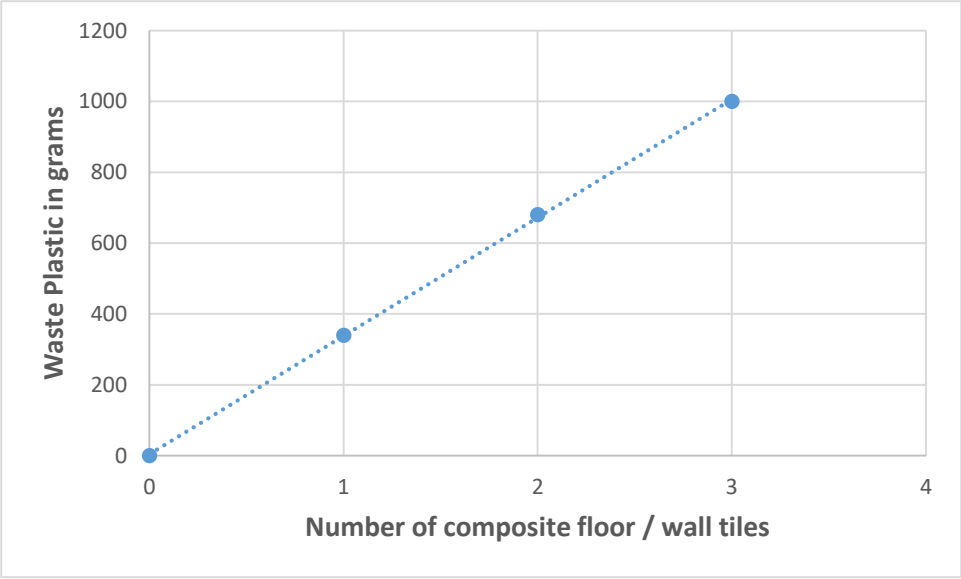
HYPOTHESIS

In this research, we focused on two main variables which are waste plastics and composite floor/wall tiles. For every 340g of waste plastics subjected under high heat to melt into molten form and mixed with 120g of local red clay to a smooth consistency produced one piece of composite floor/wall tile of dimension 35cm by 25cm. The table below shows the quantity of waste plastics, local red clay, the number of composite floor/wall tiles and time taken.

Table 1

S/n	Waste plastics	Local red clay	No. of composite floor/wall tiles	Time taken (minutes)
1	340g	120g	1	20 minutes
2	680g	240g	2	40 minutes
3	1000g	360g	3	60 minutes

Graphical Representation of the hypothesis



RESEARCH

The main aim of this research is to reduce the indiscriminate open burning of waste plastic which is the key factor for air pollution in this part of the world. Presently, it is a global problem. To achieve this, we, the students of Government Science and Technical College, (GSTC) Garki, Abuja embarked on an innovative technology using our local method of converting the waste plastics collected from our school dump site into composite floor/wall tiles using local red clay as the filler/loose particles. Plastic wastes is melted under high heat and mixed with local red clay in the ratio 17:6 to get a smooth consistency ready for moulding into various dimensions, designs and shapes of floor/wall tiles.

In this project, different grades of waste plastics were tested and the transparent plastic bags and wrappers are suitable because the strength of the tiles produced from them is much high than the normal or conventional tiles in terms of withstanding load/weight. The composite floor/wall tiles did not shatter under sudden heavy load (has high ductility). It can live for several years because it is water and humidity resistant.

To get this plastic wastes, we the 'Young Innovators' in GSTC, Garki do visit the school dump site on regular bases and also dump site at Durumi village in Area 1 Garki Abuja during weekends to pick the waste plastic materials. We then comfortably convert this waste plastics into affordable composite floor/wall tiles, which can be sold at good price to builders.

