AN EFFECTS OF PLASTIC AND EGG SHELL WASTE MATERIALS ON THE PHYSICAL AND STRENGTH PROPERTIES OF FLOOR TILES"

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ABSTRACT

Human activities often generate solid waste such as plastic and eggshell waste. Disposing of this waste is often a problem. The aim of this study was to investigate the feasibility of using waste plastic and eggshell with white cement in the production of floor tiles. Waste is collected from kitchen and waste treatment facility in Gwalior constituency, Madhya Pradesh. The raw materials have been cleaned and dried; and the plastic is shredded while the eggshell is crushed. Waste is then mixed with white cement in different proportions. Compressive strength tests were carried out to determine the suitability of using this solid waste in the production of floor tiles. Crushed eggshells pass through a 1.2mm sieve and shredded plastic with an average diameter of 1-2mm is used. The blocks were cast and cured in 28 days.

The compressive strength of the blocks was tested with a multi meter. Research shows that adding up to 50% leads to more than 10 times increase in compressive strength of the casting. The addition of resin reduces the compressive strength of the blocks while the addition of eggshell has a negligible effect on the compressive strength. An increased amount of resin and eggshell results in a high water absorption capacity, while a larger amount of cement leads to a reduced water absorption capacity. An increase in the amount of eggshell and resin leads to a decrease in density. In the presence of resin, the wear resistance has increased and the brick becomes less brittle. It is concluded that eggshell can be used as a filler material in the production of floor tiles. Since resins tend to reduce the compressive strength of bricks, they must be used with care. Research has determined that using waste plastics and eggshells in the production of floor tiles is a viable waste reduction option. However, further studies are needed to establish the chemical interactions involved in the floor tile production system, which uses household and industrial waste such as plastics and egg shells.

KEYWORDS - plastics, eggshells, solid wastes, floor tiles, industrial wastes, environment.

INTRODUCTION- Growth of population, increasing urbanization, and rising standards of living due to technological innovations have contributed to increase in the quantity of a variety of solid wastes generated by industrial, mining, domestic and agricultural activities. Globally, the estimated quantity of solid wastes generation was 62 billion tons in the year 2022 . Many authorities and investigators are lately working to have the privilege of reusing the wastes in environmentally and economically sustainable ways (Aubert et al., 2006). The utilization of solid wastes in construction materials is one of such innovative efforts. Freire and Holanda, (2006) previous study indicated that the egg shell waste samples were rich in $CaCO_3$ (50.7%) and may be used as an alternative raw material in the production of wall tile materials.

PROBLEM STATEMENT

Solid wastes including Egg shells & plastics, once used and dumped, can accumulate without decomposing resulting in unsightly sceneries, blocking of water movement channels, reduction of soil fertility by preventing moisture penetration into the soils and wide spread of diseases like malaria and cholera as a result of creation of bleeding grounds.. On the other hand, these materials may be useful for the construction industry. The aim of this study was to investigate the feasibility of conserving the environment by collecting such wastes and converting them into floor tiles.

MAIN OBJECTIVE

The main objective of this study was to assess the effect of plastic and eggshell wastematerials on the physical and mechanical characteristics of floor tiles.

- **Types of Tiles** - They are Six types tiles**.**
- Ceramic Tile.
- Porcelain Tile
- Glass Tile.
- Marble Tile.
- Granite Tile.
- Other Natural Stone Tile.

LITERATURE REVIEW-

The works of Rebeiz (2007) showed that the resins based on recycled PET can be used to produce a good quality of precast concrete. Many studies have been conducted on the use of scrap tire/rubber in mortar and concrete, and a research work has been published by Siddique a review paper (2008) on the use of recycled plastic in concrete. In the other study,

(2) Choi et al. (2005) investigated the effect of plastic waste (PET bottles) as aggregate on properties of concrete. The results obtained in this study showed that these wastes could reduce the weight by 2–6% of normal weight concrete and the compressive strength was reduced up to 33% compared to that of normal concrete.

(3) Sikalidis et al. (2002) investigated the utilization of municipal solid wastes (MSW) for the production of mortar.

(4) Batayneh et al. (2007) have shown, in their work that the decrease of compressive strength was in function of increase in the content plastic content. For a 20% substitution of sand by the waste, the compressive strength was reduced up to 70% compared to that of normal concrete.

