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Survey Paper on Cement Chequered Tiles Utilizing Waste Plastic Shredded Chips

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ABSTRACT: The safe disposal of plastic is the most challenging issue for the solid waste management across the globe. Concrete is one of the best choices of construction material in many countries today. This has increased the fast vanishing of natural resources. It could be worth experimenting the use of plastic waste in concrete to overcome the dual issues of shortage of raw material and safe disposal of plastic waste. An attempt has been made to study the possibility of disposing waste plastic as cement in concrete. The study begins with the selection and preparation of raw materials, including Portland cement, fine aggregate, coarse aggregate, and waste plastic shredded chips. The waste plastic shredded chips are obtained from local recycling facilities, cleaned, dried, and sieved to achieve uniform particle size distribution. Mix designs are developed to determine the optimal proportions of materials, considering the mechanical, and economic factors.

KEYWORDS: Cement Chequered, Waste Plastic, Mechanical, Economic Factors

I. INTRODUCTION






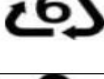

The increase of population in world has led to the generation of large amount of waste products such as waste plastic. These waste plastics will remain in the environment for hundreds of years, this has become inevitable problem in the present world. There is an immediate need for solution for such problem. To bring down the waste products many methods has been proposed and one of them is usage of these waste plastic in concrete which may reduce the environmental problems up to certain extent. It is possibility of disposal of these wastages in mass concrete such as in heavy mass concreting in PCC in pavements where the strength of concrete is not a major criterion under consideration. The waste plastic is one component of Municipal Solid Waste (MSW). Since the plastic is very low biodegradable material the disposal of the waste plastic causes big problems to the environment. As from many years the research concern that the use of by-products from industry may augment the properties of concrete. In the modern decades, the use of by-products such as silica fume, glass culvert, fly ash, ground granulated blast furnace slag (GGBS) etc., efforts have been made to use in civil construction. The application of the industrial byproducts in concrete is as partial replacement of cement or partial replacement of aggregate.

Plastics are made from long chains of hydrocarbons derived from petroleum products. Broad range of application of plastics are in packaging films, wrapping materials, shopping and garbage bags, fluid containers, clothing, toys, household & industrial products, medicinal applications, packaging and storage of food and other perishable items, electronic and electrical applications and building materials etc. Many petro-based plastics are nonbiodegradable and remain a cause of concern in the environment for several years, thus becoming an eyesore. However, its uses are increasing day by day due to low cost and convenience.

Plastics are generally categorized into two types: – Thermoplastics: Thermoplastics or Thermo-softening plastics are the plastics which soften on heating and can be moulded into desired shape. The examples of Thermoplastics are PET, HDPE, LDPE, PP, PVC, PS, etc.

Thermosets: Thermoset or thermo-setting plastics get moulded on heating, but cannot be remoulded or recycled subsequently. The examples of Thermoset plastics are Sheet Moulding Compounds (SMC), Fiber Reinforced Plastic (FRP), and Bakelite etc. are the examples of the same.

Table 1: Different types of plastics & its uses

S. No.	Symbol	Short Name	Scientific Name	Uses
1		PET	Polyethylene terephthalate	Soft drink bottles, furniture, carpet, panelling etc.
2		HDPE	High-density polyethylene	Bottles, carry bags, milk pouches, recycling bins, agricultural pipe, base cups, playground equipment etc.
3		PVC	Polyvinyl chloride	Pipe, Window profile, fencing, flooring, shower curtains, lawn chairs, non-food bottles and children's toys etc.
4		LDPE	Low-density polyethylene	Plastic bags, various containers, dispensing bottles, wash bottles, tubing etc.
5		PP	Polypropylene	Auto parts, industrial fibers, food containers, dishware etc.
6		PS	Polystyrene	Cafeteria trays, plastic utensils, toys, video cassettes and cases, clamshell containers, insulation board etc.
7		O	Other	Thermoset Plastics, Multilayer Packaging and Laminates, Bakelite, Polycarbonate, Nylon SMC, FRP etc.

Generally, the thermoplastics are recyclable plastics and thermosets are non- recyclable plastics. However, due to the contamination, technical or economic considerations a large quantity of thermoplastic waste remains non-recyclable and littered in the environment. Some of the typical examples of multilayered and non-recyclable plastics materials- that include both thermoplastics and thermosets are shown in Table 2.

Table 2: Sources and Uses of Non-recyclable Plastic Waste

S. No.	Sources	Uses
1	Food packaging	Multilayered films are used for packing of biscuits, namkeen, chips, edible oil, juices etc.
2	Pharmaceutical & cosmetics products	Multilayered packing for packing of medicines, tablets and cosmetics etc.
3	Electrical and electronic goods	Multilayered films such as bubble raps, laminates are used for packing of electrical and electronic items, housing, fuses, switchgear, MCB boxes etc..
4	Item used for food storage & serving	Thermocol products such as plates, cups etc. are used for serving food, tea, coffee etc. Also used as fillers in packing of goods/items etc.
5	Automotive industry and mass transportation	Cars, trucks and other commercial and agricultural vehicles, trains, trams, light railways and monorail (body parts, structure and engine parts)
6	Building & construction	Civil engineering and household fixtures etc.
7	Domestic appliances	Coffee machines, toasters, irons etc.
8	Sanitary	Bathroom suites and hygienic surfaces etc.