MATERIALS AND METHOD

MATERIALS USED (BOTH FIXED AND CONSUMABLE)

S/n	Material (Item)	Quantity	Unit price	Amount (N)
1	Waste plastics	1000g (1kg)	Sourced from dump	
2	Local red clay	680g	Sourced from surrounding	
3	Weighing scale	1 piece	Sourced from chemistry lab	
4	Metallic mould	4 pieces	Fabricated workshop	400.00
5	Flat metallic sheet	4 pieces	Sourced from trash	
6	Hand trowel	2 pieces	Sourced from building Dept.	
7	Activated Charcoal	Half bag	Sourced from school kitchen	
8	Heating chamber	1 piece	Recycled bucket/local pot	
9	Tripod stand	1 piece	Fabricated from workshop	200.00
10	Manual blower	1 piece	Sourced from welding workshop.	
11	Scissors	5 pieces	Sourced from garment workshop	
12	Insulated iron stirrer	1 piece	Sourced from trash	
13	Smoke trapping device	1 piece	Fabricated by project members	
14	Industrial hand glove	3 pairs	250.00	750.00
15	Nose mask	3 pairs	100.00	300.00
16	Helmet	2 pieces	Sourced from building Department	
17	Overall & safety booth	3 pairs	Individually owned	
18	A heavy weight(stone)	3 pieces	Sourced from trash	
19	Fire extinguisher	1 cylinder	Sourced from school	

Total amount spent during production……..**N1,650.00**

METHOD

The steps involved in the production of the prototype of composite floor/wall tiles are detailed as follows:

- **COLLECTION OF RAW MATERIALS**: The plastic materials were collected from our school dump site and Durumi village dump site in Area 1, Garki. The reason for using our school and the community around it is due to large volume of plastic wastes generated in these areas and most of the time these wastes are burnt openly thereby contaminating the air we breathe.
- **SORTING, WASHING AND DRYING:** This involves the separation of the plastic materials according to types (manual identification). Liquid soap, water and disinfectant were used to wash the plastics and allowed to dry. The reason for washing is to remove any label attached to the bottles, contaminants and adhesives in the plastic materials. Then, followed by drying and shredding process (cutting into smaller pieces for easy melting) which is done with the aid of scissors.
- **COLLECTION OF SUN-DRIED LOCAL RED CLAY AND SIEVING OPERATION:** The local red clay is collected from beneath the top soil in the ground, dried, then using a sieve of mesh size 0.02mm for sieving the clay to get a fine powder that will serve as the loose particles or the filler in the mixing process to give a fine surface finishing.
- **WEIGHING OF THE SHREDDED PLASTICS AND SIEVED CLAY:** The required amount of the shredded plastic and sieved clay were weighed respectively.
- **MELTING OF THE SHREDDED PLASTICS AND MIXING PROCESS**: This is a physical process that results in the phase transition of a substance from a solid to liquid.

This occurs when the internal energy of the solid increases, typically by application of heat (using charcoal) which increases the plastic temperature to the melting point. At the melting point the ordering of ions or molecules in the solid breaks down to a less ordered state melt to become liquid. This process is carried out after placing our locally recycled iron bucket on a heating source (activated charcoal) for 3 minutes and the weighed shredded plastic transferred into the heating bucket, covered and allowed to melt completely. The weighed red clay is then added to the melted plastic and the mixture is stirred thoroughly to allow uniformity and achieve smooth consistency. This is then poured into a pre-designed metallic mould, this is followed by banging the edges of the mould on the ground continuously for even spread of the molten mixture and also to aid the escape of air bubbles that can cause crack on the composite.

- **CURING AND SOLIDIFICATION:** This process involves the cooling of the composite material (floor/wall tiles) by deeping the mould and its content into a basin of water, allowed to solidify for 5 minutes and the tile is easily removed.

