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A Cursory View of Plastic Applications in Four Consumption Sectors

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Abstract

The challenges and negative externalities associated with the use of plastics have come to greater light as a result of the extensive use and applications of the product. Waste management, sanitation, health and environmental problems are all over constituting nuisance, overshadowing the numerous benefits of plastics in variegated types of consumption sectors. This review paper commences with the negative externalities of plastics. It then delves into the benefits, uses and applications of plastics with particular reference to health, automobile, food packaging and building and construction sectors. The paper observes that negative externalities of plastics can be reduced to the minimum through the use of technology. In designing plastic waste-reduction technologies, one of the bio-related technologies that came into sharp focus, apart from bio-based and biodegradable plastics is biofiber-plastic composite technology. As a relatively new area of study, the paper recommends that both industry players and researchers should collaborate to advance in this area of research.

Keywords: Automobile; Food Packaging; Health; Negative Externalities

1. Introduction

Globally, the production of plastics has been encouraged by the demand for its facilitation of societal advancement (North & Halden, 2013). Over the past century, and particularly between 1964 and 2014, the production of plastics in global terms has reached as much as 311 metric tons (Plastics Europe, 2015). This is due to the unique composition of plastics as an intricate network of monomer molecular bonds in the formation of macromolecules. Presently, between 10 and 20 plastics form the majority of plastics in use globally (Trucost, 2016; Association Plastics Manufacturing Europe (APME), 2006). The use of plastics has brought in its wake some concerns to human societies. For example, plastics contain Bisphenol A (BPA) and di-2-Ethylhexyl phthalate (DEHP) which when exposed to humans has the potential to toxify organs and tissues (Halden, 2010).

The negative environmental externalities associated with the production, use and disposal of plastics has thus been of concern. In terms of environmental costs, the use of plastics in consumer products with reference to land and air, water pollutants, production of marine debris in the global oceans, emissions of greenhouse gases, water depletion was over 139 billion dollars, an equivalent of 20% of the revenue obtained from plastics in 2015; the potential growth could reach 209 billion by 2025 if the current trends continue (Plastics Europe, 2015).Despite the adverse e effects and impacts of the use of plastics, the benefits to society cannot be overemphasized, especially within the automobile, health, packaging, and building and construction sectors for several reasons. Plastics are light in weight, cost-effective and needs relatively less energy to produce; and may be bio-compatible and single-use disposable (IBIS World, 2015). Plastics can be produced as a flexible, soft, transparent and or biodegradable material to suit various applications and use for engineering purposes (Souhrada, 1988). Over 50% of global productions of 311 million tons of plastics are disposed within one year after purchase (IBIS World, 2015; Plastics Europe, 2015; Souhrada, 1988).

The four major techniques by which plastics may be disposed of include incineration, landfilling, recycling and biodegradation (Hopwel *et al.*, 2009). Though landfilling is the simplest and most straightforward, it has two major disadvantages. One, landfilling requires space. The piece of land that may be used for agricultural and structural development purposes may have to be sacrificed thus creating competition. Two, there is a loss of chemical and thermal energy as a result of the plastic being buried and covered with earth. In the long term, landfilling is thus unsustainable due to the nonrenewable nature of land as a resource. A better disposable alternative of disposal is incineration. However, incineration also has its peculiar shortcomings. Though incineration retrieves some of the energy in the plastic, its adverse health and environmental consequences could become burdensome to the environment and living matter. This is due to the release of carbon dioxide which is a greenhouse gas (Tyndall, 1861 Feb); polycyclic aromatic hydrocarbons (PAHs) (Shemwell, 2011) which has carcinogenic; and dioxins (Yasuhara, Katami & Shibamoto, 2005). Recycling is a means of recovering some of the materials of the used plastic. The primary challenge is the sorting of general waste substances and the numerous types of specific plastics. Biodegradable plastics are designed to degrade through biological organisms and thus degrade naturally within a relatively short period concerning pure plastics that may take over a century to degrade. The challenge with biodegradable plastics is twofold. First, the period for degradation may be extended enough to avoid accumulation from continuous disposal thus causing environmental degradation. Second, as a result of similar appearance, though peculiar composition, biodegradable plastics may contaminate and disorganize the present stream of recycling (Hopwell, Dvorak & Kosior, 2009). There is also the loss of matter and energy.

