

Plastic Waste Recycle for Industrial

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Abstract. The high-income countries are leading to higher consumption of plastic, despite prominent contribution to the global problem of plastic pollution. The high quantities of plastic wastes are extremely threatening to harm the environment and inhabitants due to mismanagement such as ingested in the fish and also harmful to human health (cancer is a major disease) if such consuming a fish. This review paper explored a solution to treating plastic waste to improve the sustainability of the environment. The use of recycled plastic wastes as a component has been found to be the most beneficial as it can be used to replace all solid components.

Keywords: higher consumption of plastic, plastic wastes, recycled plastic wastes

1. Introduction

Urbanization and changing of human lifestyles are major contributors to the high volume of wastes generated and disposed of annually. There are social activities, in product manufacturing and post utilization that create wastes. The number of solid wastes generated increases annually. In contrast, only a limited amount is recycled and landfilled, and a large proportion of rubbish, such as plastic waste (PW) are deposited directly or indirectly to the marine environment [1].

One of the solid wastes generated in large quantities and being of high threat to the sustainability of our planet is the plastic wastes. It reported that damage occurs to ecology, economy, and aesthetics when plastic rubbish enters into the ocean [2]. The large quantities of plastic wastes generated all over the world because of its vast application, such as in automotive, manufacturing, packaging, and healthcare [3].

Per capita consumption of plastic continues to increases and remains at a high level in high-income countries [4]. The global plastic production is expected to continually increase from 300 million ton in the 2015 to 1800 million ton in 2050 [5]. The degradable of plastic wastes ones take a long period depending on the condition to which they are subjected [6], [7]. Consequently, most of PW end up in an environment where they conveyed to the marine environment due to various precipitation phenomena

[8]. The large consumer demands for plastic packaging materials, mostly short-term and single-use materials designed for immediate disposal after use, have resulted in tremendous amounts of PW to be managed for treatment and disposal [9]. While policy-makers have been stimulated to introduce some ideas that help to reduce plastic production and consumption, the perception of different stakeholders must be understood to manage issues relating to plastic production, its wastes, and recycling [8].

2. New challenges in waste management

The effective management of PW requires appropriate identification, collection, separation, storage, transportation, treatment, and disposal, as well as associated critical aspects including disinfection, personnel protection, and training [10]. Plastics have calorific value comparable to conventional fuels (Table 1) [11]. The assumption (e.g., the incentives, taxes, oversimplification on exact a plastic composition, collection system) made during the planning of the waste management system is suddenly no longer fully valid. They justified by the need to achieve levels of collection, recycling, and recovery defined as a political level, which has led to under-sizing of recovery and disposal nor sustainable [12].

Table 1. The calorific value of plastic and the exhaust gas released by incinerating MSW, hazardous waste, and sewage sludge [10]

Type of Plastics	LHV (MJ/Kg) [11] ^a [13] ^b
PE	42-45 ^a
PVC	15-25 ^a
PA	36.76 ^b
PET	21.81 ^b
PP	30.90-45 ^a
PS	38.97-40 ^a
Fines	15 ^a
Type	Exhaust gas release (m ³ /kt)
MSW	5.5
Hazardous waste	7.0
Sewage sludge	8.0

The PW 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, floating, fluorescence, infrared, and spectroscopy. The mechanical recycling of PW involves the physical degradation of waste by using processes such as grinding and/or shredding [14]. The recycling potential of different hard plastic products: high-density polyethylene (HDPE), polyethylene terephthalate (PET), polypropylene (PP), polystyrene (PS), and polyvinyl chloride (PVC) is presented in Fig.2. HDPE, LDPE, PET, PP, PS, and PVC are commonly used plastic resins in packaging applications for a variety of products, including bottles and tubes, pack and cups, trays, bags, caps, bubble wrapping and films, containers, and many others [5]. 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 [15]. A summary of the types of plastic wastes is presented in Fig. 1. Most PW is composed of LDPE. However, the presence of HDPE and PP is also significant and similar to that of HDPE. Table 2 shows the mechanical properties of the construction application of recycled plastic types.



