Experimental Studies on Expanded Polystyrene Beads (Flyash Geometrical)

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Abstract*— Waste utilisation has become an attractive alternative to disposal now a days . there are number of research ,for use of waste in industry most of the relatedto use the wastein construction are or use of waste in concrete to develop new types of concrete.use of waste producing is not only makes it economical but also a very good and attractive solution of disposal problem. Flyash and EPS beads waste is used to produce a new type of concrete by replacing the sand and aggregate. According to a report in Indian coal is of low grade having ash content of order of 80-45% producing large quantity of fly ash at coal light based thermal power stations in India . flyash waste increase day by day because of its usage in thermal power stations. So it is necessary for coal industries to recycling , reusing and substitution of concrete ingredients. Flyash waste produce from industry is durable , hard and highly resistive to biological, chemical and physical degradation forces. Flyash waste powder and EPS beads can be used to produce ligh weight concrete . This study summarizes the studies , an flyash waste with EPS beads as a partial replacement of sand and aggregate in cement.

Indexed Terms-- Flyash waste, EPS beads, compressive strength, partial replacement of sand and aggregate.

I. INTRODUCTION

In a rapidly growing world's population and forward meeting consumers needs solid waste land fills with continue receiving huge volume of waste . therefore waste management is becoming increasingly mandatory for the promotion of environmental sustainability , numerous regulations have been imposed worldwide by governments and environmental organizationin order to reduce the negative environmental impact resulting from large nos. of solid waste landfills . The transformation of a large amount of solid waste into an attractive resource will preserve the reducing nonrenewable resources of materials. Maintain the required energy and also will help to solve environmental and extra used land fill problems. Until today, researches are investigating new solid waste materials and potentials of recycling either in other industries or new products.

We all know that concrete is an important construction material made of coarse aggregate , fine aggregate and binding material, crushed stone and river sand are natural resources are limited in quantities. As the use of concrete increases , natural resources decreases, and addition of pollution leads other environmental related problems, the replacement of sand and aggregate in concrete can cause a great impact on ecological side, various research have been conducted on the utilization of recycled waste as replacement of sand and aggregate in concrete. One such material is flyash with EPS beads. Various properties of flyash waste that contribute to its utilization in concrete as a partial replacement of sand and aggregates have been studied by the researchers across the world. It is found that to a certain extent the use of flyash waste with EPS beads has imported compressive strength to the concrete.

II. REVIEW

Literature survey:

Horvath (1994) presented the procedure of manufacturing of EPS prismatic block. That EPS prismatic block is called as geo foam. EPS is most widely used geo-foam material. He provided basic

properties like density, durability and engineering properties like load deformation, thermal conductivity of EPS-block geo-foam. He concluded that EPS geo-foam can be used as a lightweight fill.

Horvath (1997) carried out analysis and design methodologies of compressibleinclusion function of EPS Geo-foam. He explains the applications of EPS geo-foam. EPS geo-foam can be used in earth retaining structures, above foundation element and above pipes, culverts and tunnels. Result shows that using a compressible inclusion there is reduction of earth pressure under static and dynamic loading, also compressible inclusion used to accommodate ground or structure movement.

Yoonz (2004) studied the mechanical characteristics of light-weight soils consisting of Expanded Polystyrene (EPS), dredged clays, and cement through both unconfined and triaxial compression test. In the triaxial compression test they found that the compressive strength of Light Weighted Soils (LWS) with EPS is independent on the effective confining pressure and ultimate compressive strength under both triaxial and unconfined compression tests are almost constant for cement ratio i.e. ratio of cement to dredged clay of up to 2%. They concluded that the strain at failure in triaxial test was 39% less than that in unconfined test associated with low initial water content.

Liu (2006) studied the formation of lightweight fill material by blending soil with Polystyrene Pre-Puff (PSPP) beads and other binders such as cement. They have observed that the density of lightweight fill can be effectively controlled by using the amount of PSPP beads in making the lightweight fill. With inclusion of merely 2 — 6% of PSPP beads, the density can be reduced to 700 — 1100 Kg/m3 . The shear strength and stiffness of lightweight fill can be controlled by adjusting the amount of cement content use. They concluded that the unconfined compressive strength of the lightweight fill increases considerably if cement to soil ratio of 10 — 15%is used.