(5) Remadnia et al., 2009, Yazoghli-marzouk et al. (2009 & 2007) have also studied the use of consumed plastic bottle waste as sand-substitution aggregate within composite materials for building applications. These authors showed that the density and compressive strength were decreased when the PET aggregates exceeded 50% by volume of sand. Also, It was found that the addition of plastic waste (fractions < 10%) in volume inside of cementitious matrix does not imply a significant variation of the concrete mechanical features.

(6) Ghaly and Gill, (2004) did a study on compression and deformation performance of concrete containing postconsumer plastics. It was observed that specimens containing plastics failed at lower compressive loads as compared with those made of conventional concrete. The decrease in strength may be attributed to the weak bond between plastics and cement or the weak strength of the plastic. The effect of reducing the compressive strength of concrete by the plastic aggregates is due to the fact that plastic particles aggregates do not have the compression qualities of the conventional coarse aggregates. Despite the lower compressive loads, these specimens underwent considerable deformation and did not experience brittle failure. At failure, most of the specimens were reduced to two pyramids in the vertical direction with the top one being upside down.

(7) Al-Jabir et.al (2009) investigated the properties of hollow sandcrete blocks made with cement kiln dust (CKD) as an additive and as a replacement for ordinary Portland cement. They observed that when CKD was used as a replacement for cement, the compressive strength and density of blocks generally decreased with higher replacement levels of cement by CKD. However, when CKD was used as an additive, within the investigated levels, an improvement in the compressive strength of up to 54% was observed. ASTM C 270 focuses on the importance of lime and cement in defining the quality of mortar in relation to water retention, air content, and compressive strength. These parameters by themselves define the properties of good mortar using in masonry work, making of concrete and interlocking tiles.

(8) Brown and Robinson (1986) wrote "The most rigorous mortar requirements are to provide adequate and uniform bond strength and to prevent wall leakage."Other parameters, such as workability of the mortar and durability are also important. Two types of properties should be considered. Plastic mortar properties pertain to the mortar from the time of mixing until it chemically hardens in the wall. Hardened mortar properties develop as the mortar cures after the initial chemical set. Both types of properties are important in determining the quality of the masonry application.

(9) According to Cheng and Wei-Ting, 2014, the combination of silica fume and polyolefin fiber in cement-based composites improved the strength properties and abrasion resistance than only use of polyolefin fiber due to the pozzolanic and filler effect. Cengiz et al., 2009, found that replacement of fly ash with cement reduced abrasion resistance of concrete and inclusion of the steel fiber improved the abrasion resistance of concrete. However, Using polypropylene fiber did not improve abrasion resistance of concrete made with or without fly ash.

(10) Rajalakshmi R S1 & Aryamol E P(2020), The use of natural aggregates is increasing day by day due to the new innovations and development taking place in the construction field. Because of these reasons the reuse of demolished constructional waste came into existence so that the solid waste can be minimized thereby reducing the scarcity of natural aggregates. Currently, about 33 million tonnes of copper slag is being generated yearly worldwide. Among that about 6 to 6.5 million tonnes is being contributed by Construction works. Copper slag, an abrasive blasting grit made of granulated slag is gaining importance these days. This work makes use of using copper slag as a replacement for the fine aggregate, M-sand. Rice Husk Ash which is one of the main waste product from agricultural field is also used here along with copper slag.

(11) L N Somarriba Sokolova, E V Ermakova (2018) , An immense amount of agricultural waste is produced while growing, harvesting and processing goods; which should be treated as a resource for its prevalence and renewability. While developed countries are concerned with utilization and environmental issues, developing countries are focusing on the economic factors of social housing, especially in rural areas. Fortunately, environmental awareness has been raised in the construction industry by using agricultural waste as partial replacement for fine aggregate, coarse aggregate, reinforcing materials, cement and binders.

(12) Michael Toryila Tiza(2016) This research deals with the effects of using rice husk ash (RHA) as a partial weight of cement replacement in concrete roof tile production. The work is based on an experimental study of roof tiles produced with ordinary Portland cement (OPC) and 5 %,10 %, 15 % , 20 % and 25 % (OPC) replaced by RHA. The rice husk ash used was produced by open air burning the rice husk. The tests

which were performed evaluate the performance of this material were: specific gravity normal consistency, setting time, compressive strength, rupture strength and water absorption.

