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RECYCLED SOLID WASTE IN CONSTRUCTION

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ABSTRACT: *The fast-rising increase in population and technological advancements has led to the production of solid wastes in so many countries. Many years ago, wastes were seen as unwanted and unusable by-products. The unavailability of enough waste bins in various localities, unplanned and primitive method of waste collection in different municipals affected the human health and caused environmental pollution due to the emission of nitrogen, methane and carbon monoxide gases. But recently, because of the development in proper managerial waste transportation, monitoring, collection, processing, recycling, disposal and recovery system, the above definition is no longer completely correct. Solid waste (SW) can be recycled and utilized in the construction industry for the production of building materials. Waste recycling is now an essential part for an effective waste management. SW is no longer seen as unwanted materials but a source to conserve energy and raw materials when reprocessed. Aside the conversion of natural resources and energy, the waste management system tends to contribute positively to the economy by the provision of job opportunities. This research paper reviews the essential research findings, the laboratory tests results and the analysis of reusing these solid wastes in the production of building construction materials for a sustainable environment.*

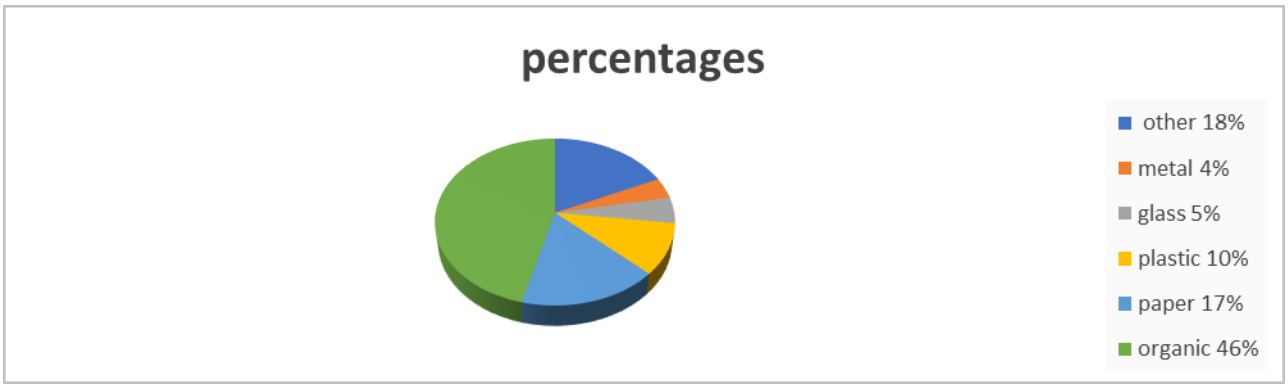
Keywords: Solid Waste, Waste Management, Recycling, Reuse.

1.0 INTRODUCTION.

Solid waste management is the regulation of solid waste generation, collection, transporting, processing and disposal activities etc. based on engineering principle at minimum environmental impact and cost. Solid wastes are unwanted materials like glass, plastics, papers, textiles, wood wastes and concrete wastes from demolished buildings etc. which is said to have lost their values in the eye of the first owner. Solid waste mishandling is a global issue with regard to environmental pollution, social and economic

conservation [1], which needs consolidated evaluation and comprehensive approach for its remedy. Concentration should be given more on underdeveloped and developing countries, where the non-sustainable management of solid waste is common. When the waste disposal is not properly controlled such as open burning, landfilling etc. it creates heavy metal pollution in the environment, unenclosed burning of these wastes emits CO, CO_2, CH_4, SO, NO, and other harmful gases into the atmosphere unfit for living [2], solid waste picking in open dumping sites causes severe health and life-threatening diseases for the individuals working on those sites. The disposal of solid waste in aqua bodies causes environmental and water pollution, hence causing problems which do not allow advancement in the sustainable economic growth. The main aim for sustainability improvement worldwide includes; to ensure safe and affordable waste managerial system particularly hazardous ones, to eradicate open burning and uncontrolled dumping of waste by 2030 [3]. Recent studies have developed practicable remedies for improvement of solid waste management in developing countries, like as biodegradable waste repurchase programs with organic matter or biofuel production, application of waste in energy conservation schemes and technologies, energy conservation by recycling of metals, plastics, glass etc. and energy production from biofuel waste by producing briquettes [4]. Nevertheless, numerous barriers still affect the improved means of SW collection, handling, treatment and final disposal, for this reason environmental pollution is still a persistent problem globally.

Fig 1. Shows the recent world's solid waste composition.



2.0 LITERATURE REVIEW

The following literatures were reviewed with respect to some books and journals.

