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Experimental investigation on Partial Replacement of Coarse Aggregate by Palm Kernel Shell and Cement by GGBS

Ramya N[1], Pradeepa s[2], Anitha J[3], Vishal Singh[2], Shadab khan[2]
[1] Assistant Professor, Dept. of Civil Engg, Sir M.Visvesvaraya Institute Of Technology, Bangalore
[2]Assistant Professor, Dept. of Civil Engg, Sir M.Visvesvaraya Institute Of Technology, Bangalore
[3]Assistant Professor, Dept. of Civil Engg, Sir M.Visvesvaraya Institute Of Technology, Bangalore
[4, 5] Under Graduate Students, Dept. of Civil Engg, Sir M.Visvesvaraya Institute Of Technology, Bangalore.

Abstract-The high consumption rate of raw materials by the construction sector, results in chronic shortage of building materials and the associated environmental damage. In the last decade, manyresearches onthe utilization ofwaste products in concrete in order to reduce the utilizationof natural available resource have been undertaken. Thus in this project we have tried to use those waste products and replace cement partially by GroundGranulatedBlast-furnaceSlag (GGBFS) and Coarse aggregate by Palm kernel shell. The aim is to experimentally determine how would GGBS and PKS would affect the compressive strength of concrete when used in different proportions of 5%, 10%,15% and 20% together.

Index Terms-Compressive Strength;. Palm Kernel Shell (PKS), GGBS.

1. INTRODUCTION

Efficient use of non renewable resources is a global concern and hence the goal of human kind should be to create a sustainable world. In order to achieve sustainability, method s that are to be employed are optimized utilization ofcurrentlyavailableresourcesforalongperiodoftime,
minimization of wastage of material , energy and controlling overuse, and ensuring that there are reserves kept for future generations without complete exhaustion. Creating quality concrete in the present climate does not depend solely on achieving a high strength property. Improving the durability of the concrete to have longer life span structures and producing a greener concrete are becoming one of the main areas of research in obtaining quality concrete. By using industrial by-products such as Ground Granulated Blast-furnace Slag (GGBFS) as partial replacement for Ordinary Portland Cement (OPC) in the concrete, the amount of energy required and greenhouse gas produced in making the concrete are minimized. It has been well established that GGBFS is a very good mineral admixture to be used in improving the properties of the concrete due to its positive effects on it andthe environment. In blending GGBFS with OPC, a concrete paste with decreased viscosity and reduced bleeding can be achieved. If GGBS is partially added to concrete, it would provideenvironmentaland economic advantagesandtherequiredworkability, durability, and strength necessary for the design of the structures. Whenused inconcrete, ground granulated blast furnace slagdoesn't significantly compromising the compressive strength as it possess cementations characteristics .A weight reduction is achieved for PKS replacement. It is also seen thatthecost is also reduced for every cubic meter of block production with useof palm kernel shell,suggesting that thematerialsare characterized by improved durability propertiesresulting from the use of chemical andmineral admixtures as well as proper production processes. Palm KernelShell (PKS) is a waste material obtainedduring the crushing ofpalm nuts in the palm oil millsfor palm oil extraction. In South Asia, it is one ofthe most quantitativewaste materials produced. Hence, utilizingPKS would imposelowerconstruction costs comparedto other waste materials like rubber waste, plastic waste, and others. With proper mix design,PKS canbe utilized as a partial replacement todevelop normalstrengthconcrete, whichrangesfrom 20 to 30MPa.Thisresearch focuses on the effects of PKSin the concrete performancein termsof workability, water absorption, density and compressive strength.

2. LITERATURE REVIEW

2.1.IJET (2015) Utilization of Ground Granulated Blast Furnace Slag to Improve Properties of Concrete. TheGroundgranulatedBlastfurnaceslag(GGBFS)is awaste of industrial materials; it isRelativelymorerecentpozzolanicmaterialthathasreceived considerable attention in both research and application. Due to growing environmental awareness, as well as stricter regulations onmanagingindustrialwaste, theworldisincreasingly turning to researching properties of industrial waste and finding solutions on using its valuable component parts so that those might be used as secondary raw material in other industrial branches. The present paper is an effort to quantify the effect on properties of ground granulatedblast furnace slag (GGBFS) at various replacement levels and evaluate its efficiencies in concrete. From the result from this study the Slump values of various mix proportions