(13) Agbede Olufemi & Tersoo Akuto,(2020) – This research deals with the effects of using rice husk ash (RHA) as a partial weight of cement replacement in concrete roof tile production. The work is based on an experimental study of roof tiles produced with ordinary Portland cement (OPC) and 5 %,10 %, 15 % , 20 % and 25 % (OPC) replaced by RHA. The rice husk ash used was produced by open air burning the rice husk. The tests which were performed evaluate the performance of this material were: specific gravity normal consistency, setting time, compressive strength, rupture strength and water absorption. The results show that addition of RHA show better results for 10 % replacement level than OPC at 28 days.

MATERIAL – This is three materials use in project work.

(i) Egg Shell (ii) Waste plastic (iii) Cement

(i) **Egg Shell** –

Eggshell concrete describes the use of crushed eggshell powder as a supplementary cementations material (SCM) that improves strength and/or reduces the amount of conventional Portland cement required. With the rapid development of infrastructure, the demand for building materials also increases. Cement is one of the most used materials in the world.

Figure -1 Egg Shell

Figure -2 Egg Shell power

The use of non-renewable resources in cement production and CO2 emissions have created serious environmental problems. The use of waste to replace part or all of cement is one of the practical solutions available. Converting waste into alternative cement can reduce the environmental problems caused by open-air

dumping. Eggshells are a waste material that can be obtained from restaurants, bakeries and households. If effective uses for eggshells can be found, the composition of the Egg shells lends the effects of its ash on the cement to be articulated. It is scientifically known that the Egg shell is mainly composed of compounds of calcium. Winton (2003), presented egg shell as being composed off 93.7% calcium carbonate, 4.20% organic matter, 1.30% magnesium carbonate, and 0.8% calcium phosphate.

(ii)Waste plastic- The goal of the present day studies is to examine practices accompanied via way of means of plastic recuperation and recycling gadgets in, India. Disposal of waste plastic is a main hassle Plastic is anywhere in today`s way of life and its disposal is a high-quality hassle. It isn't any biodegradable and it especially includes low-density polyethylene. Burning of those waste plastic baggage reasons environmental pollution.

Figure -3 Waste plastic

There are three types of plastics namely-

(i)Thermo setting

(ii) Elastomers,

(iii) Thermoplastics

Thermoplastic: Plastics that can be deformed easily upon heating and can be bent easily. Linear polymers and a combination of linear and cross-linked polymers come under thermoplastics. Example: PVC, nylon, polythene, etc.

Thermosetting: Plastics that cannot be softened again by heating once they are moulded. Heavily cross-linked polymers come under the category of thermosetting plastics. Example: Bakelite, melamine, etc. Bakelite is used for making electrical switches whereas melamine is used for floor tiles.

Elastomers plastic, elastomer, any rubbery material composed of long chainlike molecules, or polymers, that are capable of recovering their original shape after being stretched to great extents—hence the name

elastomer, from "elastic polymer." Under normal conditions the long molecules making up an elastomeric material are irregularly.

Figure -4 Elastomers plastic

Thermoplastics - Thermoplastics are defined as polymers that can be melted and recast almost indefinitely. They are molten when heated and harden upon cooling. When frozen, however, a thermoplastic becomes glass-like and subject to fracture. It is used in making CDs and DVDs. Containers like shampoo bottles, drinking bottles, and food storage containers are made up of thermoplastic polymer. Some of the thermoplastics (polyurethane) are used as a sealant, adhesives, and coating material.

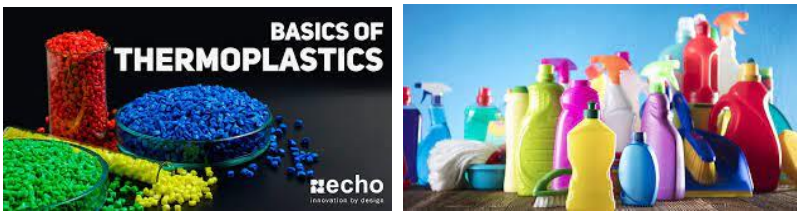

Figure 5 Thermoplastics

Recycling of Plastic

❖ Recycling of plastic is very important. If they are not recycled at the proper time, then they get mixed with other chemicals or materials and hence become more difficult to recycle and become a source of pollution. They are non-biodegradable, and they do not get decomposed by the microbial action.

❖ To avoid this, it is important to use biopolymers or biodegradable polymers.