Though the use and application of fresh and recycled plastics have benefits that far outweigh that of similar materials such as paper, steel, aluminum and glass (Franklin Associates, 2013; Denkstatt, 2011). Some of the challenges associated with recycling include sorting, fluctuation of oil prices in the global market, quality of the recycled plastic (Hopewell *et al.*,) and interfacial deficiencies of plastic-fiber composites (Eng, Ibrahim, Zainuddin, Ariffin & Yunus, 2014).

However, theoretically, the application of recycling as a waste disposal solution appears to be the best option. Though bio–material and plastic composites have limitations, the benefits in applications and as a recycling tool to deal with environmental pollution and negative externalities have invaluable benefits (Olusunmade*et al*. 2016; Temistope, Abayomi, Ruth &Adeola, 2015; Eng, Ibrahim, Zainuddin, Ariffin &Yunus, 2014; Hassan, Tesfa–Micahel & Nor, 2014; Jawaid, Khalil & Bakar, 2010; Salema, Hassan, Ani & Bakar, 2010).

The benefits of plastic use and application are manifold. The British Plastics Federation reported (2017) that plastic products save and conserves power and energy. For example, due to its insulating properties, PVC is used in thermosets for handles, light fittings and switches and wire insulation. Also, there are savings of a maximum of about 40% when plastics are used instead of other options regarding fuel costs and transport pollution savings. Additionally, concerning the weight, plastic carrier bags are reduced by six folds. Through the use of injection molding to manufacture products, between 20–50% less energy is further used as about 12 years ago.

Furthermore, if all electrical machines should be made of plastics, savings could be as high as 75%. It is further observed that when plastics are used to convey water from one point to another a substantial amount of water savings is made. Regarding durability, PVC-U, for instance, employed as double glazed windows and doors, could have a lifespan of 35 years,and could also be maintained quite easily. It can, therefore, be inferred from the preceding that more sustainably , the use of plastic recyclates in the form of plastic-bio-material composites coupled with various actions in the supply chain processes and life-cycle management regimes will inure more significant benefits of plastic usage to human societies.

2. Why not Plastics?

It appears societies, in general, have treated plastics like that dog who was given a bad name to hang it. The problems associated with plastics and the disadvantages related to its use have always been touted across the length and breadth of the globe (Onu, Price, Surendran, & Ebie, 2012). For example, concerns have been raised with the application of DEHP as a plasticizer used in polyvinyl chloride (PVC). The fear is that DEHP is not chemically bound to PVC and therefore has the possibility of leaching out (Acton, 2012). For instance, studies have shown among human beings and rodents that there is a correlation between DEHP exposure and health effects such as male and female reproductive systems, insulin resistance and increased waist circumference (Acton, 2012; Swan, 2008; Hauser, Meeker, Duty, Silva & Calafat, 2006).

Another issue of concern with this chemical is that, usually, environmental exposures do not occur in isolation, generally referred to as the “cocktail effect” (Hauser, Meeker, Duty, Silva & Calafat, 2006). Thus the presence of DEHP and its negative consequences is accompanied by other chemicals with other negative consequences as well. Other plastics which have harmful impacts and are still under study include polyhalogenated flame retardants (e.g., polybromin ateddipehnyl ethers); antimicrobials (e.g., triclosan and triclocarbon); and polyfluorinated compounds (e.g., polyfluoroalkyl compounds such as perfluorooctane sulfonate or PFOS) (North & Halden, 2013).

