USE OF PLASTIC WASTE IN PAVEMENT CONSTRUCTION

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ABTRACT

Pervious pavement blocks are noteworthy concrete blocks that allow infiltration of storm water through the ground surface into the soil. Pervious pavement blocks are a recognized runoff-reducing substitute for normal pavements in development of sustainable parking areas, sidewalks, gardens. The cavities present in the previous pavement blocks allows water to percolate through it. The compressive strength of the pervious pavement block is lesser than that of the impervious pavement blocks due to the presence of voids. Also, the strength of plastic based pervious concrete is less than the strength of pervious concrete made using cement as plastic possesses less adhesive property than cement. The waste plastic is shredded & coated over aggregate & mixed with hot bitumen and resulted mix is used for road/pavement construction. This will not only strengthen the pavement but also increases its durability. This innovative technology will also be suitable for Indian hot-humid climate. It is eco-friendly as well as economical. In this paper, we have discussed the method of using plastic waste in construction of roads and how it is better than the ordinary roads.

Key Word- *Plastic waste, bituminous roads, pollution, Global warming*

1.INTRODUCTION

Plastic have become an integral part in our daily life and so the millions of tons amount of plastic waste is generated annually today. Due to its low cost, easy manufacturing and impervious to water, plastics are used in an excessive and manufacturing wide range of products. Also due to fast growth of industries and vast population has resulted in creation of various varieties of polythene material. Also, basic sectors like agriculture to packing, automobile, electronics, electrical, building construction, communication sectors has been practically transform by the use of plastics. Plastic waste, if not recycled gets mixed with Municipal Waste or get thrown over land area. There are two methods of municipal waste disposal, land filled or incinerated. And both the methods are not eco-friendly. Incineration leads to air pollution whereas dumping the waste in open areas causes contamination of water bodies and soils. As stated above, plastic disposal is one of the major problems for developing countries like India, at a same time India needs a large network of roads for its smooth economic and social development. Scarcity of bitumen needs a deep thinking to ensure fast road construction. Hence, this new technology of using plastic waste in construction of roads not only increases the road life also retain good environment to live.

1.1 Waste Plastic Materials

Plastic use in road construction is not new recent studies in this direction have shown some hope in this terms of using plastic waste in road construction i.e. plastic roads. Plastic roads mainly use plastic carry bags, disposable cups and PET bottles, HDPE, LDPE, MDPE, PP, PS, PVC & others that are collected from garbage dumps as

an important ingredients of the construction materials. When mixed with hot concrete, sand and hot with plastics melt to form an oily coat over and the mixture is laid on road surface like a normal tar road.

Plastic is a material that contains one or more organic polymers of large molecular weight, solid in its finished state and at some state while manufacturing or processing into finished articles can be shaped by its flow.

1.2 Type of plastic

- Thermosets
- Elastomers
- Thermoplastics

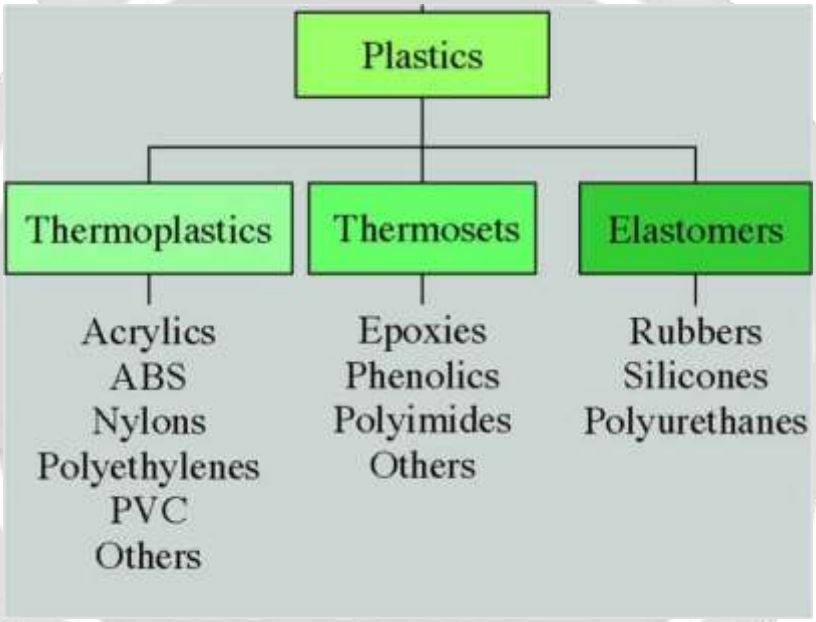

Chart -1: Types of plastics.