of GGBFS concretes increased when replacement of GGBFSwithcementincrease10-40%.TheCompressive strength decreases with increase inPercentage(%)ofGGBFSattheageof7and28 days as compared to control mix but it increases with increase in the percentage of GGBFS at the age of 56 days. Flexural strength of concrete mix decrease with increase in percentage (%) of GGBFS at the age of 7 and 28 days as compared to mix but it was nearly equal with increase in the percentage of GGBFS at the age of 56 days. The Spilt tensile strength of mix with different cement replacement 10%, 20%, 30%, 40%,showedindecrease for all replacement at 7 days and 28 days as compared to control mix Duetoslowerrateofreaction.The Spilt tensile strength of the mix with 20%, 30% cement replacement better performed than control mix at 56 days. The results obtained from the study showsthatthepercentage(%) ofGGBFS(10-40%)inconcrete increased the Sulphate and Chloride resistance.

2.2.(ICARET 2016) The Feasibility of Palm Kernel Shell as a Replacement for Coarse Aggregate in Lightweight Concrete .Implementing sustainablematerials intothe construction industry is fast becoming atrend nowadays. Palm Kernel Shell is a by-product of Malaysia's palmoil industry, generating waste as much as 4 million tons per annum. As a means of producing a sustainable, environmental-friendly, and affordable alternative in the lightweight concrete industry, the exploration of the potential of Palm Kernel Shell to be used as an aggregate replacement was conducted which may give a positive impactto the Malaysian construction industry as well as worldwide concrete usage. This research investigates the feasibility of PKSasanaggregatereplacementin lightweightconcrete in terms of compressive strength, slump test, water absorption, and density. Results indicate that by using PKS for aggregate replacement, it increases the water absorptionbutdecreasestheconcreteworkabilityandstrength.Res ultshowever, fallintothe range acceptableforlightweight aggregates,hence it can be concluded that there is potential to use PKS as aggregate replacement for lightweight concrete.

2 .WASTE MATERIALS USED

2.1. PALM KERNEL SHELL (PKS)

Palm kernel shell is a solid waste & a by-product from processing palm nuts to produce palm oil. PKS is non-toxic, inert, bio renewable, abundantly available, strong stiff light weight and corrosion resistant. Palm Kernel Shell (PKS) is a waste material obtained during the crushing of palmnutsinthepalm oilmillsforpalm oil extraction. In South Asia, it is one of the most quantitative waste materials produced. Malaysiaproduces approximately 3-4 million tons of PKS annually. Hence, utilizing PKS wouldimpose lower construction costs compared to other waste materialslikerubber waste,plasticwaste, and others. With proper mix design, PKS can be utilized to develop normal strength concrete having lesser cost.

3.2 Ground Granulated Blast Slag (GGBS)

GGBS has been well known as ground granulated blast-furnace slag (GGBS), manufactured from blast furnace flag and is obtained as by-product of manufacture of iron and it can increase the abilities to prevent water penetration, and it can improve the durability of concrete structures.Blast furnace slag is a by-product of pig iron manufacture.

3. TESTING

3.1. Material Type

The following types of the materialswere tested:
i. Cement.
ii. Coarse aggregate.
ii. Fine aggregate.
iv.PKS.
v. GGBS.

3.2. Tests

3.2.1. SpecificGravity

Specific gravity of cement defined as the ratio of the mass of the given volume of sampleto the mass of equal volume of water at the same temperature**.**

3.2.2. Normal Consistency

The amount of water require by concrete to gain the standard solidity such that the Vicat apparatus needle penetrate till 5-7mm from the bottom surface of the mould**.**

3.2.3. Setting time test

The amount of time required by concrete to gain the standard solidity such that the Vicat apparatus needle penetrate till 5-7mm from the bottom surface of the mould**.**

3.2.4. Sieve Analysis test
Sieve analysis is done to determine the grades of fine aggregate (Fineness modulus) and coarse aggregate.
3.2.5. Slump test
Unsupported concrete when it is fresh will flow to the sides and a sinking in height will takes place. This vertical settlement is known as slump test.

3.2.6. Water absorption test
The test is performed along with the specific gravity to determine the water absorbing capacity of aggregates.

3.2.7. Compressive strength

The most important property of a structural material is the compressive strength which gives an overall idea about the quality of concrete and it is determined by loading as dictated by the standards.