Another chemical found in plastics, bisphenol A (BPA) has also been found to have negative health impacts on humans (North & Halden, 2013). A study in the US found bisphenol A in the urine of 95% of the adult population in the US (Vandenburg, Hauser, Marcus, Olea & Welshons, 2007). Several studies have shown that there are correlations between exposure of BPA and perilous health and reproduction impacts including decreased male fertility, early sexual maturation, and aggressive behavior among others (Halden, 2010; Diamanti–Kandarakis, Bourguignon, Giudice, Hauser, Prins, Soto, Zoellar & Gore, 2009; Richter, Birnbaum, Farabollini, Newbold, Ruben, Talsness, Vandenberg, Walser–Kuntz & vom Saal, 2007; Safe, 2000). Currently, the Food and Drugs Administration of the US has banned the use of BPA in toddler containers (Federal Register) while the European Union and Canada have also banned its use in baby bottles (European Food Safety Authority).

The negative externalities of plastics on global oceans have also been of concern to researchers, academia and environmentalists. As Earth's natural life support body the oceans are critical in sustaining life on the planet. Global oceans provide food and act as an income source to tens of millions of people around the world. The oceans also contribute to livelihoods, culture and well–being of numerous communities across the length and breadth of the planet (Trucost, 2016). However, there has been an imbalance in the management of waste into the oceans such that, 80% of marine litter and debris which gets into the ocean annually originates from land (Jambeck, Geyer, Millcox, Seigler, Perryman, Andrady, Narayan, Lavender, 2005) while the remaining 20% is ocean-based (Allsop, Walters, Santillo & Johnston, 2006). Whereas both land and ocean-based marine debris arise from both legal and illegal poor waste handling practices, land-based marine debris results from littering, solid waste disposal, landfills, stormwater discharges, industrial activities and combined sewer overflow; the deposition being through wind, blown, washed or discharged by rain through waterway and snowmelt (Shearly & Register, 2007).

It is sad to note that between 60 and 95% of marine debris that gets into global oceans are plastics (Moore, 2008). Plastics in the oceans take relatively long time to degrade; for some, decades. Plastic debris cause economic, health and environmental risks. Plastic debris can also entangle marine animals, spread invasive species and ingested by marine animals. Ingested debris can reduce reproductive ability; reduce general quality of life of ocean animals, disrupt the digestive system, which can cause starvation and malnutrition and finally death (Gregory, 2016). Regarding tourism and recreation, marine debris from plastics at the beaches is a disincentive to the economic and environmental development and the global development. It is also worth noting that plastic litter on land has become very difficult to contend with, particularly in developing nations. In Nigeria, for instance, plastic waste account for over 65% of municipal waste (Okeniyi & Anwam, 2012; Urama, Ukwueze & Aneke, 2012; Onu, Price, Surendran, & Ebie, 2012); a large chunk arising from sachet water consumption (Urama et al., 2012). Despite all these negative externalities, plastics have numerous benefits, uses and applications, both environmentally and economically when compared with other engineering materials such as glass, metals, wood and ceramics.

3. The Health Sector

Through progressive, improvement in technology, there has been a production of a list of variegated types of plastics that have gone to improve quality of human life, particularly public health (North & Halden, 2013). It is worth noting that in various sectors of human society, wood, metal, fibers and glass have been replaced with plastics in consumer products such as food packaging, dishware, personal care, clothing, food, electronics and athletics among others (Andrady & Neal, 2009). The underlying factors of these applications, fundamentally, are the lightweight nature of plastics, inexpensiveness regarding cost and the ease with which they can be disposed of (Holmgren, 1974). The applications of plastics in public health delivery can be viewed with respect to tissue engineering, healing processes, intravenous (IV) bags and tubing, pharmaceuticals, orthopaedics and syringes (North & Halden, 2013).In tissue engineering, the use of plastics has enabled the design of various structures as well as biodegradable components through the use of polymer scaffolds (Liu, Hozwarth & Ma, 2012). Concerning healing processes, to heal patients, polymers are used to produce absorbable sutures designed, depending on the patients' requirement, to biodegrade within specific periods of time (Pillair & Sharma, 2010).

