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UTILIZATION OF POLYMERIC WASTE INTO PAVEMENT BLOCKS

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ABSTRACT

Disposal of waste materials especially the polymeric packaging material and in that too the single use plastic has become a major challenge for not only our society but the country itself. Many countries like U.S , U.K , Germany and Japan which used to dump their plastic waste into the country like China for recycling were taken aback in mid-2018 when china decided that it will no longer take plastic and other solid waste into its country for recycling. With China banning the imports the south east asian countries like India have to bear the burden of recycling their plastic waste. Major steps have been taken and various researches were conducted about using plastic waste into bitumen to make plastic blended bituminous road.Recently studies and tests are also conducted to use PET bottles into pavement system. So this proposed sand block uses crushed and shredded PVC into the pavement system as a replacement to the fine aggregate sand in the conventional sand cement pavement block. Thus this paper gives idea about global activity for using plastic in pavement block and their impact.

Keywords: *PVC, concrete paver block, M-sand, replacement, crushing strength, water absorption*

Introduction

Plastic is very common material widely used by everyone and used everywhere due to its advantages such as lightweightedness, utility, compactness and strength. Commonly used plastic items are bags, bottles, containers, food packages etc. It is very flexible, robust and rigid that is why we are reluctant to not use use it even if of single use or in spite of it being polluting the environment especially groundwater and affecting human beings. According to a study every individual in America is contaminated with microplastic particles and is termed as carcinogen that has potential to turn into cancer.Plastic is a polymer made of the large molecules called as monomer that are join together in the chain by process of polymerisation to form polymer which makes it difficult to decompose and it takes upto 4500 years or so.World annual consumptions of plastics waste turns from 5 million tonnes in 1950 to around hundred million tons in 2012. Consumption of plastic has been increasing rapidly due to growth of industries and standards of living.

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The use of plastics waste in the manufacture of Paver blocks is efficient and effective way of utilising the plastic waste and to solve the problem of storing plastic waste into landfills and dumping grounds, hand to decrease the cost of production of the manufacturing materials such as the bricks, blocks and tiles. In the recent research, researchers have studied and perform the test on direct inclusion of Polyethylene, polyethylene terephthalate (PET) bottles in chip formin building materials to test its physical and Mechanical properties on combining with building materials such as sand and cement. Most of the studies that were conducted for replacement on volume basis. In this study the replacement is being done on mass basis instead of volume basis and the manufactured blocks have gone under the test for compression, water absorption, efflorescence and flexure.

State of art

Ahmed k. Jassim et al. [1] performed experiment forproducing plastic cement by using polyethylene wastes. In this research the experiments were done by using polyethylene waste in range of 20.0 % to 80.0 % by volume. The result from this research showed the possibility ofproducing plastics cement from 60.0 % polyethylene wastes plastic and 40.0% the Portland. Cement, other things which were found from this research was the density of the plastic waste showed decrement, ductility showedincrement and the improved workability, and this implied theproduction of lightweight building materials.

Mohan D.M.S et al.[2] worked on manufacturing of bricks by utilising the plastic bags.In this project the waste plastic was effectively utilised in order to reduce the space required to dump these wastes.Polyethylene bags for cleaned, added with fine aggregate at various ratios of 20%,40%,60%,80% so that to obtain high strength bricks.From this research it was found that utilising polythene bags into brick was one of the best way to effectively utilise the waste polythene bags .

R. Mahadevi et al.[3] had done an experimental investigation to utilise Poly vinyl chlorideplastic material in Concrete Paver blocks the PVC material was used in the form of powder as partial replacement in M sand as fine aggregate, using 197*167*60 mm bone shaped paper block moulds and M30 grade of concrete mix were used the aim of this research was to reduce the cost of block, unit weight and to reduce the environmental pollution. From this research it was found that using the PVC plastic waste in making concrete pavement block will be a better option.

