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Case study

Plastic wastes to construction products: Status, limitations and future perspective

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ABSTRACT

Plastic waste is becoming extremely threatening to the environment due to their high quantities generated which pose serious harm to both the environment and its inhabitants. A major victim of this menace is the marine environment. Plastic wastes generated on land find their way to water bodies where they cause detrimental effects such as flooding and poisoning of the animals in the marine ecosystem. The plastics in the marine environment, which are ingested in fish, are also deleterious to human health if such fish are consumed. Cancer is a major disease that emanates as a consequence. In order to find an effective way to manage these wastes and improve the sustainability of our environment, this study, therefore, explores various approaches to recycling plastic wastes into new products. The critical threat of the presence of plastic wastes in our marine environment is also presented. The limitation of the use of plastic waste for construction applications alongside the prospects is discussed. It is concluded that the use of plastic wastes for construction applications will improve the sustainability of the environment significantly, and also serve as a reliable source of materials for construction purposes. In addition, the use of recycled plastic wastes as a component in cementitious composites has been found to be the most beneficial as it can be used to replace all solid components of the composite. Finally, areas for further studies are also presented.

1. Introduction

Urbanization and changing human lifestyles are major contributors to the high volume of wastes generated and disposed of annually. There are human activities, in product manufacturing and post utilization that generate wastes. Yet, these wastes are mostly managed by disposal into landfills. However, high costs associated with landfilling, coupled with its ineffectiveness in some less developed precinct, and land-space consumption, can be a major constraint to the management of these wastes. The volume of solid wastes generated increases annually, whereas only a limited amount is recycled and landfilled, and a large proportion of wastes such as plastic wastes (PW) are deposited directly or indirectly to the marine environment.

One of the solid wastes generated in large quantities and being of a high threat to the sustainability of our planet is plastic wastes. It has been reported that damage occurs to ecology, economy, and aesthetics when plastic debris enters into oceans [1]. About 300 million metric tons of plastic wastes have been estimated to be generated annually [2]. Large quantities of

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plastic wastes are generated all over the world, because of its vast application, such as in automotive, manufacturing, packaging, and healthcare. A report by the Environmental Protection Agency [3] has shown that out of several tons of plastic wastes generated annually, only 7% is recycled, about 8% incinerated and the remaining are landfilled. However, the high cost and energy associated with the landfilling process have resulted in these wastes being deposited in water bodies. In addition, the low biodegradability of plastic poses a huge limitation on its recyclability and disposal into the environment. Therefore, finding applications where plastic wastes (PW) are useful will proffer a sustainable way to its management. In addition, reuse and recycling of plastic wastes have been found to be more effective when compared to landfilling and incineration [4].

Notable attempts such as source reduction, reuse and landfilling have been employed to reduce the critical amount of PW generated annually. However, owing to rapid developments, there has been a persistent increase in the amount of PW generated. Therefore, finding effective alternative ways to recycle this plastic waste will go a long way to ensure a sustainable environment. Recycling PW will prevent contamination of the environment and will add value to the PW by creating an avenue to incorporate these materials for different applications such as in construction. The opportunity to use these PW for construction applications will not only conserve the marine environment but reduces the overall environmental threat the production of these plastic imposes. In addition, the possible use of PW for construction applications will help the construction industry to achieve its sustainability objectives. Significant reduction in energy consumption and carbon emission will ensue when the PW is reused as the amount of new plastic processed and produced will reduce.

Several types of plastic wastes exist, and the most common ones in waste streams are polyethylene and Polyethylene terephthalate (PET). As recycling of PW has been found to be effective, different ways to recycle these wastes have been extensively explored by the packaging industry, however, its use in the construction industry is less common.

The construction industry is a promising sector where PW can be beneficially used for various applications, mainly because it is the largest industry in different economies and the highest consumer of raw materials. PW can be used as a civil construction material in the form of aggregate in cementitious and asphalt mixtures, filler, insulation, etc. However, despite the huge potential for the application of PW in construction, its use and development are still very limited. Therefore, this paper covers the current application of PW for various construction applications, alongside the current limitations facing its use. The potential areas to further the development of plastic recycling and research programmes are also articulated.