PICTORIAL DESCRIPTION OF OUR EXPERIMENTAL PROCESSESS

OPEN BURNING OF DUMP AND TEMPERATURE OBSERVATIONS

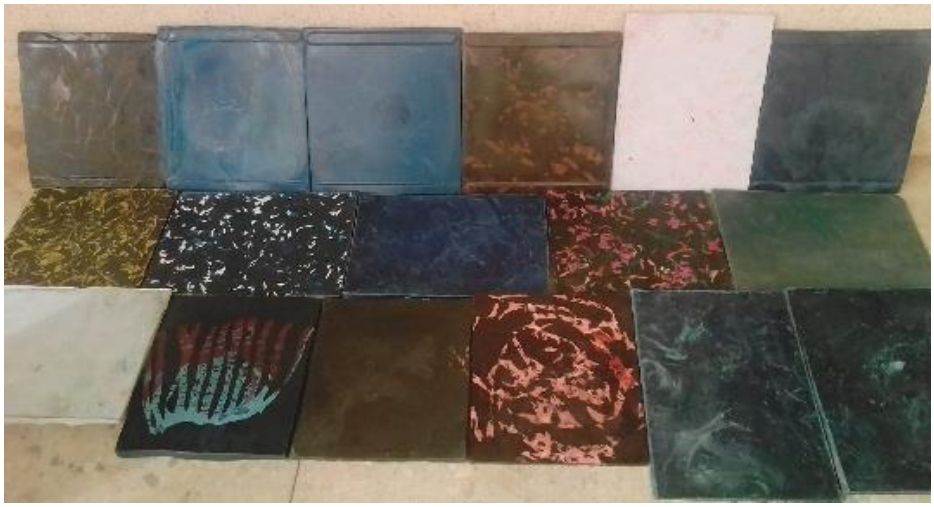
PICKING OF WASTE PLASTICS FROM THE SCHOOL DUMP SITE

SORTING, WASHING, DRYING AND SHREDDING OF WASTE PLASTIC.

MELTING MIXING WITH RED CLAY STIRRING TRAPPING OF FUMES



POURING OFN THE SMOOTH MIXTURE, MOULDING AND REMOVAL OF TILE



FINAL PRODUCT

FLOWCHART OF PRODUCTION PROCEDURE

Collection of waste plastics

↓

Sorting out

↓

Washing and drying

↓

Shredding into smaller pieces

↓

Weighing and melting

↓

Mixing

↓

Moulding

↓

Solidification and removal from the mould

THE GLOBE PROTOCOL

The GLOBE protocol we are looking at is 'Air'- Air pollution by open burning of waste plastic materials in our community dump site.

Open burning according to Sirintornthep Touprayoon et al (2019) is the combustion of unwanted combustible materials such as waste plastic in open dump site where smokes and other emission are released directly into the air without passing through chimney or stack. Open burning of waste plastic is a source of greenhouse gas emission. It is a high-temperature exothermic (heat releasing) redox (oxygen adding) chemical reaction between a fuel and an oxidant (O_2).

Major sources of air pollution in Nigeria include tailpipe exhaust from cars and trucks, smoke from the open burning of residential, trash etc.). WHO 2016.

This air pollution is a critical risk factor for non-communicable diseases (NCDs) worldwide, causing about 24% of all adult deaths from heart diseases, 21% from lung cancer, 25% from stroke and 43% from chronic obstructive pulmonary diseases (COPD), this is the World Health Organization estimates.