SinaSafinia and Amani Alkalbani[4]studied and examine possibility of the using the waste plastics bottle into the concretes block. In this study, plastic bottle uses to create void atthe equal distance among them in the masonarystructure, the bottles were insertedinto the concretes. in this study waste of 500ml plastics bottles place in the masonarystructuresand then crushing strength test was done, the result was found to be reasonable. The study showed 57% more strength when the plastics bottles than the local concretes blocks.

Dinesh A. et al. [5]conducted tests to utilise the plastic waste into the production of bricks and Paver blocks. He designed different mix ratios of sand and plastics in the proportion of 1:2,1:3,1:4,1:6 and conducted various experiments of water absorption efflorescences, the fire resistance

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and compression for which the strength for different ratios.

Nanda et al. [6] proposed that on adding stone crusher dust at certain percentage with fine aggregate it added upto 50% by weight so no effect on reduction on the mechanical, physical properties of paver block and they also reduce costs of the conventional block up to 56%.

Patel et al.[7] found that foundry sand is physically sound and environmentally safe for sustainable development. Preferential replacement of cement with foundry sand in paver block greatly affect the crushing strengths and cost of paver blocks with maximum replacement of 50% results obtained are water absorption is of 2.0% & crushing strength 23.49 N/ mm^2 cost of paver block is 20.14% lower than standard mix proportion commercial block.

Atul Thakur et al [7] studied partial replacement of cement with rice husk powder in paver blocks for determination of the effect on the crushing strength, extent of water absorption and abrasive resistance of paver blocks. Partial replacement of cement in various percentages like 0%, 15%, 20%, 25%, 30%, 35% and 45% was done. The crushing strength was determined at end of 8, 28 and 56 days, water absorption test and abrasion resistance are determined at end of 30 days period.

Tapkire et al. [7] studied the utilisation of plastic waste in concrete paver block as huge amount of plastic waste causes environmental degradation, so plastic waste can be used in the different industries like the construction industry for partial replacement of building composites like sand and cement. They saw polypropylene and polyethylene terephthalate as alternative which can take a part of the aggregates of concrete. In his study they used 20% of recycled plastic waste in place of aggregates in concrete, which does not affect the properties of concrete at all.

M. C Nataraja and Lelin Das [2] studied the properties like as the crushing strength, the bending strength and the water absorption of paver blocks made of crushed granites, materials like as kadapa and broke pavers for different scale of replacements of coarse aggregete were studied as per IS15658:2006.

Zahra NiloofarKalantar[8]conducted a research to improve the road pavement performance by adding polymeric material into asphalt. This research was review of the using polymers in asphalts paver. in the study it has been presented the histories and benefitsof the use of waste and virgin.polymer in the asphalts. from this research it is found that in comparison to virgin Polymers recycled polymers added to asphalt has showed improved road pavement performance.

Amit Gawande [9] conducted a research to dispose waste plastic, as plastic waste disposal is hectic job due to it's very low biodegradability and environmental aspect. In this research he tried to partially replace the conventional building material by waste plastic to improve desired mechanical properties for road mix. Bitumen is being used as binder in conventional road making process so bitumen can be modified by using waste plastic pieces in Bitumen mix that could be used as a top layer court of flexible pavement. From this research it was found that the waste plastics with modified bitumen mixtures has good bind property density, the stability and is more resistant to the water due to its almost no absorptivity.

Al Manasir and Dalal conducted [10] experiment to investigate how the bulk

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density of concrete get affected on using plastic aggregates. In their investigation, they made twelveconcrete mixtures of different ratios having variable percentage (0.0%, 20.0%, 30.8%, and 50.0%) of the plastics aggregates. In this experimenttheangularplastic aggregate with a max. Size of 13.0millimetrewere being use. Hence, they concluded that bulk density of concretes was decreasing while making an increment in plastics aggregates contents.

Marzouk et al. [11]conducted experiment to study the reduction in bulk density of the mortar mixes by preparing the cement mortar mixtures by replacing 0.0 to 100.0 percent. In volume of sand by two size ofthe PET aggregate. From the experiments it was found that the reduction in bulk density was remain less when thevolume occupy by the aggregates varied b/w 0.0 % to 31.0 %, but when the volume was made more than 50%, it was found that the composites bulk densities was started to decrement in its value until it reached a value of 1000 kg per metre cube, also found that for same volume % of substitutingof the PET aggregates, the bulk density was decreas while making decrement in the particlessize.