Intravenous (IV) procedures are by far the fastest means by which medicines and fluids are delivered into the bloodstream of patients when the need arises. Plastic bags and tubing, by their disposability have made these transfusion procedures quick, simple and more feasible. It is estimated that between a substantial 20 and 25% of all hospital waste are from intravenous (IV) bags and tubing (Lee, Ellenbcker & Moure-Rtaso, 2002). As bone cement, the plastic polymethyl-methacrylate has been of prominent use in the field of bone surgery in the field of orthopaedics; the application of plastics as a controlled drug delivery system in the field of pharmaceuticals is also well established in health delivery systems (ASM International). The indispensability of syringes in public health care delivery has been well acknowledged by both patients and healthcare workers through single-use and reusable applications (Battersby, Felden & Nelson, 1999). Since the early 1980s the use of disposable syringes have been in vogue as a time-saving measure to save time for equipment sterilization; and inexpensiveness of plastics and for safety purposes with particular reference to dangers in transmitting blood-borne infections such as Human Immunodeficiency Virus (HIV)/Acquired Immune Deficiency Syndrome and Hepatitis B through contaminated used needles (Battersby *et al.*, 1999; Steinglass, Boyd, Grabowsky, Laghari, Khan, Qavi & Evans, 1995). Through innovative designs total plastic serializable syringes are being produced and used for both reusable and throwaway medical purpose (North & Halden, 2013).

4. The Automobile Sector

The lightweight property of plastics results in the reduction of transportation cost and, consequently, carbon dioxide emissions into the atmosphere. In the manufacture of public and private transport vehicles, over 20 percent of plastic materials are used to produce various components such as electrical components, electronic components, parcel shelves, steering wheels, door handles and liners, bonnets, bumpers, wheel caps and roots among others (Andrady & Neal, 2009). Plastics for auto parts include polypropylene, polyethylene, and polyvinyl chloride. The rest include polystyrene and PET. The combustion of fossil fuels in the transportation industry for the propulsion of vehicles makes the sector one of the major producers of greenhouse gas emissions globally and particularly the USA (NASA, 2009), contributing about 26% of total greenhouse emissions in 2014 (EPA, 2016a). According to the EPA (2016a) passenger vehicles and heavy-duty trucks are the immense, significant and prominent contributors of air pollutants such as carbon monoxide, benzene, nitrogen oxides, sulfur oxides, hydrocarbons and carbon dioxide. The WHO (2014) has identified air pollution as the main cause of health risk related to cardiovascular diseases, respiratory disorder and related reduction in life expectancy. Apart from the social cost of air pollutants, air pollution is also hazardous to agriculture, crop yields, biodiversity and natural ecosystems (DEFRA, 2013).

With reference to the United Nations Framework Convention on Climate Change, the transportation sector has been given the recognition in the Intended Nationally Determined Contributions (INDC) as a result of its negative contribution to greenhouse gas emissions. Arising from this convention is the target of the European Union to reduce road transport emissions by 70% by 2050, using 2005 emissions as the benchmark (de Wilde & Kroon, 2013). Similarly, the United States government, using 2005 emission levels as the benchmark, has targeted to reduce greenhouse emissions in the transportation sector by 17% by 2025 (IEA, 2015). The adherence of fuel economy standards is therefore essential in achieving these targets through reduction of combusted fuel by transportation vehicles.

Various techniques may be adopted in order to reduce fuel consumption, thus ensuring fuel economy. One of such techniques that could be adopted during the design stage of automobile manufacturing is the selection of lightweight materials from materials properties point of view. For instance, the Boeing Dreamliner is produced using 20 percent plastics as the contribution of plastics to its lightweight characteristics (Andrady & Neal, 2009). Pyper (2012) reports of a study conducted by the United States Department of Energy (USDE) which shows that by reducing a vehicle's weight by 10%, between 6 and 8 percent energy savings can be obtained. Pyper (2012) also reports that manufacturers including BMW and Ford have used plastic composite materials that are 10–50% less in weight about other materials though the durability is comparatively similar. As a lightweight material when compared to metals, with marched other properties such as durability, the quest for plastic materials that ensure fuel economy and efficiency and reduction in environmental pollution will, therefore continuously be searched for (Trucost, 2016).