4. RESULTS

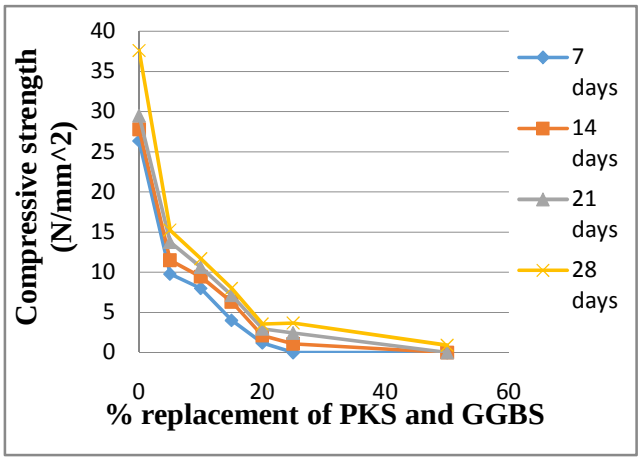
Table 1.Tests Performed on materials.

Material	Test performed	Result obtained
Cement	Specific gravity	3.20
	Normal consistency	35%
	Setting time test	110 minutes
Coarse Aggregate	Specific gravity	2.65
	Water absorption	1.73 %
	Sieve analysis	The above test sample confirms to the requirement of single size aggregates as Per IS: 383-1970(RA in 2007)
Fine Aggregate	Specific gravity	2.67
	Fineness modulus	4.2195
PKS	Specific gravity	1.62
	Water absorption	14%
GGBS	Specific gravity	3.10
Concrete	Slump test (w/c ratio)	75mm

4.1. Theory
As shown in the tabular column below , the first specimen had 5% of cement replaced by GGBS and 5% of aggregate replaced by PKS. Likewise the replacement of cement and aggregates in other specimens went on increasing at +5% replacement, till 50% of both cement and aggregates was replaced. Then 7^{th},14^{th},21^{st} and 28^{th}day compressive strength

Table 2. Compressive strength of GGBS and PKS Replacement

Specimen no	% of GGBS &PKS replaced	Compressive Strength (N/mm2)			
		7^{th} day	14^{th} day	21^{st} day	28^{th} day
1	5	9.78	11.5	13.75	15.05
2	10	8	9.45	10.5	12.5
3	15	4	6.3	7.45	9.75
4	20	1.2	2.1	3.75	6.5
5	25	0	0	0	0
6	50	0	0	0	0



Graph 1.0 Graphical representation Compressive strength of concrete blocks with partially replacement of cement with GGBS and Coarse aggregate withPalm Kernel Shell.

5. CONCLUSION

Based on the present work, the following conclusions were made:

- The results of the workability tests on each sample show that the PKS sample requires more water due to it is high water absorption capacity.
- The results obtained from the crushed granite concrete indicate a true slump.
- The workability test indicated that granite was also within the range but that of PKS was quite workable but did not slump as some of the water were absorbed.
- The efficiency of GGBS in concretes containing normal Portland cements from the results of the investigation sported in recent years.
- The replacement levels in the concrete studied varied from 5% to 50% and the strength efficiencies at the 7 days, 14 days and 28 days were calculated.
- The primary conclusions can be listed as follows Slag replacement by weight decreases the strength of concretes in short term when compared to control Portland cement concrete.
- The strength loss caused by increasing slag replacement level is more evident at early ages.
- However, the strength loss disappears in long term and concrete containing slag develops equivalent or higher strength than that of control Normal Cement concrete.

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REFERENCES

[1] International Journal of Scientific & Engineering Research, Volume 3, Issue 8, August-2012 1 ISSN 2229-551 Daniel Yaw Osei, Emmanuel Nana Jackson. International Conference on Advances in Renewable Energy and Technologies(ICARET 2016) IOP Publishing, IOP Conf. Series: Earth and Environmental Science 32 (2016) 012040 doi:10.1088/1755-1315/32/1/012040 ZarinaItam, SalmiaBeddu, NurLiyanaMohd Kamal, MdAshrafulAlamUsamaIssaAyash, Department of Civil Engineering, Universiti Tenaga Nasional, Malaysia.

[2] International Journal of Engineering Research & Technology (IJERT)ISSN: 2278-0181 Vol. 3 Issue 3, March – 2014 M. Ramalekshm, R. Sheeja, R. Gopinath.

[3] International Journal on Emerging Technologies (Corresponding author:Magandeep) (Received 30 June, 2015 Accepted 08 August 2015) (Published by Research Trend, Website: www.researchtrend.net).