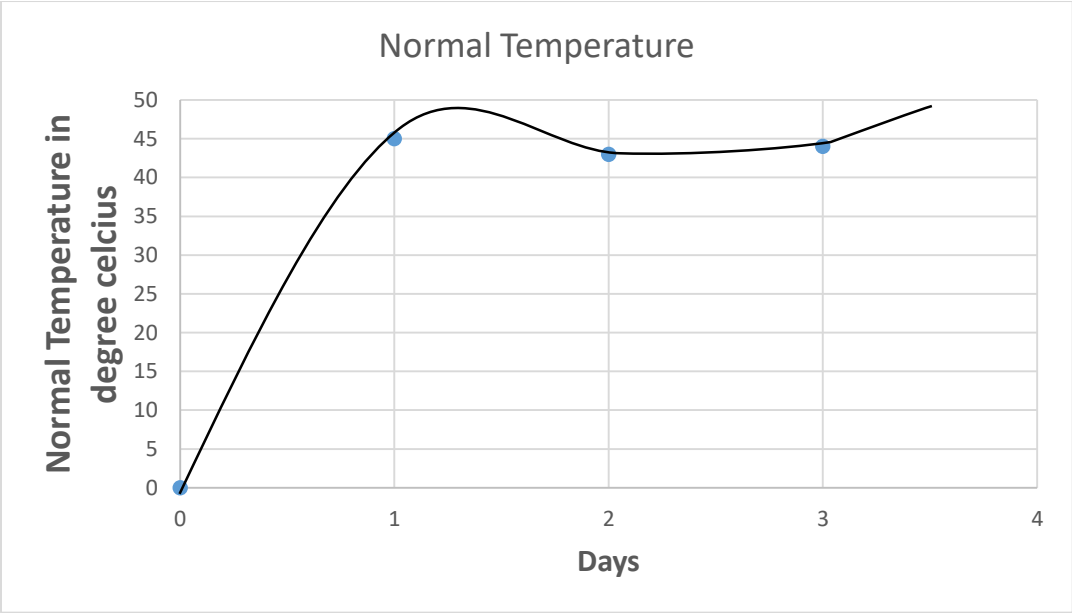
DATA SUMMARY

Table below shows the normal (control) and the experimental temperatures of the days under observation and time of the day.

Table 1

Days	Normal Temperature of the Day (0^c)	Experimental Temperature of the Day (0^c)	Time of Day (minutes) (W.A.T)
Day 1	32^{oc}	45^{oc}	3.10 pm
Day 2	30^{oc}	43^{oc}	5.30 pm
Day 3	31.8^{oc}	44^{oc}	1.35 pm