2. Environmental issues emanating from plastic disposal

Plastics are used in large quantities due to their beneficial properties such as lightweight, high impact resistance, ability to form it into different shapes and resistance to bacteria. However, as it is largely utilized so also there is a consequential amount of wastes generated. A larger percentage of plastics produced are used for a one-time (short term) application while about one-fourth is used for long term applications such as pipelines. This short span usage of plastics has led to a consequential increase in plastic wastes generated annually and improperly disposed of in the environment. A plastic dumpsite, among several others, found in the western region of Nigeria is shown in Fig. 1. The plastics are disposed of on open land, thereby constituting a nuisance by polluting the environment and occupying valuable land space.

As stated earlier, not only is the high quantity of plastic produce a sustainability threat due to its high energy consumption and carbon emissions during production, but the disposal of its waste a huge threat to the environment. Alassali et al. [5] investigated the concentration of antimony (Sb) in plastics used for manufacturing electric and electronic gadgets. While all the tested plastics exhibited high Sb concentration, certain materials like those used in microwave ovens have Sb above a threshold level (800 mg/kg), however, their study concluded that concentration of Sb is mostly dependent on the type of polymer used for the plastic production.

Despite the intervention of governments to enact laws and policies that prohibit the use of plastic bags in certain regions, so many nations are still far behind in this regard [6]. Inadequate management of plastic wastes has led to its disposal in places such as the marine environment. Not only did these plastic wastes find their ways into the marine environment, but they are also consumed by animals, and end up in human foods. In contrast to other solid wastes generated, the disposal of PW is plagued due to the non-biodegradable properties of most types of plastics [7]. Alas, the degradable ones take a long period depending on the conditions to which they are subjected [8,9]. Consequently, most of PW end up in an environment where they are conveyed to the marine environment due to various precipitation phenomena. While policy-makers have

Fig. 1. Plastic waste dumpsite located at Ogere town, along Lagos-Ibadan expressway, Ogun State, Nigeria (Photo courtesy of Paul Awoyera).

been stimulated to introduce ideas that help to reduce plastic production and consumption [10], the perception of different stakeholders must be understood so as to tackle issues relating to plastic production, its wastes and recycling.

3. Recycling plastic wastes

Compared to other materials used in large quantities such as paper, ceramics, glass and aluminum [11], plastic is less recycled. Owing to the numerous stages entailed in plastic recycling - production, distribution, use, disposal and sorting, the entire process of recycling plastic is regarded as complex [12,13].

Nevertheless, plastic wastes can be recycled either mechanically, chemically or thermally. However, before the plastic wastes are recycled, they undergo sorting which is mostly done automatically using technology such as electrostatics, floatation, fluorescence, infrared and spectroscopy. The mechanical recycling of plastic waste involves the physical degradation of the waste by using processes such as grinding and/or shredding [14]. In contrast, mechanical recycling is reported to be somewhat inefficient as a result of the complex nature of plastic waste mixtures, and instead, the majority of plastic wastes are incinerated [15,16]. But it is clear from the literature that mechanical recycling is still the most used technique for plastic recycling. It is effective and rapid to execute.

For recycling chemically, plastic wastes can either be broken down into monomers or chemically modified, which, subsequently, may be used in place of virgin raw materials in the production of new plastic materials. Thermally recycling waste plastics involves heating plastic waste at elevated temperatures to melt them followed by pouring into a mould to form new products. The recycling potentials of different hard plastic products: high-density polyethylene (HDPE), polyethylene terephthalate (PET), polypropylene (PP), polystyrene (PS) and polyvinyl chloride (PVC) was studied by Faraca and Astrup [17]. The study revealed that the detailed characteristics of plastics affect their recycling potential. A comparison of sorting, reprocessing and recycling potentials of various plastics is presented in Fig. 2. The sorting and reprocessing potential of plastics in this category is above 50%. However, PET, out of all the plastic types, exhibits a low recycling potential. It can be deduced that PET may be more suitable for other applications than recycling. In terms of energy value (Fig. 3), both Polyethylene and Polypropylene exhibit higher impact than Polystyrene. This suggests that recycling the former will be of better value to energy consumption and its management. In addition, a study by Hashem et al. [18] showed that plastic wastes exhibit ash contents <2% with calorific values (around 9000 cal/g), which is an indication that high energy values can be obtained when reusing plastic waste as fuel.

As increasing urbanization and population growth are imminent, there will be a corresponding increase in the demand for various infrastructures to be constructed [19]. Therefore, the use of PW for different construction applications seems to be one of the effective ways to tackle this sustainability issue and meet future infrastructure demand.

