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Piezoelectric Plastic Tiles

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Abstract

This paper reviews the utilization of plastic waste for making tiles and other construction materials to reduce disposal problems due to increasing plastic and make economic and environment efficient construction material. Modern life cannot be imagined without plastic. Waste generated by plastic is very huge and disposal takes more than 300 years of time. The use of plastic waste in construction materials is one of new way to deal with disposal of plastic. India produces 3.4 million tons of plastic waste in a year, only 30 per cent of it is recycled. The paper is focusing on making 100% HDPE tiles this helps to reduce plastic pollution and making environment efficient tiles. So the study provides green building material through recycling waste plastic for sustainable development. Some additional work in this project can be done which will help environment with generation of energy which is known as piezoelectric effect. The piezoelectric effect is ability of certain material to generate an electric charge in response to applied mechanical stresses. So by use of footstep, waste energy for generation of electric energy with the help of piezoelectric sensors with waste plastic tile will help to reduce pollution and reduce energy demand and final product will be piezoelectric plastic tiles.

Keywords: *Plastic, Plastic Waste, HDPE, Environment Efficient, Recycle, Sustainable, Electricity Generation, Energy Harvesting*

INTRODUCTION

Plastics play an important part in modern society and are used daily in different operations due to their low cost, ease of manufacturing and attractive qualities. About 300 million tons of plastic are produced encyclopedically each time of which only about 25 is reclaimed. An estimated 7 million tons ends up as trash in the ocean each time causing significant environmental and health problems for fish and ocean creatures. Plastic waste brings serious environmental challenge to modern society because it's made of several toxic chemicals that can pollute soil, water and air if not managed duly. HDPE is one of the most popular accoutrements used in manufacturing moment. HDPE is known for its high strength- to-density rate. The density of HDPE ranges from 930 to 970 kg/m3.High Density Polyethylene is a polyethylene thermoplastic made from petroleum. HDPE is a Type 2 plastic generally used in making holders for milk, motor oilpainting oil, detergents and conditioners, cleaner bottles, cleaners, and bleaches. It's also harder and more opaque and can repel kindly advanced temperatures. Around 52% of total plastics wastes are generated from HDPE/ LDPE accoutrements and 23% of unclassified/ other plastics waste. The conventional styles of PW disposal are incineration and landfilling, but it has downsides. To overcome this problem we can use waste plastic for making construction material analogous as tile. There have been numerous studies looking into harnessing the energy of pedestrians walking through busy public spaces. In this technique application of waste energy of foot power by mortal is veritably important for largely populated countries. When pressure is applied electrical energy produced by the pressure is captured by floor sensors and converted to an electrical charge also stored and used as a power source.

LITERATURE REVIEW

Mehdi Sigheret.al. (2017)

This paper is mainly focussing on the Possibility of Making a Composite Material from à sand dune (A natural source abounds) and recycled height density polythene (Here) by mixing the amount.so experiment was conducted to make a composite roof tile with plastic and sand dune containing different percentage (30%, 40%, 50%, 60%, 70%, 80%).Tests conducted on density shows, density tends to decrease with increase in plastic ratio that gives light weight polymer tile. Breaking bond by flexure test resulted that the increase in ratio of hyper gives material enough bond strength so increase breaking also gives good impermeability. This is one of the most effective ways that can be applied to get rid and save

the world form the environmental. Polymer roof tile containing 70 here with 30s and dune gives the best quality

Sourabh Jadhavet.al. (2022)

This paper is focusing on reduce plastic in environmentally and economically sustainable manner by making tiles. For test polyethylene type plastic is used. Tile was prepared by using plastic waste, fly ash and stabilizing agent. Two test specimen were prepared. Mixing applied the two different composites to the soil to compare 50% plastic effect in tile with 65% in the other emulsion and press the emulsion to the ground to avoid air leakage in the pipe leaved the soil at room temperature for 2 hours to stabilize. Test performed on specimen are abrasion test, flexure test and water absorption test. Results showed that 50 per cent plastic binder provides swish results and instead of using plastic we can use polypropylene plastic.

BibiIntan Suraya Murat et.al. (2020)

The accoutrements were mixed with sawdust to probe their felicity and properties. Some destructive and non-destructing tests performed which are tensile, impact, water immersion and ultrasonic testing. Results set up that tensile and impact resistance properties of HDPE is better than LDPE. It's also observed that the samples with fresh sawdust filler in comparison to their original polymers have higher stiffness and lower impact resistance. Study reveals that the mechanical properties of the recycled HDPE and LDPE are closer to their virgin accoutrements, and they've huge eventuality for plastic recycling. Mixing rates used LDPE AND HDPE with wood sawdust of 80:20 and 70:30. Tensile properties indicated that recycled HDPE has advanced strength, better resistance to deformation, but when blended with sawdust it'll relatively a brittle material although LDPE have larger extension but it's week as compare to HDPE. Impact property result indicates that The HDPE- LDPE- without any fresh filler captured a higher quantum of energy before failure compared to the composit bend. Water immersion test results indicate that the recycled LDPE samples absorbed more water compared to HDPE samples. Ultrasonic wave parameter shows the wave attenuation in HDPE samples are advanced compared to the LDPE. Paper shows that the the tensile properties, impact and water resistance of recycled HDPE samples are lesser than the recycled LDPE.