Fig 1. GRAPHICAL REPRESNTATION OF NORMAL TEMPERATURE FOR 3 DAYS



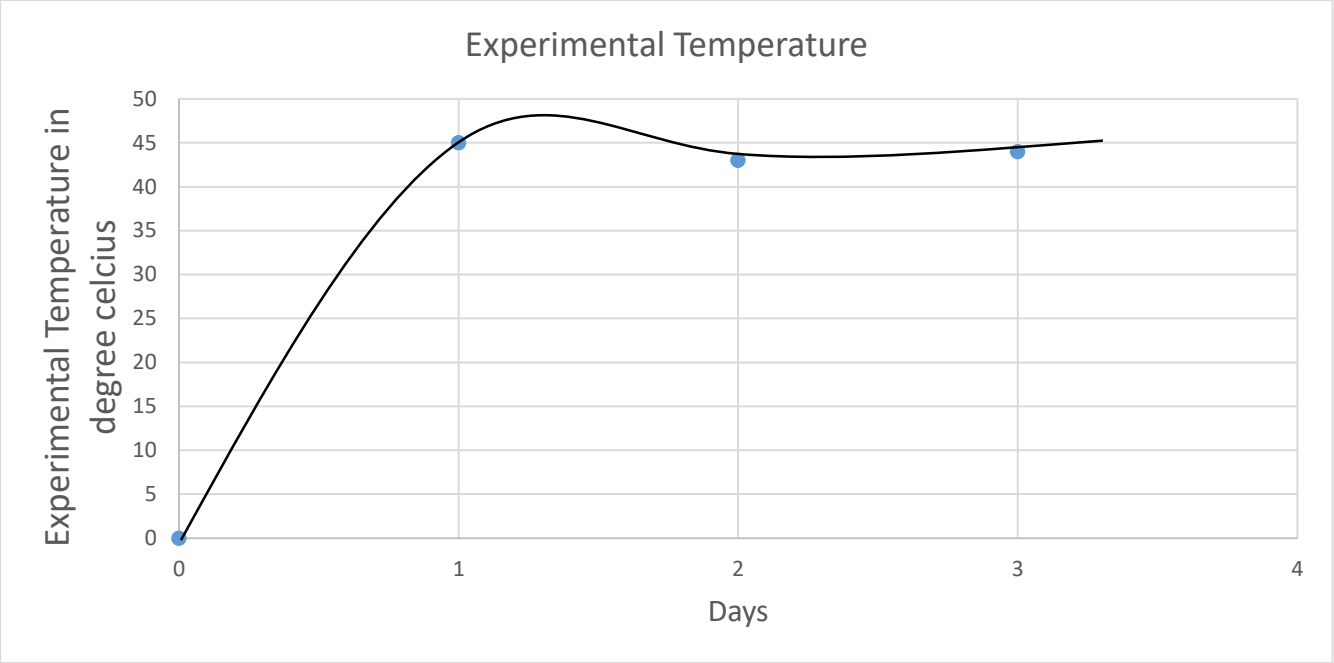


Fig 1.2. GRAPHICAL REPRESNTATION OF EXPERIMENTAL TEMPERATURE FOR 3 DAYS

DATA ANALYSIS

In figure 1 above, from the control graph, there is a fluctuation in the days normal temperature, this could be as a result of different time of the day when the temperature was observed and taken around the vicinity of the school refuse dump site, usually before the dump was set on fire.

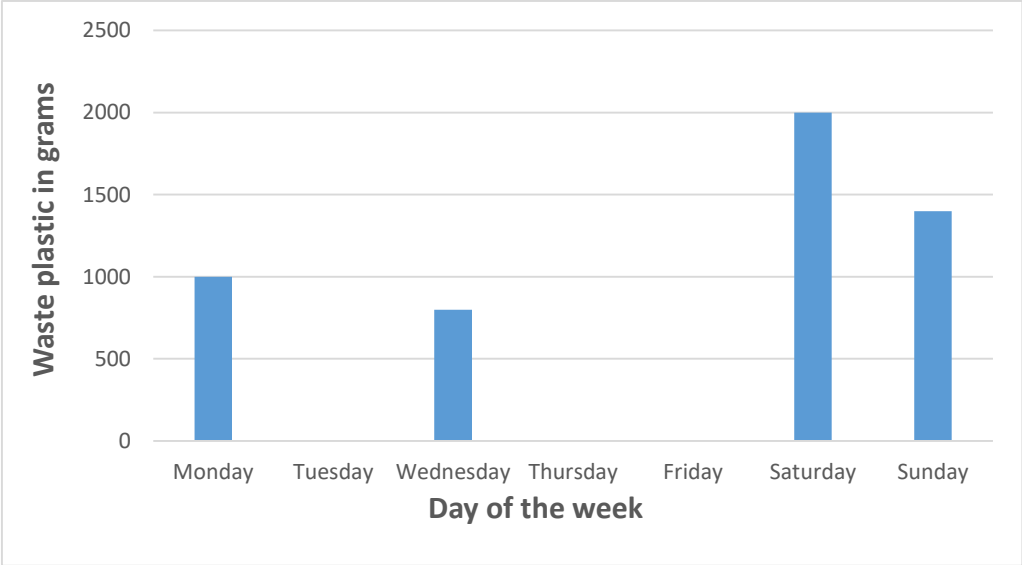
While in fig 1.2 graph, for the experimental graph, there is a sharp increase in the temperature of the dump site surrounding which is very high as a result of exothermic (heat releasing) reaction, therefore heat was released to the surrounding of the dump site. At the same time, a lot of smoke with suffocating odour is emitted largely, thereby making the air around the dump site uncondusive to inhale.

The table below shows the amount of plastic collected each day by 5 pm from school dump site.