4. Types of plastics and possible construction application

The construction industry serves as a backbone of every nation and a major contributor to its economy. Therefore, the possible use of waste materials will improve the sustainability of construction processes and practices. The sustainable use of plastic wastes for construction purposes also provides economic benefits. The innovative sustainable use of PW in construction applications will significantly reduce the amount of plastic wastes disposed into the marine environment and will proffer alternative materials to meet the demand of the construction industry. However, in order to use PW for

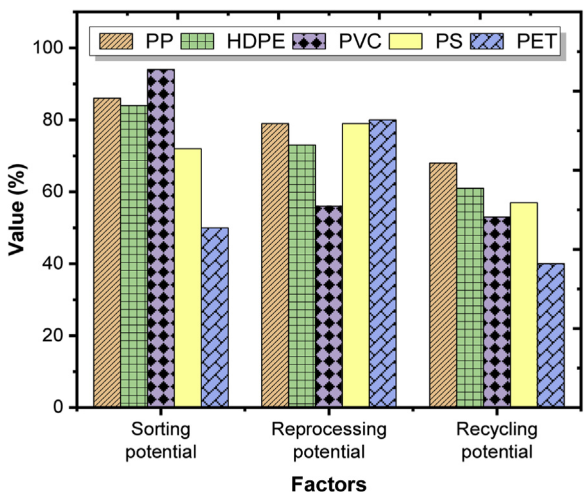

Fig. 2. Comparison of sorting, reprocessing and recycling potentials of various plastics (adapted from Faraca and Astrup [20]).

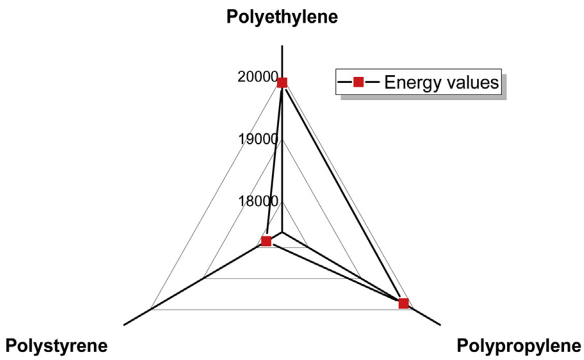

Fig. 3. Energy values (in 0.00233 MJ/kg) of common plastics (adapted from Subramanian [21]).

construction purposes, it has to satisfy both the mechanical and durability properties of the intended application. In addition to the performance of PW as a construction material, it should be cost-effective and sustainable to encourage its use over other types of materials. Waste plastic bags, which are non-biodegradable, have been recycled for the production of floor and wall tiles with lesser flammability and enhanced tensile strength [22]. It has been shown that plastic bags, which routinely contribute to soil and water pollution, can be developed into a lightweight and highly durable products. Hama and Hilal [23] studied the fresh properties of self-consolidating concrete (SCC) incorporating plastic wastes as fine aggregate. The study concluded that the addition of plastic to SCC, at 12.5% by weight of fine aggregate, improved its fresh properties, such as passing ability and filling ability.

Depending on the initial usage of plastics, several types of PW composed of polyethylene terephthalate (PET), High-density polyethylene (HDPE), low-density polyethylene (LDPE), polypropylene (PP), polystyrene (PS), etc. are being generated. A summary of the types of plastic wastes and estimated quantities are presented in Fig. 4, and Fig. 5 shows the typical composition of various types of plastic wastes

It can be observed from Fig. 4 and Fig. 5 that most PW is composed of LDPE, however, the presence of HDPE and PP is also significant and similar to that of HDPE. Table 1 shows the physical properties of some of the plastic compositions listed in Fig. 5 and their possible construction applications after they have been recycled.

Khalid et al. [24] studied the performance of plastic wastes in fibre-reinforced concrete beams. A ring-shaped PET (Fig. 6) was added to the concrete in a bid to enhance compressive strength, splitting tensile, fracture energy, and beam flexural strength. The study showed that plastic fibres added to concrete did not show any significant effect on the failure mode, however, it enhanced the mechanical behaviour of the beams, in terms of first crack load and strength.

Aside from the application of plastic wastes for construction purposes, there are other products that have been developed for general engineering and indoor use. A summary of some secondary products developed using waste plastics as raw materials is presented in Table 2.