II. LITERATURE SURVEY

Several studies have explored the utilization of waste plastic in the manufacturing of construction materials, including concrete blocks, pavements, and tiles. These studies have demonstrated the feasibility of incorporating waste plastic as a partial replacement for conventional raw materials, leading to improvements in mechanical properties and environmental performance. However, there are still gaps in the literature regarding the specific application of waste plastic shredded chips in the production of cement chequered tiles. Further research is needed to investigate the optimal dosage, processing methods, and performance characteristics of waste plastic shredded chips in chequered tile formulations. Additionally, comprehensive assessments of the environmental and economic implications of using waste plastic shredded chips are required to evaluate the overall sustainability of this approach.

S Vanitha, V Natarajan, M Praba (2015)-The rapid industrialization and urbanization in the country leads lot of infrastructure development. This process leads to several problems like shortage of construction materials, increased productivity of wastes and other products. This paper deals with the reuse of waste plastics as partial replacement of coarse aggregate in M20 concrete. Usually M20 concrete is used for most constructional works. Waste Plastics were incrementally added in 0%, 2%, 4%, 6%, 8% and 10% to replace the same amount of Aggregate. Tests were conducted on coarse aggregates, fine aggregates, cement and waste plastics to determine their physical properties. Paver Blocks and Solid Blocks of size 200 mm X 150 mm X 60 mm and 200 mm X 100 mm X 65 mm were casted and tested for 7, 14 and 28 days strength. The result shows that the compressive strength of M20 concrete with waste plastics is 4% for Paver Blocks and 2% for Solid Blocks.

Zainab Z. Ismail, Enas A. AL-Hashmi (2008) - Industrial activities in Iraq are associated with significant amounts of non-biodegradable solid waste, waste plastic being among the most prominent. This study involved 86 experiments and 254 tests to determine the efficiency of reusing waste plastic in the production of concrete. Thirty kilograms of waste plastic of fabriform shapes was used as a partial replacement for sand by 0%, 10%, 15%, and 20% with 800 kg of concrete mixtures. All of the concrete mixtures were tested at room temperature. These tests include performing slump, fresh density, dry density, compressive strength, flexural strength, and toughness indices. Seventy cubes were molded for compressive strength and dry density tests, and 54 prisms were cast for flexural strength and toughness indices tests. Curing ages of 3, 7, 14, and 28 days for the concrete mixtures were applied in this work. The results proved the arrest of the propagation of micro cracks by introducing waste plastic of fabriform shapes to concrete mixtures. This study insures that reusing waste plastic as a sand-substitution aggregate in concrete gives a good approach to reduce the cost of materials and solve some of the solid waste problems posed by plastics.

Arvind Singhal, 2Dr. Omprakash Netula (2018) Plastic waste is a non-biodegradable waste which cannot decompose and this creates water, land pollution and air pollution. Also, while we burn the plastic waste in Dumping Ground, the percentage of plastic waste is increasing rapidly. It is estimated that the plastic waste will double after a decade as we use hundreds grades of plastic in our daily life. We can recycle, reuse the plastic waste. As a civil engineer we have to innovate something new related to this, which is a boon for civil engineering. So, here we try to do something innovative as PLASTIC SAND BRICKS/ TILES. Basically in bricks and tiles, we used earth based clay. Due to excessive use of the clay, it shows the result of resources depletion and environmental degradation. In plastic waste we consider Drinking Water Bottles (polyethylene terephthalate), Carry Bags, Bottles Caps, house hold Articles (High Density Polyethylene), Milk Pouches, Sacks, Carry Bags, Bin Linings, Cosmetics and Detergent Bottles (Low Density Polyethylene), Bottle Caps and Closures, Wrappers of Detergents, Biscuit (Poly Propylene), Electricals Fittings, Handles and Knobs (Urea Formaldehyde), Casting, Bonding Fibers (Polyester resin) etc. In this, we get to crush the plastic waste into fine particles and heated on a furnace (Bhatti) . We use stone dust as fine aggregates (size below than 4.75mm),heated on a furnace (Bhatti). Now, we mix heated plastic waste and heated stone dust and pour into mould and form bricks and tiles. We observed that the characteristics of bricks and tiles is far much better than normal bricks and tiles as minimum water absorption, highly compressive strength, smooth surface, unbreakable, less weight etc.