Ismail and Al. Hashmi [10] conducted research work to determine the strength of concrete by addition of polyethylene and polystyrene plastic wastes into the concrete mixture. He showed the possibility of using different plastic wastes with approx20.0% polystyrene and 80% polyethylene (as thefine aggregates up to maximum size of 4.750 mm in the concrete). From his research work, it was found that by increasing the plastic waste content in the mixture, the compressive strength values of plastic waste concrete (from the compressive strength test) tend to decrease, at everycuring ages, below the reference concretes. The concrete having 10.0 % of plastics wastes had showed the low crushing strength and found that the strength was about 30.1 % lowthan that ofreference concretes mixtures.

Bhavin K. Kashiyani[12] studied the use of polypropylene in paver blocks. Paver blocks are widely used in footpath and also use other constructionspurpose.The paver block have low maintenance costs and they easily replace with new one at time of failure.To improve thecrushing strength andmany other parameters ofthe paver block this study was important. In the study, inclusions of PP fibers only the top layer of paver block use for finding the change in the compressive strength of thepaver blocks and optimizing the maintenance cost of paver block. Also, it's very significant in improving the lifetime of paver block. The paper showed the result deduce by the adding of the PPF in the peak most layers of 0.410% giving and minimal water absorptions.

KhileshSarwe[13] performed research work to show the effects with addition of thewaste plastic into the steel fibers to making maximum usesof plastics wastes into the concretes. They casted two category of mixture in cubes (150x 150x 150 mm3), one was with the variable percent of plastics waste &cement and other mixture of plastic waste/steel fibers, in order to study crushing strengths. The combined mix of plastics waste and steel fiber had show more strengths in comparedwith concrete mix that prepared only with the plastics wastes. They reached the conclusion that the plastic waste having 0.60% weight of cement were when used with steel fiber having 0.3% weight of

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thecement had showed the maximum crushing strength in the test.

Kou et al.[14] performed experiment to investigate and determine the hardened and fresh properties of the lightweight aggregates concrete that were prepared by using recycled plastic wastes that were source from the scrapped PVC pipe in order to replace the river sand as the fine aggregate. The different concretes mixtures test inwhich the river sand was partial replace by the PVC plastics waste granules in percentage of 0%, 15%, and 45%. The splitting tensile strengths were found to be 3.05,2.888,2.850,1.830Mpa respectively.

ACI Committee 544-89 [15]had proposed an experiment-dropweight impact tests in order to investigate and evaluates thefibre concretes impact resistance. The experiment yielded no. of blows that found necessaryin order to cause the prescribe level of distresses in test specimens and the no. served as an estimate of the energy that being absorb by Specimen at a different level of distresses that being specified. From the test it was observed that the result exhibits a morevariability and these could vary with different types of mixes & fibers contents. The result showed that flexural strength of concrete mixtures with PET was to decrease with increasing in PET ratios in mixes. Trend was attributed to decrease in adhesive strengths value of cement between the surfaces of wastes plastic particle.

PSuganthy et al.[16] did experimental study to know the application of pulverize fine crush plastics (that were produced by crushing of high density polyethylene) for replacing of thefine aggregete into concretes withthedifferent percentage of the mixes. They mainly focussed on the optimumreplacement of natural sand by using plastics sand. They made different concrete mixtures from concretes materials in order to study the results from the test of the different concrete properties. The experimental study the results showed the increase in water/cement ratio with the increase in the plastics particle so that to achieved desired concretes, slow decrement in the strengths of concretes specimen withincluding the plasticsaggregate to the 25.0 % but when the further increment was made,it was observed rapid decrement in strengths that showed up proper replacements for up to 25.0 % of sand having plastic pulverize sand. It was also concluded after performing tests on the specimen which had different proportions of the plastic replacement, study focussed only on crushing strengths andno any efforts made in order to investigate the use of other mixtures to control the reduction the crushing strengths in a mixture with the pulverizeplastics.