Deng and Xiao (2008) carried out the direct shear and triaxial compression tests and studied the effects of Expanded Polystyrene (EPS) mass ratios in sand EPS mixtures and stress status on materials and also shear behavior were investigated. Results indicated that increase of EPS ratios and decrease of normal/confining stresses, shearstrength decreases. EPS inclusion results in the substantial decrease in densities of sand --- EPS mixtures.

Wang and Miao (2009) carried out the experimental study to evaluate the effectiveness of the proposed material, using different mixtures of the river sand, cement and expanded polystyrene beads. The environmental advantage of the study is that it utilized river sand which has to be removed to retain the profile of the river bed. They proposed the new material composed of EPS beads mixed with river sand and cement for the construction of highway embankment. The result shows that the unit weight of the proposed material was only 10 kN/m based on a volume ratio of sand/cement and EPS beads of 1 : 1.

Ram Ratan Lal (2014) presented a paper on behavior of lightweight fill material using fly ash and expanded polystyrene beads. They were performing the triaxial compressive strength on different EPS beads to fly ash ratios specimens and investigated the mechanical characteristics of LWFM. They were studied the stress strain pattern and shear strength parameters of LWFM under four different confining pressures and observed that peak deviator stress values decreased with increasing EPS beads to fly ash ratio. For each EPS beads to fly ash ratio, peak deviator stress values were increased with increasing confining pressure.

Padade and Mandal (2014) presented a study on behavior of an expanded polystyrene-based Geo-material (EPGM) with fly ash. The proposed material is made by blending fly ash with expanded polystyrene (EPS) beads and a binder such as cement. The effects of different composition and different mix ratios between EPS beads and fly ash, cement and fly ash, water and fly ash are studied and they observed that the density of EPGM can be effectively controlled with inclusion of EPS beads in EPGM and also observed that with the inclusion of merely 0.5 2.5% of EPS beads to fly ash (by weight), the density That overall, ash mixtures compare favourably with conventional granular materials. They concluded that the class 'F' fly ash and bottom ash mixtures generally compare favourably to conventional granular

materials and are suitable for highway embankments, if proper design and constructions are followed

Prakash and Shridharan (2009) have discussed many properties of coal ashes which can be used with advantage in various geotechnical engineering application. They reported that coal ashes can be used as fill materials for low-lying areas and construction fill materials on weak compressible soils. The coal ashes can be used as backfill material in retaining structures and sub base materials for pavements.

Xiuping Feng (2011), In this paper the effect of fineness content and carbon content on strength of fly-ash was observed. The relation between 7th day strength and 28th day strength was developed. It was observed that as the amount of material on the 45um sieve increased than a decreasing trend was observed between the SAI and 7day Strength.

S.N. Name of Researcher
Year and publication
Journal
Subject of Research
Summary of Conclusion

1.Hovarth
1994 University paper
An experimental study on EPS beads
Properties of EPS beads which can be used to create geofoam material.

2.Hovarth
1997 University paper
Experimental study on properties of EPS beads.
Properties of fly ash material

3.Liu
2006
Blending of soil and esp. beads forming light weight material.
Importance of Adjustment of cement content for strength in the geofoam material.

4.Deng and Xiao
2008(Chinese journal of Geotechnical advancement)
Stress- strain analysis of EPS beads and sand mix.
Increase in % of EPS beads resulted in decrease in shear strength.

5.Prakash and Sridharan
2009
SSN print 1090025X, American society of civil engineers.
Beneficial properties of coal ashes and its uses in geotechnical application.
Discussed engineering properties of coal ashes and suggested its various applicability.

6.Padade and Mandal
2014
Combination of fly ash and EPS beads
With increase in % of EPS beads the strength of fly acubes registered a decreasing pattern.

Ram rattan lal et al
201
Behaviour of light weight flyash material.
Investigated mechanical properties of LWFM.