Table 2

S/n	Day of the week	No. of waste plastics in grams(g)
1	Monday	1000g
2	Wednesday	800g
3	Saturday	2000g
4	Sunday	1400g

Fig 2. Histogram of waste plastic collected from our school dump site.



In **fig 2.0** above, the histogram shows that more waste plastic –based materials were generated during the weekends (Saturday and Sunday) in the school, this can be attributed because our school is boarding and usually parents do visit more during the weekend and students also do a lot of buying from the school shop.

Table 3: The table below shows the amount of waste plastic required to produce a prototype composite floor/wall tiles of dimension 35cm by 25cm and the time taken for the process.

S/n	Waste plastics (g)	Local red clay(g)	Number. of Tile produced	Time taken (minutes)
1	300g	100g	1 piece	20 minutes
2	600g	200g	2 pieces	40 minutes
3	900g	300g	3 pieces	60 minutes

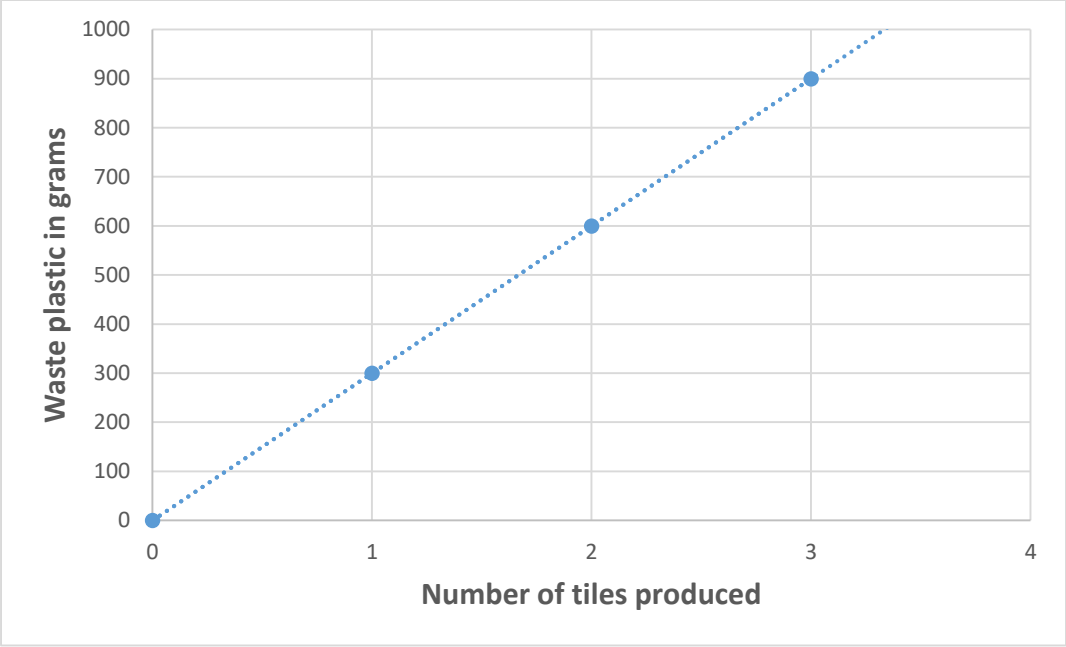


Fig 3: Graphical representation of the two variables
Waste plastics and number of tiles produced at a given time

From the graph above it shows that the number of tiles of dimension 35cm by 25cm is dependent on the amount of waste plastics collected, washed, sorted out and shredded, since the waste plastic is the main raw material needed in this production. And the graph also shows that by the straight-line graph which is in ascending order forming a sharp slope, meaning that the more waste plastics melted the more number of composite floor/wall tiles produced at an increased time. But, our focus

here is on the waste plastics and its recycling into useful building material (composite floor/wall tiles). This product was passed through water absorption test by taking the weight of the composite tile before immersion inside water and left over night, it was reweighed the next morning and the observation was as follows:

Weight of the composite before immersion Y = 0.30 kg Weight of the composite sample after cold water immersion Z = 0.30 kg Amount of water absorbed = Weight after immersion - weight before immersion = Y-Z = 0.30-0.30 =0.00 kg

From the above result the composite tiles produced from the recycled plastic has a zero absorbing capacity when immersed in cold water and hence can serve as a better alternative to conventional tiles.