1.3 Various resins of plastic

- Polyethylene terephthalate (PET,PETE)

Fig -1 Polyethylene terephthalate (PET, PETE) material.

This image shoe the polyethylene terephthalate type plastic these plastic we are generally used in our daily routine such as cold-drinks, mouth gargle etc.

- High Density polyethylene (HDPE)

Fig -2 :Density polyethylene (HDPE) material.

This image show high density polyethylene these type of plastic are generally used in chemicals liquids sach as finial, hand-wash etc.

- Vinyl (Pol vinyl chloride or PVC)

Fig -3 Vinyl (Pol vinyl chloride or PVC) material.

This image show Pol vinyl chloride these type of plastic are generally used in water supply fitting.

- Low density polyethylene (LDPE)

Fig1.5:Low density polyethylene (LDPE) material.

This image show Low density polyethylene these type of plastic are generally used in our daily activity such as carry bags, water bottle, material packing etc.

- Polypropylene (PP)

Fig -4 Polypropylene (PP) material.

This image show Polypropylene plastic these type plastic are generally used in furniture

2. LITERATURE SURVEY

Alaa M.Rashed 2015, give an idea A Brief on high-volume class fly ash as cement replacement- A guide for civil engineer, international journal of sustainable built environment. Disposal of fly ash (FA) resulting from the combustion of coal-fired electric power stations is one of the major environmental challenges. This challenge continues to increase with increasing the amount of FA and decreasing the capacity of landfill space. Therefore, studies have been carried out to re-use high-volumes of fly ash (HVFA) as cement replacement in building materials. This paper presents an overview of the previous studies carried out on the use of high volume Class F FA as a partial replacement of cement in traditional paste/mortar/concrete mixtures based on Portland cement (PC). Fresh properties, mechanical properties, abrasion resistance, thermal properties, drying shrinkage, porosity, water absorption, sorptivity, chemical resistance, carbonation resistance and electrical resistivity of paste/mortar/concrete mixtures containing HVFA (⩾45%) as cement replacement have been reviewed. Furthermore, additives used to improve some properties of HVFA system have been reviewed. He give the result the inclusion of HVFA in the mixture reduced the heat of hydration, the degree of hydration, bleeding, segregation, density, but increased workability and setting time. The inclusion of HVFA in the matrix sharply decreased the mechanical strength and abrasion resistance especially at early ages. The gap of mechanical strength and abrasion resistance between the HVFA and the control decreased with increasing curing age. The mechanical strength and abrasion resistance decreased with increasing FA content.

APARNA MENON ; IN 2015 ,Government order in November 2015 has made it mandatory for all road developers in the country to use waste plastic, along with bituminous mixes, for road construction. This is to help overcome the growing problem of plastic waste disposal in India. The technology for this was developed by the 'Plastic Man' of India, Prof Rajagopalan Vasudevan, and Professor of Chemistry at Thiagarajar College of Engineering, Madurai.

She's work is lanthanum oxide (La_2O_3) has been studied for the methane partial oxidation reaction. We report long term experimental studies on La_2O_3, prepared by the solution combustion method with 5 wt. % of Ni being added using chemical reduction method. Thorough characterization is done using XRD, SEM and FTIR. The activity is measured in terms of methane conversion and hydrogen and carbon monoxide selectivity. Methane oxidation is also carried out by varying the residence time, which changes the product distribution. She found the methane activity in the absence of oxygen and effect of pretreatment is also disused in detail. It is observed that the addition of nickel on the La_2O_3 catalyst (5 % Ni/La_2O_3) increases the catalytic activity significantly. Long term tests at isothermal conditions on both La_2O_3 and 5 % Ni/La_2O_3 catalysts are carried out to study the deteriorating effect of carbon (coke) deposition. Hydrogen production with 5 % Ni/La_2O_3 is significantly enhanced compared to La_2O_3, and it is experimentally observed that both the catalysts show excellent coking resistance capabilities.