Figure 1. Plastic wastes composition [1]

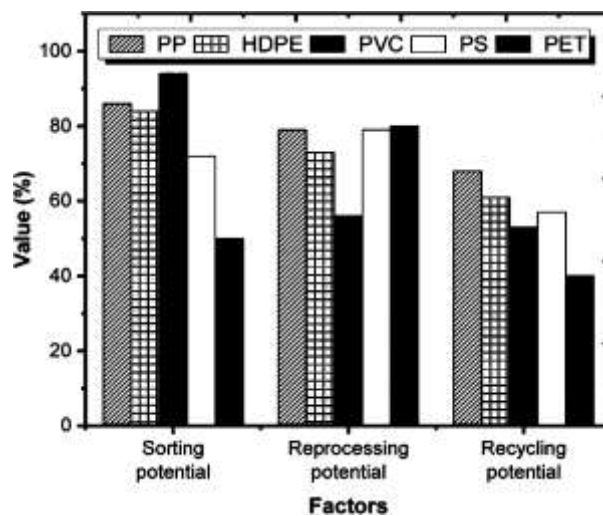


Figure 2. Comparison of sorting, reprocessing, and recycling potentials of various plastics [15]

Table 2. Mechanical Properties construction application of recycled plastic types [1].

Plastic composition	Mechanical Properties	Possible construction application
HDPE	Rigid	Plastic lumber, table, chairs
LDPE	Flexible	Brick and block
PP	Hard and flexible	Aggregates in asphalt mixture
PS	Hard and brittle	Insulation material
PET	Hard and flexible	Fibers in cementitious composites
PC	Hard and rigid	Aggregates in cementitious composites

The utilization of PW in the manufactory of another material is a partial solution environmental that will reduce the proportion of PW incineration of landfills. The enviromental and economic performance of different PW management approaches is presented in Fig.3. Pyrolysis and gasification are in development, stimulated by the request of a more sustainable wastes treatment option [12]. An economic assessment proposes the present scenario is sustained by a tipping fee that is continuously rising due to the high costs of transportation toward the treatment processes, both those for recovery as well as those for disposal [16]. The development and production of PMC (polymer matrix composite) using nature reinforcement and PW are a promising solution for recycling the waste and utilization of such waste as a renewable source for beneficial use [17].

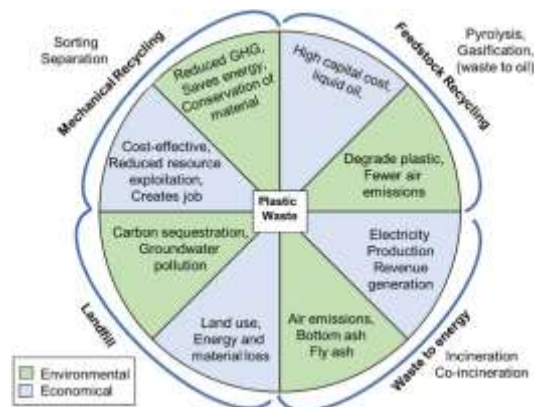


Figure 3. Environmental and economic performance of various PW management approaches [12]

3. Limitations and the potential revenue generation of plastic waste application

Products of PW recycled have limitations and the potential revenue generation [1]. Some of the major limitation associated with the use of PW for construction applications such as harvesting (PW are contaminated with various types of plastic and another material), varying composition (PW are made up from different grades and types of plastic which might result in a non-isotropic performance), Low-density (unsuitable in application where high toughness and elasticity modulus), lack of understanding (the long-term performance has limited), low surface energy (poor mechanical bonding can lead to a reduction of the mechanical properties), and lack of standards (no standard that supports the use of PW for construction)

The potential revenue generation as a result of using PW: lower cost, reduction in waste management, value addition, lower transportation cost, and reduction in energy cost.

4. Conclusion

Plastic wastes are inevitable. Therefore, plastic wastes recycling plays a significant role in improving the sustainability of the environment. The use of PW for many application support the sustainability trend of a circular economy. The PW recycle products can replace all components, with somewhat acceptable detrimental effects on the performance of the products.

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