Zhou, Yi et.al. (2022)

Overview of paper says the growing rate of population which increases rate of plastic and biomass waste combining these 2 accoutrements is one way to solve problem. Material used for making floor tiles are coconut filaments and HDPE plastic waste to make a bio composite material which were further tested for mechanical properties(Tensile test, flexural test and impact test), hardness test, water absorption test and thermal insulating test. Proportions used was 5%, 10%, 15%, 20%. Results has been proved that these tiles are suitable for external floor tiles. Flexural strength for 20 blend is more than other proportions which is16.52 mpa. Tensile strength is more for 5 % rate which is24.1 mpa. Impact strength of pure hdpe is much more advanced than composite. Fiber is a hydrophilic material, HDPE is a hydrophobic material and the measured water absorption of the composite is veritably low. By use of this way the pollution and environmental damage caused by HDPE waste could bereduced.

Prof. Patil A.A .et.al. (2020)

This paper presents disquisition at manufacturing of floor tiles by using waste plastic and fly ash with different proportions to estimate different physical and mechanicals properties, tests like water absorption, transverse resistance, resistances to impact, an abrasion resistance test. Waste plastic is added as binder with fly ash according to different proportions which are 30%, 40%, 50%. Also paper gives comparison between ceramic and plastic tile. Sample confines are 130x130x20mm. As per results attained 50% proportion pipe is good.

B. Shanmugavalli et.al. (2017)

The paper study focusing on replacement of cement with LDPE plastic waste in paver block and reduce cost as compared to conventional concrete paver block. The plastic used in different proportions with quarry dust, coarse aggregate and ceramic waste. though compressive strength is low as compared to concrete paver , results investigated for block 3 having proportion 1:1.5:2 also have good strength can be used gardens, pedestrian path and cycle way etc

P.O. Awoyera, A. Adesin (2020)

Study explores the various approaches to recycle plastic waste into various products in order to find effective way to manage plastic waste and improve sustainability of our environment. Paper also shows the comparison of sorting reprocessing and Recycling potential of various

plastic estimate quantities of various types of plastics and composition of plastic waste . Different type of plastic can be used for various purposes as component in compendious composit, component in asphalt, filler, wood replacement, door panels, insulationmaterial, walls and bricks etc.

Rishav Singh et.al. (2022)

Paper explains how waste plastic can be converted into plastic tiles and blocks. Raw materials used were Remained/ left-over liquid containers, polyethylene, Gravel and different colour.1:3, 1:1.5, and 1.1(plastic: sand) proportions used having size 70 x70 x 70mm. Resulted compressive strength for specimen 1 is greater than others which is 15mpa water absorption test resulted specimen 3 consumes less water about 1.5% of its weight in water, bulk density is more for 2nd specimen and specific gravity is more for 1st specimen. It is concluded that Compared to clay tiles, sand plastic tiles have stronger compressive strength and reduced water absorption.

RUSHIKESH MODHE et.al.(2022)

His main objective of paper is to reduce reuse and recycle PET bottles which are also one of major solid waste for better solid waste management. PET and sand are the materials used for making tiles. Results are made for 40%, 50%, and 60% of waste plastic. Tests performed are Water Absorption Test, Abrasion Resistance, Flexure Test. Test results for 60% of waste plastic by weight of sand is found to have better to normal cement tile.

Singh, R. K., & Ruj, B. (2015)

As plastic is adding day by day, after completing its average life it's getting the major problem for the environment as it's an on-degradable product. Paper Study shows Indian scenario of plastic waste operation and disposal. Types and classification of plastic thermoplastic and thermosetting Thermoplastic can be reheated several times to form different shapes while in the case of thermos sets they cannot be remolded by applying heat. In India substantially rehearsed way is land stuffing in which the waste is dumped to a low land spots and also covered with sand or soil. In early 2000, the largest quantum of waste is disposed by land filling (60 – 70), an incineration (20 – 25), and recovering account to only about 10. Mechanical recycling is used for making new products by recovering the plastic waste without changing the introductory structure of accoutrements. Incineration refers to

the combustion of waste material at a veritably high temperature around 1000 – 1500 °C which affect in conformation of veritably little residue and gas emigration. Biological recycling process isn't veritably trendy and doesn't use or enforced in India. Chemical recycling, pyrolysis are also ways used to recycle plastic waste. So conversion of waste into useful products and will help to drop the waste generated.