Abdel Tawab OF, Amin MR, Ibrahim MM, Abdel Wahab M (2020)- Plastics play an important role in modern society and are used daily in diverse applications due to their low cost, ease of manufacturing and attractive qualities. About 300 million tons of plastic are produced globally each year of which only about 25% is recycled. An estimated 7 million tons ends up as trash in the sea each year causing significant environmental and health problems for fish and sea animals. Plastic waste brings serious environmental challenge to modern society because it is made of several toxic chemicals that can pollute soil, water and air if not managed properly. However, the percentage of recycled plastic can

be increased by transforming waste plastic into mortar and concrete products suitable for housing and construction. In this study, the use of melted waste plastic bags as a replacement for cement in production of building bricks and concrete blocks was evaluated. The results showed that thermal conductivity depended upon the plastic content of the molded materials. Decreases in the thermal conductivity were observed with increases in the plastic content of both the bricks and concrete blocks. Increasing the plastic content from 33.33% to 66.67% (100%) in the bricks decreased the thermal conductivity from 1.70×10^{-3} W/m.K to 1.43×10^{-3} W/m.K (16 %) while increasing the plastic content from 20% to 50% (150%) in the concrete blocks decreased the thermal conductivity from 1.61×10^{-3} W/m.K to 1.50×10^{-3} W/m.K (7 %). It was also noticed that bricks and concrete blocks with similar plastic contents (50%) have similar thermal conductivity values. The thermal conductivity apparatus and the transient measurement methods used in this study provided consistence results with high degree of accuracy. The variations in ΔT were within the range (1-3%) reported in the literature for the thermal conductivity transient measurement technique and resulted in very small variations in the thermal conductivity measurements (0.59-0.70% for bricks and 0.62-0.69% for concrete blocks). The results obtained from the flexure test showed that the bending moment and thus the bending stress increased with increasing the plastic content in both the bricks and concrete blocks. Increasing the plastic content of the brick from 33.33% to 66.67% (100%) increased the bending moment from 540.00 N.m to 1711.25 N.m (216%) and the bending stress from 3,24 N.m⁻² to 10.26 N.m⁻² (216%) and increasing the plastic content of the concrete blocks from 20 % to 50 % (150%) increased the bending moment from 901.40 N.m to 1442.55 N.m (60%) and the bending stress from 5.40 N.m⁻² to 8.65 N.m⁻² (60%). It was also noticed that for similar plastic contents (50%), the concrete blocks had a lower bending moment (1442.55 N.m) than that of the bricks (1711.25 N.m) and thus a lower bending stress (8.65 N.m⁻²) than that of the bricks (10.26N.m⁻²). Using waste plastic in making construction materials such as bricks and concrete blocks is advantageous due to its light weight, extreme versatility and ability to be tailored to meet specific technical needs. Also replacing cement with waste plastic will reduce environmental problems associated with the disposal of waste plastic as well as those associated with the cement industry.

III. PROBLEM FORMULATION

The traditional manufacturing process of cement chequered tiles contributes to environmental degradation and resource depletion. There is a need for innovative approaches that reduce the environmental impact of construction materials while maintaining or enhancing product performance and durability. This research aims to address this challenge by investigating the feasibility of using waste plastic shredded chips as a partial replacement for traditional raw materials in the production of cement chequered tiles.

IV. METHODOLOGY

The raw materials used in this study include Portland cement, fine aggregate (sand), coarse aggregate (crushed stone), waste plastic shredded chips, water, and chemical admixtures. The Portland cement conforms to ASTM C150 specifications and has a standard fineness of 3000–4000 cm²/g. The fine aggregate consists of natural sand with a fineness modulus ranging from 2.2 to 2.6. The coarse aggregate comprises crushed stone with a maximum particle size of 10 mm.

The waste plastic shredded chips are obtained from local recycling facilities and sorted to remove contaminants such as dirt, labels, and other non-plastic materials. The shredded chips are then washed, dried, and sieved to obtain particles with a uniform size distribution. The waste plastic shredded chips used in this study have a maximum size of 5 mm and a density of approximately 0.9 g/cm³.

Preparation of Waste Plastic Shredded Chips

The preparation of waste plastic shredded chips involves several steps to ensure uniformity and cleanliness. First, the waste plastic materials are sorted to remove any non-plastic contaminants such as paper, metal, and glass. Next, the sorted plastic is shredded into small chips using a mechanical shredder. The shredded chips are then washed with water to remove any remaining impurities and dried to remove excess moisture. Finally, the dried plastic chips are sieved to achieve a uniform particle size distribution.

The size of plastic shredded chips

The size of plastic shredded chips that can be utilized in the making of cement tiles typically varies depending on the specific manufacturing process and requirements of the tiles. However, in general, shredded plastic chips used in

cement tile production are often in the range of 5mm to 10mm in diameter. The waste plastic shredded chips used in this study have a maximum size of 5 mm and a density of approximately 0.9 g/cm³.

V. CONCLUSION

Co-processing of plastic wastes in cement kiln is practiced substantially in different countries as an environmentally sound option for management of plastic wastes. In cement kiln, different kinds of hazardous and non-hazardous wastes including plastic wastes get utilized as Alternative Fuel and Raw materials (AFRs). During the usage of plastic wastes in cement kiln as AFRs, the material and energy value present in them gets fully utilized in the cement kiln as replacement to the fossil raw materials and fossil fuels that are conventionally utilized in the kiln. The research findings conclusively demonstrate the feasibility and viability of integrating waste plastic shredded chips into the manufacturing process of cement chequered tiles. Through systematic experimentation and analysis, it has been established that the inclusion of waste plastic not only enhances the sustainability profile of the tiles but also contributes to improved mechanical properties, such as flexural strength and impact resistance.

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