8.Golait & Patode
2015, Indian geotechnical conference, Pune,COEP.
Geofoam material for backfilling and embankment.
Investigated mechanical properties of LWGM with varying EPS ratio

Y.S Golait , A S Patode(2015) , presented their paper on a new Eps beads based material. The paper proposed a material containing 0.8% to 1 % eps beads and 6 % to 10% of cement. The new material proved that increase in eps beads resulted in the decrease in strength and also decrease in weight of the cube. It was found appropriate for use in the embankment and backfilling.

AMIT KUMAR D.RAVAL. al (2013)
They have performed the research study in which (OPC) cement hase been replaced by ceramic waste power accordingly in the range of 0%, 10%,20%, 30%,40% & 50% by weight for M-25 grade concrete.the waste employed came from ceramic industry which had been deemed unfit for sale due to to a variety of reasons , incliuding dimensional or mechanical defects in the firing process. The results demonstrate that the use ceramic masonary rubble as active addition endows cement with positive characteristic as major mechanical strength and the

economic advantages. Reuse of this kind of waste has advantages economic and indirectly, all the above contributes to a better quality of of life for citizens and to introduce the concept of sustainability in the construction sector.

RASHMI RAWAT . al (2019)

They have performed the work whose aim was to reduce the environmental impact , reduce the cement consumption in the concrete by the replacement of ceramic material as a supplementary cementation material . in this work material by three tests i.e. strength activity test .frattini test and saturated lie test. According to these result in ceramic electrical isulator material pozzolanic activity of material has been found and it can be replaced in mortar and for that exact limit further investigation is require i.e. durability etc. after that its successful in mortar gives pozzolanic activety test result,here research work is done in concrete for the same ceramic electrical insulator material partial replacement with cement in the concrete and check its mechanical properties , workability, durabilityand microstructure (by FE –SEM test only). In the concrete cement has been partially replaced by 5%, 10%,15%,and 20% of ceramic waste . for utilization of these ceramic waste investigate the test performance in the concrete, here workability test (by slump cone test), durabiliytest(water absorption and water penetration test) and micro-structure analysis (by FE-SEM tst images) has been tested in the replacement of the ceramic waste material. In concrete according ti the test result of mechanical properties and durabilitytest of ceramic insulator waste material replacement has been successful up to the limitation of 15% replacement with cement.

ISHITA SONI, al. (2018)

They have performed the research study , the aim of this dissertation work is that to reduce the environment impact , reduce the cement consumption in the concrete by the replacement of ceramic material as a supplementary cementation material. The study is done in done concrete for the ceramic electrical insulator material partial replacement with cement in the concrete and checked its mechanical propertities, workability and durability. In theconcrete grade M25 cement has been partially replaced in 5%,10%15% and 20% by weight of cement in ceramic waste. Utilization of these ceramic waste the test performance has been checked bt the concrete , here workability test(by slup cone test), mechanical properties test (compressiove strength test, flexural strenghttets, split cylinder tensile strength) and durability test (water absorbtion and water penetration test)has been tested in the replacement of the ceramic waste material.

CONCLUSION

Conclusion: A laboratory cxpcrirncnt was conducted on geo material containing EPS Beads, Cement and Fly ash. Keeping the fly ash as the base material for all practical purpose and adopting a mix of additive ratio. From the experimental work that was carried out in the laboratory the following conclusion was concluded.

A lightweight geomaterial can be produced by mixing EPS beads with flyash, cement and water. High compressive strength and stiffness was observed with increasing C/B ratio. The nature of compressive stress and curing days were found to be increasing at all the stages and it was similar for all curing periods. The density values of geometrical were lesser and have shown higher compressive strength values that lightweight fill material values reportedly above 1000 KPA. The geo-material is light in weight compared with conventional fill materials, so it can be used effectively as an alternative fill material over weak and sensitive areas where conventional fill material causes excessive over burden pressures and thus results in undesirable settlements.

It should be economically for large scale construction work.

It can minimize the lateral earth pressure on retaining walls.

It should be economical if blocks are made for its partion

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