A study by PE International (2011) indicates that North America has 15.8 percent of the global automobile market share with gasoil- and gasoline-driven passenger vehicles and light trucks accounting for 85 percent of the market. Trucost (2016) estimates that if North American passenger vehicles were replaced by other materials other than plastics an additional 336 million liters of gasoil and gasoline would be required in their operations during the lifetime of 150,000 miles of the vehicles. The environmental cost of production, distribution and combustion would also amount to 2.3 billion US dollars over the lifetime of the vehicles (Trucost, 2016). The Trucost (2016) study concludes that in the North American automobile sector alone, substituting plastics for other materials such as glass and metals and ceramics can reduce environmental cost (greenhouse gases, land and water pollution) by about 90 percent. It is for this reason and others such as availability and durability, stiffness, toughness, ductility, corrosion resistance, bio-inertness, high thermal/electrical insulation, non-toxicity, thus being resource efficient (low cost),that plastics and plastic composites would in the long term, continue to be pursued as a manufacturing material as far as the transportation sector is concerned.

5. The Food Packaging Sector

Plastics used for packaging include polystyrene, ethylene, vinyl acetate, polyethylene and expanded polystyrene. Over 33% of manufactured plastics find its way into the packaging sector, the common products being containers and plastic bags, particularly in the developed countries (FAO, 2011). In the developing countries, this proportion may go as high as 42 percent (Mutha, Patel & Premnath, 2006). In the United States of America using plastics as a substitute for food packaging, such as meat products alone, could save the country 218 million dollars per annum (Trucost, 2016). In Nigeria, over 65% of plastic materials are involved in municipal solid waste, an indication of the extent to which plastic materials are used (Onu, Price, Surendran, & Ebie, 2012). It is estimated that about 33% of all food produced annually is lost or wasted (FAO, 2011).

There are various ways through which food loss may occur. Particular examples include households, retail outlets, and farms, processing and others within the supply chain. For example, in the United States, waste food of about 31% occurs at the retail and consumer stages in the supply chain (Buzby, Wells & Hyman, 2014). Whereas about 40% food loss occurs at the post-harvest processing stages in industrialized regions of the world (FAO, 2011), it is estimated that over 60% of household food waste happens as a result of shorter shelf life or perishable nature of crops (WRAP, 2016). In addition to the loss of food as the economic cost to various countries, there are additional cost due to the natural resources and environmental cost that is expended in producing lost and wasted food. In the United States, for instance, the environmental impact and natural resources involved include 15% of energy budget (USDA, 2012); 80% of all freshwater use (USDA, 2015a); and 51% of land use (USDA, 2015b). Thus in the US 4% of total oil consumption is wasted on lost and wasted food while 25% of all freshwater use is expended in this regard (NRDC, 2014). Additionally, whereas 34% of the 3.3 billion Mt of CO_2 carbon footprint is from waste cereals, that of meat is 21%, concerning food waste decomposing to release methane in landfills (FAO, 2013).In

Europe and North America alone, increasing plastic packaging waste recovery to a minimum of 55% and reducing landfilling could raise an amount of 4.8 billion US dollars per annum; and this amount could increase to 7.9 billion US dollars if plastic products are included (Trucost, 2016).