2.1 The Use of Recycled Plastics in Building Construction.

The global yearly utilization of plastic materials increased from about 6 million tons in 1940s to 100 million tons in 2001 [5]. In the construction industry, recycling of plastics wastes into building materials can serve as an effective method of solid waste management. Past studies and researches by [6-11] reviewed that plastic wastes can be use in a concrete mix or mortars. Specifically, an investigation was carried into the use of recycled polyethylene terephthalate (PET), which is a synthetic resin that serves as a packing material by-product and as a binder in polymer concrete and a positive report was obtained. The plastic waste was modified using a transesterification reaction, with the presence of dibasic and glycols acid into wet polyester resin, which after the resin is mixed with sand and gravel. The result stated that the polymer concrete gotten exhibited a high resistance in both Compressive and flexural strength when compared to the normal concrete [12], [13]. The mechanical strength is increased to 80% within a day except that it has low temperature resistance [14], [15], [16]. However, the low bonding characteristics of plastic wastes was pinpointed to be a major obstacle in its usage in concrete due to lack of skid resistance, therefore the need to ascertain a surface roughening treatment for a better bonding property is important.

2.2 The Use of Recycled Textile in Building Construction.

In Europe, about 5.9 million tons of textile waste are discarded annually, 1.5 million tons are recycled by few industries while the remaining 4.4 million tons of non-recycled wastes are dumped in waste incinerators or landfill sites causing more pollution [17]. Studies to examine the effect of heat transfer through fabricated textiles revealed that it has high thermal insulation properties, a good capillary structure and air volume distribution [17-20]. The advanced knowledge regarding the chemical, physical, mechanical and thermal properties is essential to help in the optimization of its use as a raw material in construction. The analysis of various textile fibrous materials to produce reinforcements for cement mortars components [21], light weight concrete [22], and fibrous insulation materials [23] resulted to a better durability and mechanical behavior similar to polypropylene or glass [21], except for minor variation in the water vapor permeability due to its loose-fill cellulose pattern [23]. Recent studies have shown that textile wastes can be used in the manufacturing of lightweight materials and bricks [24-26], especially the usage of cotton waste products in combination with other materials like fly ash, paper,

limestone powder and barite, where its insulation, bending strength, thermal conductivity and radioactivity has been examined. The analysis showed that the brick produced had a high compressive strength, high energy absorption, good thermal conductivity [27], and a fire resistance of about 30 minutes [24]. It can be concluded that the application of these recycled textile wastes as a likely thermal insulation material, is a profound means to manage solid waste and achieve a sustainable living.

2.3 The Use of Recycled Metal in Building Construction.

In the metal recycling process, very little energy is required when compared to the energy needed during the first manufacturing process [28]. Steel and aluminum products manufacturing requires a million tons of energy throughout its chemical reaction process, while the recycling of these products requires less than 95% energy, i.e., the recycling process utilizes about 4%-5% of its total energy. Steel slag waste is a derivative from iron ore steel scrap conversion, which has the potentiality of being used in construction. In India, ground granulated blast furnace slag is classified as group A waste is used in the production of concrete to enhance its strength, durability, abrasion resistance and soundness. The group B waste like ferro-alloy commercial waste is not broadly used but is said to have a considerable possibility for recycling. Reviews showed that recycled metal waste can be used for the manufacturing of super sulphate cement, light weight concrete, high strength concrete and aggregates used in building construction [29]. The group C wastes like copper, zinc, iron and gold ore tailings gotten during these metals' beneficiation process are used as concrete filler materials or as fine aggregates replacement in construction [30]. A research by [31] showed that, steel slag responsiveness is due to the loose CaO present, although past studies has stated that, high amount of loose CaO in a steel slag causes volume expansion issues.

More investigation is being made on steel waste slag usage in the production of construction materials like bricks and cement paste. The addition of steel slag improves brick manufacturing, by reducing the firing temperature but decreases the firing shrinkage and compressive strength of the bricks. Therefore, it was deduced that bricks manufactured with steel slag can be used as third grade bricks in building construction [32].

3.0 CONCLUSION

From the research conducted, it shows that there is a probability of using solid waste materials like metals, plastic, textiles etc., as components of building materials in

construction. The reviews on the use of solid waste in construction consists of the production raw materials, fine and coarse aggregates replacement, binder materials and cement replacement etc. for buildings. Most research works analyzed, concentrated on the effect of solid wastes on the mechanical and physical properties of building raw materials and concrete concerned. The result of these studies showed that recycled plastic waste in powder, granulated and fibrous forms has no visible effect on the properties of concrete manufactured but it can help enhance the flexural and compressive strength workability, self-weight reduction and thermal insulation. The usage of recycled textile materials in the right proportion can produce a concrete with good mechanical characteristics, mortar with good durability, physical and mechanical properties with similarity to polypropylene or glass. It was also said that there is a visible increase in the thermal insulation. The granulated blast furnace slag was said to enhance the morphological strength, soundness and the abrasion resistance of the cement mix. The addition of recycled waste steel slag in brick production produce bricks with low fire resistance temperature, low compressive strength and low firing shrinkage.

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