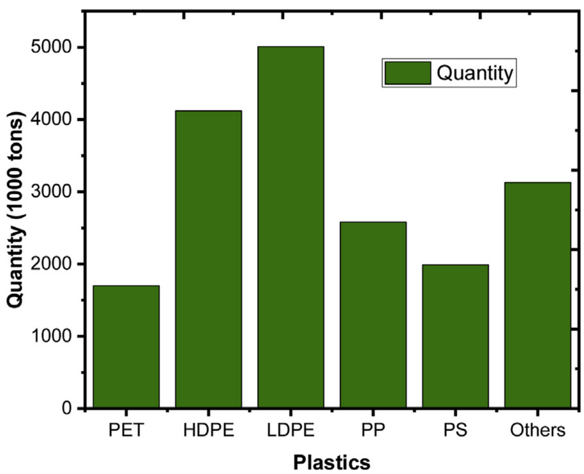

Fig. 4. Types of plastic wastes and estimated quantities (adapted from Subramanian [21]).

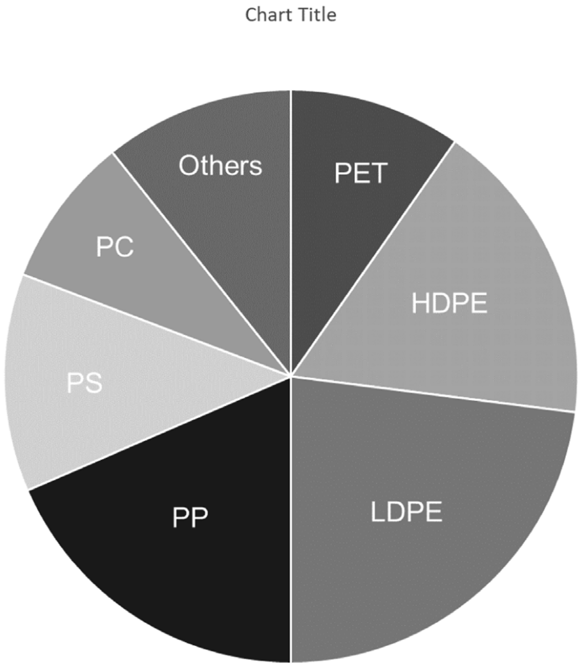

Fig. 5. Composition of plastic wastes (data from Association of Plastic Manufacturers in Europe, 2004).

Table 1
Physical properties and possible construction application of recycled plastic types.

Plastic composition	Physical properties	Possible construction application
HDPE	Rigid	Plastic lumber, table, chairs
LDPE	Flexible	Bricks and blocks
PP	Hard and flexible	Aggregates in asphalt mixture
PS	Hard and brittle	Insulation material
PET	Hard and flexible	Fibres in cementitious composites
PC	Hard and rigid	Aggregates in cementitious composites

Fig. 6. Ring-shaped plastic fibres used for improved concrete beam performance [24].

4.1. Component in cementitious composites

The ability to incorporate various materials during the mixing process of cementitious composites has opened a pathway for the incorporation of various materials into it. Several types of waste materials have been incorporated into the cementitious composite as a binder and aggregate [30–32]. A review by Awoyera and Adesina [33] showed that slag can be used solely as a binder in geopolymer mixtures. Similarly, waste materials such as fly ash, recycled concrete, silica fume, rice husk ash etc., can be used as pozzolans and fillers in cementitious composites [34]. Mechanically recycled PW can be incorporated into cementitious composites as aggregates and fillers due to their hardness and stability. When PW is used in such applications, its chemical composition is of low significance as fillers and aggregates are not expected to alter the hydration process. The use of PW as aggregate in cementitious composites creates an avenue to reduce the strain caused on

Table 2
Products development from processing plastic wastes.

Type of plastic	Other raw materials	Treatment method	Composite/product developed	source
Metallised packaging plastics	layer of aluminum foil	Thermo-delamination of materials at temperature above 500 °C	high-quality aluminum and hydrocarbon fuel gases	[25]
Not specified	–	thermochemical method (pyrolysis)	high-calorific fuels	[15,26]
Not specified	rubber	burning at 1000 °C for three hours	refused fuel	[18]
Waste plastic bags	fly ash (FA) and flame retardant	simple extrusion and compression moulding technique	Floor and wall tiles, road paver	[22]
PET	–	Cutting into flakes	Light weight concrete	[27]
Not specified	–	Shredding and burning	Pellets, flakes, garbage bags and hoses	[28]
post-consumer packaging	–	Pyrolysis	Chemicals and Fuels	[29]

the environment as a result of the mining of natural aggregates. In addition, the lightweight nature of PW makes it a viable component for the production of a lightweight cementitious composite which is advantageous for various structural applications due to the reduction of deadweight [35,36]. However, because plastics wastes have been tagged as an impurity in cementitious mixtures, underlining its potential to weaken the strength of concrete, Research [37] suggested that plastics should not be used in nonstructural concrete.