Jayasankar. R, Mahindran. N, Ilangovan. R; “Studies on Concrete using Fly Ash, and Egg Shell Powder.He give an idea to use of waste materials in buildings is an innovative approach towards sustainability. The objective of this paper is to study the properties and behavior of cement mortar using eggshells wastes. Various low concentrations of eggshell powder (ESP) (0, 1, 3, 5, 7 and 10 wt. %) were used as partial replacement of cement in mortar of (1:2) mixing ratio by weight. The maximum particle size of ESP is 75 µm. Soundness of cement in ESP-cement pastes was evaluated using Le-Chatelier method. The influence of ESP on strengths of cement mortar was investigated by means of compression and flexural tests at various curing periods. It was found that, there was no negative impact of ESP on soundness of cement. A significant enhancement in compressive strength was recorded for all ESP-cement mortars at 7 days and 28 days. The highest improvements, (31.63%) and (11.65%), were observed for samples with 10wt% and 5 wt. % of ESP respectively. At moderate periods of curing, samples with 1 wt. % of ESP have the highest enhancements in compressive strength of about (8.93%) and (1.75%) for 42 days and 56 days respectively. A reduction in compressive strength was observed for all samples at late ages (70 days and 90 days). In terms of flexural strength, the addition of ESP (up to 5 wt. %) results in improvement in the flexural strength when compared with the control samples. The highest enhancement (21.20%) was recorded when cement was replaced with only 1 wt. % at 7 days. His inference possibility of utilize eggshell wastes as partial replacement of cement in mortars, and without using admixtures, was explored. The effect of inclusion low concentrations of ESP on properties and behavior of cement mortar was investigated. Flexural Strength (MPa) ESP (wt. %) 28 days 7 days 56 days Journal of Engineering and Development Vol. 19, No. 06, November 2015 www.jead.org (ISSN 1999-8716) 207 1. Partial replacement of cement with various concentrations of ESP causes the same expansion (0.5 mm) of cement paste when compared with control specimens. 2. A significant enhancement in compressive strength was achieved at early age (7 days) and the highest improvement (31.63%) was obtained for samples with 10 wt. % of ESP. 3. The compressive strength at 28 days enhanced with the addition of ESP and the highest improvement (11.65%) was obtained for samples with 5 wt. % of ESP. 4. The addition of 1 wt. % of ESP results in highest improvement in compressive strength at moderate periods of curing (42 days and 56 days). The rates of enhancement are (8.93%) and (1.75%) at 42 days and 56 days respectively. 5. Reduction in late compressive strength was obtained when ESP was used to replace the cement

JOHNSON KWABENA APPIAH; IN 2010, He is research interests comprise, recycling, solid waste management, polymer composites fabrication and polymer material technology. His essence In the year 2000, one of the millennium development goals (MDGs), which Ghana appended to was the promotion of environmental protection and sustainability; However, for well over a decade which has seen the transformation of the MDGs in to Sustainable Development Goals (SDGs), the country is still grappling with the proper disposal and management of its Municipal solid Waste (MSW), especially plastic waste.Currently, the common waste disposal methods employed are land filling, incineration and haphazard littering in the cities, municipalities and the countryside. These disposal methods have a negative impact on human health and the environment; consequently, rivers, gutters and roadsides are choked and filled with waste plastics. His gist the addition of thermoplastic modifiers to conventional bitumen is known to improve the viscoelastic behaviour of

the bitumen and change its rheological properties. Two types of modifiers were used, High density polyethylene (HDPE) and Polypropylene (PP); they were observed to display different amount of influence i.e. increasing the softening point, decreasing penetration value whilst enhancing the overall dynamic and absolute viscosities of the binder.