RESULTS

The results from our research/experiment shows that:

- Each time the refuse dump in our school is burnt openly, the temperature of the surrounding increases drastically as the digital thermometer indicated when compared to the normal temperature of the day. While the normal day's temperature just fluctuates slightly within the normal temperature. The measurement is in degree Celsius.
- The results also shows that the amount of waste plastic materials generated or collected from the school dump site varies daily (every day of the week). From our research, the amount collected during weekends is higher than the amount collected on week days.
- Our result also shows that by processing 300g of waste plastics using 100g of local red clay as the filler (loose particles) in the presence of high heat and under 20 minutes, one piece of composite floor/wall tile of dimension 35cm by 25cm. And the trend continuous as more plastic wastes is melted more number of composite floor/wall tiles is produced with increase in time taken.
- From our observations during the experiment, we found out that the nature of air in the dump site surrounding is not natural, it has been contaminated by the smoke from the open burning of the refuse in the dump site. The trees around the dump site area were also covered by thick smoke from the burning as the pictures showed above.

EXPERIMENTAL ERRORS

During the temperature observations of our research environment, the digital thermometer reading was fluctuating and could not be read at that time. So, we checked the power source and found out that the battery was not properly fixed, so we properly fixed it and allowed it to normalize for 5 minutes before taking the reading.

CONCLUSION

In conclusion, it can be summarized in the following words:

- Open burning of refuse dump which pollutes the air thereby releasing greenhouse gas emission leading to climate change (global warming) should be discouraged by making proper arrangement for waste management by creating waste bins with labels, according to the nature of the wastes.
- The culture of recycling of waste plastics into useful items such as building materials like composite floor/wall tiles should be adopted, since the amount of plastic wastes being generated daily is second to food waste generated according to research. This will help to create a sustainable and eco-friendly environment, this is line with SDGs- goal 3, 11 and 13. The waste plastic recycling will also create decent jobs for the unemployed youths roaming the street- goal 8. By the time this waste plastic is recycled into floor/wall tiles- it agrees with goal 9.

DISCUSSIONS

From our conclusion, proper disposal of all the wastes generated from the school should be a priority to everyone, by creating different waste bins for collection of different wastes is important and should be stationed in various locations in the school compound. In so doing, we the young innovators can easily sort out the waste according to types for easy collection and recycling of the waste plastic materials among them into composite floor/wall tiles.

To improve on this our research work, there is need for transition from manual/local method to mechanical method {Mechanization} for maximum production, lesser man-power, and time consumption.

The impact of this our research beyond the classroom is as follows:

- We would be creating awareness on the dangers of open burning of wastes especially waste plastics.
- The skill from this research (converting waste plastics into composite floor/wall tiles) should be impacted to youths/job seekers who are aspiring to become young entrepreneurs.
- Creation of a cleaner/green environment for our health and well-being.
- Popularizing the production of affordable, durable and cost effective composite floor/wall tiles for Nigerian builders.
- Bringing a better alternative to conventional tiles into the building construction industry.
- From our findings, majority of the work carried out on waste plastics are on recycling the waste plastics into paver tiles(interlocks) and covets slabs and these are for the outdoor decorations such as our walkways, gardens, gutter covers etc. So, we suggest that more research should be carried out on making floor/wall tiles with the waste plastics for interior

decoration of houses. We suggest that researchers should continue were we stopped in the research.

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Secondly, we would like to thank our parents who gave us the permission to embark on this important research. We are also grateful to Mr. Job Joshua who helped us with the graphical designs in this project.

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