PW, when shredded, can also be incorporated into cementitious composites as fibres, however, compare to its use as aggregate, the resulting properties of the resulting composite differs. For example, the use of PW as fibre has been found to reduce the slump of the cementitious mixture while an increase in a slump was observed when used as aggregate [38]. Similarly, an increase in the air content of cementitious composite was observed when PW is used as fibre at dosages above 0.3% [39,40]. This increase in air content with the incorporation of PW fibres in cementitious composites can be attributed to the possible introduction of voids into the matrix and another reason is the influence of residual surfactant on the surface. In terms of the mechanical properties, the use of PW as fibre in cementitious composites has been found to have no detrimental effect on the compressive strength [40]. The insignificant effect of PW fibre can be a result of the toughness and hardness of the PW which eliminates the detrimental effect of the voids incorporated in to the matrix. In contrast, the use of PW as aggregate resulted in a decrease in the compressive strength of concrete mixtures, which further decrease with higher PW content [38,39,41]. This decrease in compressive strength can be attributed to an insufficient bond between the PW and the cement paste. Similarly, the use of PW as aggregate in cementitious composites results in lower split tensile and flexural strength.

Considering the permeability properties of cementitious composites incorporating PW, the permeability of the composites has been found to increase with the incorporation of PW as fibre [41]. On the positive side, the abrasion resistance of the composite was improved with the incorporation of PW as fibre [39]. Similarly, the use of recycled plastic as fibres in cementitious composites has been found to be able to control plastic shrinkage [42,43]. Also, significant improvement in the thermal properties of cement-based materials can be achieved when recycled plastics are incorporated [44]. The ability of PW to improve the thermal properties of cement-based material can be attributed to the low thermal conductivity of the PW.

In addition to the previously mentioned use of PW in cementitious composite, few studies have explored the use of PW as a binder to produce polymer concrete that possesses enhanced properties [45]. The PW type used as a binder is polyethylene terephthalate (PET) which is mostly used as a packaging material. The PW is converted into a binder by a process called “transesterification”. The transesterification process uses dibasic acid and glycols to converts the PW into unsaturated polyester resin. After the resin has been formed, it is can be mixed with aggregates to produce concrete or mortar. The study by Marzouk et al. [40] showed that polymer concrete exhibits enhanced mechanical and durability properties. Their enhanced durability can be attributed to the high resistance of PW to an aggressive acidic or alkali environment.

An innovative application of plastic has been explored in reinforcing building plaster [46]. By using 1–2 % of plastic fibres and 5–10 % of glass powder in paste preparation, it was reported that the flexural strength and fragile behaviour of reinforcing plaster beams was improved.

4.2. Base and subbase for road constructions

The use of PW as a replacement for aggregate in base and subbase construction for pavements has been found to improve the shear, stiffness and bearing capacity of the pavement [47]. A similar observation was also reported by Choudhari et al. [48,49] and Jha et al. [50] where they observed enhanced properties in pavement reinforced with recycled plastic strips. Arulrajah et al. [51] also explored the viability of using PW granules alongside demolition wastes as blends for road construction. Their study showed that the incorporation of PW lowers the stiffness, bearing capacity and resilient modulus of the blends, however, the acceptable performance was still achieved. The reduction in the properties of the blends was attributed to the physical properties of the PW (i.e. their smooth surface).