- P Asokan, M Osmani 2010, Improvement of the mechanical properties of glass fiber reinforced plastic waste powder filled concrete. His argument A comprehensive laboratory experiments were conducted to improve the mechanical properties of glass fibre reinforced plastic (GRP) waste powder filled concrete using superplasticiser for widening the scope for GRP waste recycling for different applications. It is imperative to note that the 28 days mean compressive strength of concrete specimens developed with 5–15% GRP waste powder using 2% superplasticiser resulted 70.25 ± 1.43–65.21 ± 0.6 N/mm^2 which is about 45% higher than that of without the addition of superplasticiser (with GRP waste) and about 11% higher than that of the control concrete (without GRP waste) with 2% superplasticiser. His inference the tensile splitting strength of the concrete showed 4.12 ± 0.05–4.22 ± 0.03 N/mm^{2}with 5–15% GRP waste powder which is also higher than that of the control concrete (3.85 ± 0.02 N/mm^2). The drying shrinkage, initial surface absorption and density of GRP waste filled concrete were evaluated and found better than the desirable quality for use in structural and non-structural applications.

  P Panyakapo, M Panyakapo 2008**;** He paper presents the utilization of thermosetting plastic as an admixture in the mix proportion of lightweight concrete. Since this type of plastic cannot be melted in the recycling process, its waste is expected to be more valuable by using as an admixture for the production of non-structural lightweight concrete. Experimental tests for the variation of mix proportion were carried out to determine the suitable proportion to achieve the required properties of lightweight concrete, which are: low dry density and acceptable compressive strength. The mix design in this research is the proportion of plastic, sand, water–cement ratio, aluminum powder, and lignite fly ash. His consequence the experimental results show that the plastic not only leads to a low dry density concrete, but also a low strength. It was found that the ratio of cement, sand, fly ash, and plastic equal to 1.0:0.8:0.3:0.9 is an appropriate mix proportion. The results of compressive strength and dry density are 4.14 N/mm^2 and 1395 kg/m^3, respectively. This type of concrete meets most of the requirements for non-load-bearing lightweight concrete according to ASTM C129 Type II standard.

  S.S.Verma, (2008), Road from plastic waste, The Indian Concrete Journal. His declarative the debate on the use and abuse of plastics vis-a-visa environmental protection can go on, without yielding results until practical steps are initiated at the grassroots level by everyone who is in a position to do something about it. The plastic wastes could be used in road construction and the field tests withstood the stress and proved that plastic wastes used after proper processing as an additive would enhance the life of the roads and also solve environmental problems. The present write-up highlights the developments in using plastics waste to make plastic roads. Plastic is everywhere in today's lifestyle. It is used for packaging, protecting, serving, and even disposing of all

kinds of consumer goods. He found in cessation Plastics will increase the melting point of the bitumen. The use of the innovative technology not only strengthened the road construction but also increased the road life as well as will help to improve the environment and also creating a source of income. Plastic roads would be a boon for India's hot and extremely humid climate, where temperatures frequently cross 50°C and torrential rains create havoc, leaving most of the roads with big potholes. It is hoped that in near future we will have strong, durable and eco-friendly roads which will relieve the earth from all type of plastic-waste.

Shirish V. Arun D. Parametric Study for Replacement of Sand by Fly Ash for Better Packing and Internal Curing.His epitome the use of fly ash as replacement of sand is an economical solution for making green and denser concrete. The paper presents a concrete mix design procedure for partial replacement of sand with fly ash. Present method could produce additional compressive and flexural strength for concrete with partial replacement of sand with fly ash over control concrete, with higher slump. Addition of 0.5% super plasticizer could further improve compressive and flexural strength with higher slump over control concrete. Concrete with sand replaced by fly ash was also found to be economical without and with super plasticizer, when cost per N/mm2 was compared. The beneficial effect may be attributed to better packing, pozzolanic activity of fly ash and internal curing by fly ash as partial replacement of sand. Based on experimental results, correlations are developed to predict compressive strength, flexural strength and cost per N/mm2 for percentage sand replacement with fly ash. His epilog the following conclusions could be drawn from the present investigation. 1) Present mix design procedure clearly achieves lesser voids as indicated by higher pulse velocity, compressive and the flexural strength. 2) The compressive and the flexural strength of concrete mixes with partial replacement of sand by fly ash was found to be 15% higher without super plasticizer and 28% higher respectively with super plasticizer. 3) The compressive and the flexural strength of concrete mixes with the partial replacement of the sand by the fly ash by the minimum voids method could be higher than the replacement by the maximum density method. Hence the minimum voids method is preferable over the maximum density method for the partial replacement of the sand with the fly ash. 4) The maximum compressive and flexural strength could occur with the partial replacement of the sand with fly ash by the minimum voids method and the super plasticizer. 5) Slump was higher without and with super plasticizer in fly ash concrete over control concrete due to lubrication, ball bearing effect and better packing due to fly ash.