Bamig boye, G. O. et. al. (2019)

This study deals with the effects of using Polyethylene Terephthalate (PET) and river sand in roof tile product. It's grounded on experimental study of roof tiles produced with river sand and recycled PET in varying proportion of 10, 20, 30, 40, 50, 60 and 100 % of PET combined with the corresponding fine total percentage. Particle size distribution test is used to determine the aggregate gradation of fines and. The normal specific gravity of2.68 attained. Water absorption test showed that increase in plastic content led to corresponding drop in water absorption up to 100 PE. As per density delved the average densities of the tile samples with smallest recorded density was at 100 PET(852.07 kg/ m3) and the highest for PET was 10 PET(1899.56 kg/ m3). Compressive strength values increase 10 up to 50 PET and drop at 60 PET so as per study plastic compound tiles have both good strength and absorptive property for roof tiling.

Liu, Y., Yang, W. M., & Hao, M. F. (2010)

As, the old tire and waste plastic increase year and year, which bring a serious environmental problem. So get a suitable formula of roof tiles made from waste rubber tire powder and waste plastic. Rubber-plastic tiles were made from waste rubber tire powder and waste plastics. It has several merits such as light, good earthquake-proof, waterproof, long service life, anti-ultraviolet radiation, heat preservation, bearing high and low temperature, erosion resistance, low cost and so on. Sample is prepare as per Blend ratio of rubber and plastics in samples and the relative diameter of rubber powder. To roof tiles, the impact strength in mechanical performance is the most important property so as per results a sample that contains equal rubber powder and plastics was taken as the best.

Moussa, R. R. et.al. (2022)

This paper presents a comprehensive use of piezoelectric. In this paper the application of piezoelectricity was investigated in a Metro station in a core urban area in Egypt, with an

estimate of almost 57,000 daily passengers. The selection of place of fixing the tiles was depending on the maximum passenger density. The results showed that 12 tiles needed to generate electric energy using Sustainable Energy Floor tiles and only 8 tiles were needed using Winery piezoelectric tiles. The results also showed a decrease in energy consumption and carbon emissions. The average energy daily consumption of the station is 4500 kW/day. This shows that using 12 SEF tiles will generate 4788 kW/day while installing 8 Winery tiles will generate 4560 kW/day. By applying piezoelectric tiles in the station, a CO2 reduction of 5490 pounds/day is expected.

Elhalwagy, A. M. et.al. (2017)

This paper shows how to get maximum benefits from piezoelectric energy harvesting floor in different spaces. Here different types of harvesting floors and their uses explained. Two case studies such as high pedestrian public space and low pedestrian private space are studied. Piezo sensors produce electricity when pressure is applied on them. These sensors are then connected in series and parallel combination and placed in a tile like structure; this tile can be used in any place wherever pressure is applied. The harvested power can be stored in a battery and used for AC or DC loads and also voltage generated by a single tile can be displayed on display devices like LCD.

Kumar, D. et.al. (2014)

This paper describes the design of energy harvester prototype and the power conditioning circuit. The generation of electric energy when some load is applied on the sensors either in the form of direct strain or ambient vibration depends upon various factors such as number of piezoelectric transducers, electromechanical coupling coefficient of the piezoelectric sensors, amount of load applied, and also on the scheme of arrangement. An efficient way has been presented to capture the generated energy via dedicated IC and boost it by a converter to get regulated output. It is observed that the output increases initially and after sometimes it saturates at some particular value. Some improvements have been done in this model to reduce the voltage drop at rectifier stage.

Boby, K. et.al. (2014)

Paper focusing on step power generation using piezoelectric transducers. Two most generally available piezoelectric material- PZT and PVDF, better output is attained from the PZT than

the PVDF as per V- I graph. From the study of connections graph that the voltage from a series connection is good but the current attained is poor, whereas the current from a parallel connection is good but the voltage is poor. But this problem is remedied in a series-parallel connection where a good voltage as well as current can be attained. It's working maximum theoretical voltage generated which is 39 v and and analysis on piezoelectric tile is done. A piezo tile able of generating 40V has been devised.

Naresh, K. et.al. (2018)

The introductory objective of study is the techniques of step generation include study of piezo material, connections, maximum theoretical power generation, system description and working, etc. The weight applied on the tile and corresponding voltage generated is studied and they're set up to have linear relation. Power in w is shown with weight applied inkg.

CONCLUSION

Based on study it can be conclude that manufacturing of tiles by plastic waste is best way to reduce or recycle municipal solid waste and it causes less pollution and more beneficial to environment as well as economy when compared to current methods of waste disposal into open dumps.so as per study tiles Lightweight, easy to assemble, and affordable. Recycled plastic tiles are very resistant to bad weather and climatic variations. As they are not porous and are 100% watertight, the risk of cracks due to severe changes in temperature is minimized , and the tiles' lifetime is extended. After utilizing product it can again recycle further to manufacture new tile and by this way we can use and recycle a single tile much more times and reduce production of waste. They are easy to install and can be more affordable. By utilizing these two different ideas we can make such type of construction materials which are environmental efficient economic and energy generating floortiles.

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