4.3. Components in asphalt

Similar to the use of plastic waste as aggregate in cementitious composites, it can also be incorporated into asphalt mixtures [52]. The use of PW as aggregate in asphalt has been found to improve the skid and crack resistance of the pavement. Costa et al. [56] reported improved performance in terms of stiffness and rutting resistance of asphalt mixtures modified with plastic wastes. Similar observations were also reported by Fuentes-Auden [57] where they reported higher resistance to rutting and fatigue of asphalt mixtures incorporating plastic wastes. The increased performance in both studies incorporating PW can be attributed to the improved resistance of the matrix with the incorporation of the PW. However, 5% was concluded to be the optimum amount of plastic waste that can be incorporated into asphalt mixtures without any detrimental effect on its viscosity. In addition, there is a significant reduction in traffic noise on pavements made with asphalt mixtures incorporating recycled plastic wastes. The lower traffic noise associated with asphalt mixes incorporating PW can be attributed to the ductile behaviour of the matrix coupled with high energy absorption. With several types of wastes obtain from different plastic types, the use of low-density polyethylene (LDPE) and high-density polyethylene (HDPE) plastics have been found to be the most promising in asphalt mixtures compared to other types [56,58]. Nevertheless, studies such as that of Hassani et al. [59] have been carried out to investigate the use of polyethylene terephthalate (PET) plastic wastes as aggregates in asphalt mixtures. Their results showed that there was no significant difference exhibited between the control asphalt mixtures and the mixtures incorporating up to 20% volume of PET plastic wastes as aggregate.

4.4. Filler

Another prospect for the use of PW for construction applications is to be used as fillers. The use of PW as fillers is one of the most effective and easy ways to use it for application purposes as their application is non-dependent on the chemical properties of the RPW. This application is similar to how the RPW is used in cementitious composites and asphalt mixtures.

4.5. Wood replacement

Few studies have been able to produce a wood replacement from PW [53,54]. The PW used was from commingled plastics and after being recycled can be used like wood (i.e. cut, sawn, nailed, etc.). In addition to their wood-like behaviour, they are also more durable than the wood in terms of their weather, biological and saltwater resistance. However, the high cost associated with the recycling of this type of plastic coupled with its bulky nature limits its application. Nevertheless, these types of PW are suitable for railroad ties, fences, boat docks, benches, etc. It is worth mentioning that this type of wood replacement has also been referred to as plastic lumber.

4.6. Door panels

PW can also be combined with wood to produce an eco-friendly door panel [55]. These eco-friendly door panel can be obtained by combining PW in pellets or powder form with cellulose fibre or wood flour to form a thermoformable wood plastic matrix that can be used for door panels.

4.7. Insulation material

Insulations materials are critical components of buildings [56]. However, the economic and sustainability issues related to conventional insulation materials has called for a need to use alternate materials as insulation materials. One of the possible greener alternative materials that can be used is recycled plastic. Particularly, PW in the form of expanded polystyrene (EPS) can be incorporated as insulation material during the construction process. However, the low density of EPS coupled with its fire safety has limited the capability to recycle and transport the recycled materials [57].

4.8. Walls and bricks

PW can also be used as a replacement for conventional block, brick or wood walls. These plastic walls are made by placing recycled plastics in heat moulds and pressing the moulds together to form blocks. However, it is worth mentioning that these types of walls cannot be used for load-bearing applications but are suitable for wall construction applications such as partition walls.

In contrast to conventional bricks, waste plastic bottles can be arranged in a similar format as bricks and used for walls. The waste bottles are connected to each other by inserting the bottleneck of each bottle in the base of another bottle. However, similar to the plastic walls, plastic bricks can be used as a structural material to a limited extent – albeit with a low strength. Similarly, construction can also be made using plastic wastes made up of LDPE. Kumi-Larbi et al. [58] were able to make sand blocks with PW. Their study showed that sand blocks that are strong and durable can be made with no need for water for the manufacturing process.

Akinwumi et al. [59] investigated the use of shredded plastics for the production of stabilized earth blocks. Their study recommends the use of 1% by weight fines shredded plastic wastes of size finer than 6.3 microns for effective block stabilization. In a similar study, Aciu et al. [60] utilized recycled plastic wastes for the production of ecological mortars. The authors concluded that 75% of plastics (PVC) could be used as a partial replacement of sand to achieve mortars that suits the masonry mortars class of M20 grade [61].