Despite such developments, packaging of food products could reduce these staggering developments, with fact that consumers would normally prefer fresh products (Trucost, 2016). Denkstatt (2015) has shown that packaging techniques such as vacuum skin packaging (VSP) and Modified Atmosphere Packaging (MAP) to extend the freshness of food products. Trucost (2016) has also shown that using improved composite (of polystyrene, ethylene, vinyl acetate and polyethylene) skin packaging could improve loss and waste of food products. For example, applying the improved composite skin packaging instead of conventional packaging (expanded polystyrene tray sealed with a plastic film with a modified atmosphere) could reduce environmental costs by 606 US dollars per metric ton of sirloin steak that is wasted. Environmental cost concerning emission of air, land and water pollution, greenhouse emissions, water consumption; the cost of land excluded (Trucost, 2016). Thus 544 metric tons of food waste could be prevented in the US alone annually if one percent of sirloin sold is packaged using improved plastic packaging instead of conventional packaging. The call for improved and composite plastic development is, therefore, in the right direction to reduce economic, natural resource and environmental costs.

6. Building and Construction Sector

The living standards of every society are a reflection of its development regarding the building and construction evolution over a period (Gardi, 1973). Apart from air, water and food, shelter becomes the most important need to humanity (Ede, 2011). However, the provision of adequate building and construction demands of both developed and developing countries have become difficult to be met. For instance, according to Lee et al. (2006), in most developed nations, there is an inadequacy in housing needs due to the continuous use of conventional building technologies which tend to waste resources. In developing countries, housing challenges include overcrowding, high building densities, poor health, acute environmental and sanitary challenges, substandard houses, and inadequate spaces for open air between houses (Ede & Ogundiran, 2014).

Polymer Converters Ltd (2006) reports that dealing with building and construction challenges calls for the introduction of new materials in the building and construction industry, and plastics appear to be the best alternative. Dissolved or dispersed plastics, for instance, are used in the production of adhesives, paints and varnishes. Currently, plastics are mainly used in the production of sheets, pipes, thin coverings, foams, panels, etc. Plastics are also applied in façade panels, exterior covering, weather boarding, windows, rolling shutters. For interior coverings, for example, they are employed in wall lining; floor covering ceilings; counter ceilings; roof coverings; roof tightness; domes; lightning elements; sanitary equipment and piping; and insulation.

One of the few plastics that have been found to be useful in the industry is expanded polystyrene (EPS). Expanded polystyrene has found numerous uses and applications in the building and construction industry due to its unique properties. Its applications include insulation foam for roofs, closed cavity walls and floor insulation. Other applications involve road construction, floatation, bridges and drainage systems. It is also used in EPS 3D reinforced wall systems, performing the dual functions of compressive force transfer and corrosion resistance (Ede & Ogundiran, 2014). From an economic point of view, expanded polystyrene ensures good product quality, is low in cost, and lower building and construction completion rate (Wahab, 2011).

Environmental advantage of polystyrene is rooted in energy consumption and transfer in building and construction products. As an advanced polymer expanded polystyrene has been found to be quite useful in large structures such as bridges; embankments; slope stabilization; public buildings; road constructions; railway lines; retaining walls such as dams and weirs; basements; and household residences (Green Passive Solar Magazine, 2012). Among lightweight aggregates, expanded polystyrene has found its way in the production of slag, EPS beads and fly ash (Chen, Zeng, & Zhou, 2012)). As an artificial material, EPS beads are used as a partial or total replacement aggregate to achieve expected properties and strength. Lightweight concrete is used in the formation of cement-foam composites. EPS is also employed in permanent form work as a composite construction material with a sandwiched core (Boni & De Almeida, 2008). EPS panels are also useful in wall panelling and floor slabbing. In a nutshell expanded polystyrene is moisture resistant, has remarkable thermal resistance, is cost-effective, ease of installation which leads to high product completion time, better strength, durable, good acoustic property, design versatility, flexible mechanical properties, environmentally friendly and low production cost (Ede, Alegiuno & Awoyera, 2014).