Properties of Plastic

✓ Strong and ductile.

✓ Poor conductors of heat and electricity.

- ✓ Easily moulded into different shapes and size.
- ✓ Resist corrosion and are resistant to many chemicals.

MATERIALS AND METHODS

(i)Collection and processing of solid waste materials- In particular, plastic is collected from hospitals and other landfills, washed and ground into pieces with an average diameter of 1 mm (Figure-6). Plastic is a durable material and is resistant to chemical and physical attack, making it difficult to decompose. It is also resistant to water intrusion, which is why it is considered one of the main threats to soil fertility. This makes it a suitable component in this material as it increases the material's water resistance. Resin also increases bonding in composites. Plastics are mainly used as fillers to increase volume and reduce the use of other materials such as cement and eggshells.

Figure -6 Sorted and crushed plastics

(ii)Collection and processing of egg shells -Eggshells are obtained from local poultry farmers, hotels and traders; they have been deeply cleaned by soaking in water for 24 hours to easily remove dirt and film during cleaning. The main component of eggshell is calcium carbonate, making it a very important material. The eggshell is waterproof, which makes its combination with plastic suitable for use.

Figure 7 Crushed eggshells

The eggshells were first placed in boiling water for 5-10 minutes to remove the film, then dried in the sun for 3-4 days, then some were beaten with a motor and pestle and others crushed with a crusher. The broken shells

were sieved through a sieve with a mesh size of 1.2 mm . Egg shells were used to increase volume and reduce the use of other materials.

(iii)White cement binder – This is the third component that binds plastic and eggshell together, creating a material that is resistant to water penetration. In this case, white cement was used to bring out the colors of the plastics or eggshells. White hydraulic cement is a good ingredient as it prevents water penetration and strengthens the material. White cement (Table 3.6) was used mainly for aesthetic reasons. However, regular Portland cement (OPC) can also be used. Pure drinking water was used to mix the ingredients.

Figure -8 White cement

Mixing plastics, Egg shells and cement and casting cubes- The densities of plastics, white cement and egg shells were 400 kg/m^3, 1,440kg/m^3, and 1,290kg/m^3, respectively**.** For the production of building tiles, crushed plastics, crushed and pounded egg shells and white cement were mixed in different quantities (Table 3.1). Commercial production of these tiles should aim at minimizing the cost of production. In order to manufacture the tiles, a ratio that gave the maximum compressive strength was used. 07 cubes were cast

for each ratio; they were cured for 28 days under water. Three cubes for each ratio were tested for compressive strength at 7, 14 and 28 days respectively.

Table 1.1: Quantities (kg) of different materials in each ratio

Cement plastics egg shell	Cement (kg)	Plastics(kg)	Egg shells (kg)
1:1:0	.94	.26	.00
1:1:1	.62	.17	.56
1:1:2	.47	.13	.84
2:1:1	.94	.13	.42
1:2:1	.47	.26	.42
1:2:2	.27	.21	.67
2:1:3	.75	10	.67

Figure -9 Cast cubes

Making of the tiles- After obtaining the ratio (2:1:1) that gave the maximum strength, the making of the tiles commenced. Moulds of different sizes (300x300x10mm, 200x200x10mm and 180x180x10mm), were used to make these tiles (Table 3.12). The mixture of white cement, plastics and crushed Egg shells was hand compacted into the moulds and the surface finished smooth using a steel float and then the tiles are left to set and dry in the moulds for 24-48 hours before they were removed and let to dry at room temperature. The mixture was made fairly plastic to enable proper compaction manually. Three moulds of 200x200x10mm, one mould of 300x300x10mm and one mould of 180x180x10mm were used in the study.

Figure -10 Making the tiles with the moulds

CONCLUSIONS-

(I) The compressive strength of tiles increases with increasing cement content. Compared with plastic and eggshell, cement contributes the most to the compressive strength of tiles which decreases as the amount of resin increases. Adding eggshells does not significantly affect the compressive strength of tiles. Plastic tends to reduce the compressive strength of tiles. Therefore, they should be used with caution.

(II) Economically, the penstocks made using cement, plastics and egg shells admixture are affordable compared to for Ceramic tiles available commercially and the product process is cheap since it doesn't involve more precious artificial outfit. Wastes (plastics and egg shells) are the major accoutrements that are demanded to manufacture of these tiles.

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