Concrete incorporating plastic wastes as partial replacement of sand in fine aggregates constituents has been found to produce good resistance to impact loading [62]. The impact of the concrete increased by 39% when 20% of plastic constituents were used, and with this mixture, a stronger and more energy-absorbing concrete was achieved, which performed well under impact loading

5. Limitations to the application of plastic wastes

Though there exist numerous sustainability and economic benefits associated with the use of PW for construction purposes, there still exist some limitations that inhibit its large-scale use. Some of the major limitations associated with the use of plastic waste for construction applications are briefly discussed as follows:

a) Harvesting: One of the major limitations to the use of PW is its harvesting before recycling. Typically, PW are contaminated with various types of plastics and other materials when collected from various streams in which it is generated
b) Varying composition: In contrast to construction materials such as steel, PW are made up of different grades and types of plastic which might result in a non-isotropic performance when used for construction purposes. Also, the complex composition of some types of plastics such as EPS makes the conventional recycling methods not suitable for its reuse thereby resulting in these types of plastics being deposited to waste and ending up in areas such as the marine environment.
c) Low density: Though the use of low- density materials is advantageous in some constructions; the low density of plastic wastes makes it unsuitable in applications where high toughness and modulus of elasticity are anticipated. This low density also increases its transportation cost as the PW has to be reduced to lower sizes to ensure it fits the limited space available.
d) Lack of understanding: The limited understanding of the performance of recycled plastic especially the long-term performance has limited the use and acceptance of PW by contractors for different construction applications.
e) Low surface energy: the low surface energy of plastics generally results in poor mechanical bonding when used for applications such as those where the PW is incorporated into a composite. This poor bonding can lead to a reduction of the overall mechanical performance of the resulting composite
f) Economical constraints: recycling some types of plastic requires advanced technology which is expensive at the moment thereby inhibiting the ability to recycle these types of materials.
g) Lack of standards: currently there is no standard that supports the use of PW for construction applications. Though extensive studies have been carried out on construction application such as the use of PW in cementitious composites, these applications are still not well standardized commercially.

6. Potential revenue generation through plastic recycling

The potential revenue generation as a result of using PW for different construction applications can be achieved in the following ways:

a) Lower cost of construction materials: since PW are deemed wastes, they are estimated to have little to no value. Therefore, the use of such materials for construction purposes will eliminate the cost associated with conventional building materials and will reduce the overall cost of construction.
b) Reduction in waste management expenditure: Landfilling and incineration are cost-intensive processes that are being allocated a huge sum of money by municipalities annually. The possible use of PW for construction instead of subjecting them to landfills and incineration will result in huge cost savings and serve as revenue used for other important work to be done by the municipalities.
c) Value addition: The possible use of PW will add a monetary value to materials that have been deemed as wastes. The monetary value added to these materials will create an extra source of revenue for stakeholders interested in recycling waste materials and manufacturers of plastics
d) Reduction in energy cost: The use of PW as insulation material will improve the energy efficiency of buildings, thereby reducing the overall costs associated with running buildings.
e) Lower transportation cost: the viability to use RPW for construction applications will create an avenue to use locally generated plastic wastes, thereby reducing the high cost generated by transportation of construction materials. For example, the local availability of RPW that can be used as aggregates in the cementitious composite will eliminate the long hauling and transportation cost associated with the transportation of aggregate. In addition, attributing financial costs to carbon emissions; the reduction or elimination of transportation of some building materials will reduce the detrimental pollution emitted into the environment during transportation.

7. Conclusion and future perspective

Plastics play a significant role in our society, and wastes generated at the end of the usage of these plastics are inevitable. Therefore, in order to properly manage these plastic wastes while improving the sustainability of the environment, their use for various construction applications is a viable option. This overview has explored extensively the current research that has been done on the use of various recycled plastic waste for construction applications. Based on this overview, the following conclusions can be drawn

- The use of PW for construction applications will solve both the solid waste management problem and depleting deposits of raw materials used for construction purposes. In addition, the use of PW in different construction applications supports the sustainability trend of a circular economy.
- The use of PW for construction applications creates a pathway to use these wastes for long term applications compared to short term ones such as recycling into new products which will end up as waste within a short period of time.
- The possible use of PW as binder, aggregates and fibres makes it a viable replacement for all components in cementitious composites, with somewhat acceptable detrimental effects on the performance of the resulting composite.
- The use of PW for various construction application will lead to various revenue generation

Despite the numerous limitations of the application of plastic wastes for construction applications mentioned earlier there still exists a great prospect of its use with the progression of research and technological advancement. Also, it is anticipated that the government and construction regulatory body will put forward regulations that will encourage the use of recycled wastes such as RPW for construction purposes.

Declaration of Competing Interest

There is no conflict of interest between the authors.

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