M Elzafraney et al. [17] incorporated the using of recycleplastics aggregates into the concrete's materials for constructions purposes and its performance as compare with the normal aggregate concretes. The plastics content concretes were prepared from highly refined recycled plastic aggregates in order to meet the different requirements ofthe building constructions purpose like workbility, strength etc, It was recorded that the recycled plastic concrete building with had more insulate had used energy 8% less energy than normal concretes. It wasrecommended that the efficiency of energy could be further increased by using recycled plastics having high thermal capacities.

Davide Lo Presti et al. [18] worked recycled tyre rubber for the asphalt road

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mixtures. They considered the RTR-MBs (recycled tyre rubber modified bituminous) for the handling and stortime. Their limitation was that RTR-MBs technology was struggling to be fully adopted worldwide because of lack of training and support. Hence, this research reported the result of literature review on existing technologies.

Dr. Sudesh Kumar Sohani et al. [19]did research on the design of the pavement block design using LDPE and its utilization. They stated that the strength of block of both proportions is less than the strength of conventional pavement block. But as far as other properties are concerned namely water absorption and brittleness, the block is proved to be better than that of the conventional blocks. The water absorption of block is drastically lower than that of the conventional blocks, which implies that the material can also be used as water resistant covering on roof top. The weight of both blocks is less than that of conventional blocks as the density of LDPE is less than that of the Cement. Though the strength of the constructed block is less than that of conventional pavement block, the one quality that was observed was that the block is less brittle than conventional block and the reason being that the plastic is used instead of cement which has a tendency to get deformed under application of load. Blocks have very low water absorption as compared to conventional blocks reason being that the plastic does not absorbs water. This gives the block a unique property of water resistance which is absent in the conventional pavement block. Blocks can be used in all weather conditions. No curing is required in making of blocks as plastic doesn't require water to gain any strength, it naturally gains strength when cooled down.

Ahmad K Jassim et al.[1] worked on recycling of polythene to produce the eco-friendly plastic cement. They mixed HDPE type of plastics with the Portland cement and substituted sand by finely cutted polythene in the value of 10% to 80% by the volume as a short type of reinforcement structure. The best achieved was 60 % and 40% fraction. The test show increase of the ductility and decrease of the density along with improved ability to work.

Eric ababio et al. [20] worked on use of LDPE in good strength cement pavements. When the sand got substituted by the wasted plastic the mechanical and physical strength got effected. It was observed that crushing strength, density and the tensile strength got reduced. As the fraction of plastic increased, the density and strength decreased. The result showed that 10% to 50% wasted plastic was best.

CONCLUSIONS

The waste plastic disposal in the environment has become a serious problem because of its presence in large amount and having its low biodegradability.Many research works have been carried out to find out different and appropriate ways of disposing the waste plastics in safe and eco friendly manner.The inclusion of waste plastics in the concrete is one of the appropriate ways of disposing waste plastics.Various attempts has been made to utilize the waste plastics like pulverized fine crushed plastics as aggregates into the concrete, by using polymeric materials into the asphalt, by adding waste plastics in road mixes,cement mortar mixes,polypropylene fibre with different percentages in concrete

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paver block, by replacing coarse aggregates by LDPE, by adding crushed PET bottles in the concrete .So, this study on sand plastic block uses crushed and shredded PVC into the pavement system as a replacement to the fine aggregate sand in the conventional sand cement pavement block. It is seen that powdered PVC gives better results than the shredded PVC. The partial replacement range lies from 20% to 40%. The use of plastic in the concrete has reduced the unit weight of the concrete. It has also found that the maximum crushing strength is occurred at the age of 29 days. The estimated decrease in the compressive strength of the block is mostly 5%. The block will use higher water during manufacturing but will have lesser water absorption capacity. The cost of the paver block will decrease due to the use of waste plastic.

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