TRINITY AMA TAGBOR (MRS.) 2012 she is currently involved in research into new and innovated building materials, modification of bituminous materials for road construction. His summarize, It was observed that polypropylene polymer, showed profound effect on homogeneity and compatibility with slight linear increment in the viscosity, softening and penetration values as against relatively high changes for HDPE modified bitumen.The viscosity of unmodified bitumen was enhanced with the addition of the polymers and thixotropic effect was observed for both HDPE and PP at 60 °C. For all modified binders prepared, the penetration values decrease as polymer-bitumen ratio increases whiles softening temperature generally increases as polymer ratio increases. The most compatible and incompatible blends for HDPE were respectively observed at 2% and 3% polymer loading. The most enhanced, homogenous blend is achieved with PP at 3% polymer loading. His inference in this study has also shown that waste plastic modified bitumen carries great promise as an

alternative recycling method for plastic waste management in Ghana, as well as a non-traditional, modified binder for road construction. Further studies should be done to investigate long term performance of field test sections with PMB so as to evaluate the effect on storage, rutting, cracking resistance under various traffic conditions.

United Nations Environment Programme Converting Waste Plastics into A Resource: Assessment Guidelines(2009**);**Polypropylene plastics can be observed to have a comparatively reduced influence on the microstructure of the binder at low polymer ratios as compared to HDPE. His curtailment Concrete is the second most widely used construction material next to water globally, owing to its better controllable structural properties, which significantly increased its demand in construction industry. Cement industry is manufacturing cement on a gigantic scale to fulfill this demand since it is the main constituent of concrete. The global production of cement is estimated at over 2.8 billion tones according to recent industry data, the concept of geo-polymer concrete was forwarded by a French scientist Joseph Davidovits who proposed alkaline liquid as an activator to be used to react with some source material rich in silicon and aluminum, such as industry and agro waste products like fly ash or rice husk ash to produce geo-polymer mortar which act as binder. His Verdict From the experimental investigation the following conclusions are made: 1) Geo-polymer concrete can be manufactured with low calcium fly ash with different molarities of NaOH. The steam cured geo-polymer concrete beams with 8 Molarity NaOH solutions attain higher strength. 2) Adequate curing temperature (600C – 750C) and adequate curing time (minimum 24 hrs.) can give better results. 3) The geo-polymer concrete with steam curing at 750C increases the strength by 35-50 percent when compared to geo-polymer concrete without steam curing. 4) Workability which influences the properties of the fresh concrete and cube compressive strength, flexural strength which influences the properties of the hardened concrete have been identified. Low-calcium fly ash based geopolymer concrete has an excellent compressive strength and is suitable for structural applications. 5) The reason for the improvement in compressive strength of geopolymer concrete is the chemical reaction due to the speedy polymerization process and aging of the alkaline liquid.