7. Conclusion

The disadvantages and challenges associated with the use of plastics have been touted all around the globe to the extent that the good side of plastics has been relegated to the background. Whereas the truism of the limitations of plastics have been established more or less, plastics have more significant advantages as compared to engineering materials such as glass, steel and paper. In various consumer applications such as public health, automobile, packaging and building and construction, to mention a few the benefits, uses, and applications are incalculable. Nevertheless, there is room for improvement to reduce the darker side of plastic usage and applications. This paper supports interventions suggested by Trucost(2016) by which the limitations associated with plastics use and applications could be reduced. Firstly, there is the need for environmental leadership in the plastic industry. Since plastic manufacturers have direct and indirect control of supply chain management activities, the industry is well grounded and positioned to act as a leader in ensuring the advanced improvement of environmental performance. In short to medium term, enhanced use of renewable energy such as hydro, wind and solar for electricity and fuel economy for the logistic fleet with the industry can remarkably reduce environmental costs. Innovating alternative feedstock technologies, improved design in recyclability can also help reduce environmental cost. Secondly, by adopting innovative plastic applications, environmental efficiency could be enhanced. Improving plastic packaging efficiency (light-weighting for example), for instance, can reduce plastic waste and thereby enhance environmental gains, by reducing demand for energy and raw materials. Encouraging reuse of plastic products could also go a long way to reduce waste management and environmental costs.

Thirdly, a complete seizure of accumulation of plastic waste into the ocean can help reduce environmental costs. This can be achieved by enhanced waste management practices on land and on oceans such as increasing the rate of municipal waste collection, efficient material and energy recovery, prevention of waste leakages, reducing harmful plastic additives that may leach into streams, rivers, lagoons, and oceans. Fourthly, the introduction of the circular plastic economy, whereby energy recovery practices are coupled with recycling of post-consumer plastic waste can positively impact on environmental costs. Introducing enhanced standardization of packaging format systems and materials will encourage sorting and separation which are two major processes that militate against recycling of plastic materials. There is also the need to adopt accounting techniques that can better evaluate actual environmental, economic and social costs associated with post-consumer wastes so that enhanced targeting of subsidies and incentives related to waste management systems could be estimated adequately in the planning process.

This paper is of the view that in designing plastic waste-reduction strategies, one of the bio-related technologies that come into sharp focus, apart from bio-based technologies and biodegradable plastics is bio-fiber plastic composites. Bio-based plastics are derived from commodity food crops such as sugar, grains or vegetable oils. It is estimated that the use of bio-based plastics (bioplastics) has the potential to reduce greenhouse gas life-cycle emissions, to a considerable extent, compared with petroleum-based plastics. Biodegradable plastics may be derived from renewable biomass (bio-plastics) or from petrochemicals with biodegradable enhanced additives to address the challenge of persistent plastic debris into water bodies. As a recycling strategy, the design of biofiber-plastics has attracted the attention of engineers, researchers and academics as well as industry players. Bio-fibre-plastic composites are composed of fiber from biological plants and plastics. Apart from contributing to enhanced waste management, the production of bio-fiber-plastic composites captures energy and materials that would otherwise have gone to waste. When waste plastics are collected and utilized in the production of engineering materials sanitation is improved thereby directly and indirectly reducing public health and environmental cost. Composites so produced may also substitute or supplement some existing products. The manufacture of such composites is easy and simple.

Nevertheless, bio-fiber composites have their limitations. One major limitation is the hydrophilic nature and adhesion between fiber-plastic interfaces of the product. It is in this light that there is the need for further and continuous research and studies in the design of bio-fiber-plastic derivatives. Since various bio-fibers are available, it is high time such studies are made to ascertain which design can circumvent the limitations associated with the design, manufacture and usage. Characterizing the manufactured product in the laboratory will be a step in the right direction as which design could be suitable for what applications. Biofiber-plastics could be applicable in the building and construction industry, automobile industry, packaging industry, public health industry among others. This paper, therefore, recommends that researchers and industry players should collaborate to advance studies in this area of materials technology to deal with the environmental, economic, and social costs related to the use of plastics.

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