- **V**.A.Rossetti, L.D.Palma, F.Medici; (2002); Assessment of the Leaching of metallic elements in technology of solidification in aqueous solution. His essence in the Results are presented of experiments performed to optimize the solidification/stabilization system for metallic elements in aqueous solution. This system involves mixing cement and a solution of metallic elements in a conventional mixer: the paste thus obtained is transferred drop by drop into a recipient filled with an aqueous solution of NaOH at 20% by weight, in which it solidifies immediately. The separate use of chloride solutions of Li^{+}, Cr^{3+}, Pb^{2+} and Zn^{2+} makes it possible to obtain granules displaying various levels of compressive strength. Three different initiation matrices were used in the experiments, the first consisting solely of Portland cement, the second of Portland cement and a superplasticizer additive, and the third of Portland cement partially replaced with silica-fume and super plasticizer. His epilogue in the results of the tests performed showed a very low level of leaching into the alkaline solidification solution for Cr^{+3}, the quantity leached being under 2% as against higher levels for the other metallic elements. For all the considered elements, the best results were obtained by using silica-fume in the initiation matrix.

- VICTOR NANA BERKO-BOATENG; IN 2011, He is currently involved with Recycling, plastic waste management, composite fabrication and fiber technology research. His give an curtailment in this paper forms part of research to solve two main problems in Ghana: firstly, the management of municipal solid waste (MSW), particularly with regards to used plastics which have overwhelmed major cities and towns; secondly, the formation of potholes on roads due to excessive traffic and axle weight. This study examines the effect of blending waste thermoplastic polymers, namely High density polyethylene (HDPE) and Polypropylene (PP) in Conventional AC-20 graded bitumen, at various plastic compositions. The plastics were shredded and blended with the bitumen 'in-situ', with a shear mixer at a temperature range of 160 °C–170 °C. Basic rheological parameters such as penetration, ring & ball softening point and viscosity tests were employed to determine the resulting changes from base bitumen.FTIR spectroscopy was also employed to study the chemical functionalities present in the bitumen composite. The properties of the unmodified bitumen were found to be enhanced with the changes recorded in the rheological properties of the polymer modified bitumen (PMB). It was observed that polypropylene polymer, showed profound effect on homogeneity and compatibility with slight linear increment in the viscosity, softening and penetration values as against relatively high changes for HDPE modified bitumen. His found the gist in Spectroscopic analysis carried out by FTIR spectrophotometry did not show new functionalities distinct from the spectrum of the base binder for all the modified bitumen samples. However, the original prominent peaks occurring at the 3000 cm^{-1}–2850 cm^{-1} for aliphatic ⎯C⎯H stretching, 2400 cm^{-1}–2100 cm^{-1} for triple bond C≡C- or −C≡N group and 1465 cm^{-1} and 1375 cm^{-1} for CH_2 and CH_3 bends are observed to increase in intensity depending on the polymer type and blending ratio. The viscosity of unmodified bitumen was enhanced with the addition of the polymers and thixotropic effect was observed for both HDPE and PP at 60 °C. For all modified binders prepared, the penetration values decrease as polymer-bitumen ratio increases whiles softening temperature generally increases as polymer ratio increases. The most compatible and incompatible blends for HDPE were respectively observed at 2% and 3% polymer loading. The most enhanced, homogenous blend is achieved with PP at 3% polymer loading. Three prominent peaks were identified in the spectrum of the unmodified bitumen, occurring at the 3000–2850 cm^{-1} IR frequency range, typical of aliphatic ⎯C⎯H symmetrical and asymmetrical stretches in alkanes. CH_2 and CH_3 bends were also observed at the characteristic frequencies of 1465 cm^{-1} and 1375 cm^{-1} respectively. A low intensity peak was observed within the 2400 cm^{-1}–2100 cm^{-1} range, indicating the presence of a very weak −C≡C- or −C≡N group with an absorbance of precisely 0.12.The use of waste commodity plastics in binder modification carries the advantage of a cheap and effective means of enhancing conventional bitumen binder performance characteristics and is an alternative way to utilize plastic waste. This suggests a successful 'blending-in' of the polymer strands into the bitumen matrix.

3.CONCLUSION

There is marginal increase in the cost because of the mixing requirements for shredded plastic waste and the bitumen but this get overcome by large amount of the total mix volume resulting in less bitumen requirement. 2. Lots of problems at a global level can be solved by utilizing non-biodegradable waste material like plastic in road construction. 3. There is overall increase in road life by opting these technologies in the pavement construction. 4. Properties of bitumen get enhanced with the addition of plastic waste. The resulting mix shows good result when compared to standard results.

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