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A Review on Using Coconut shell as Coarse Aggregate in Concrete

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ABSTRACT

In the era of Infrastructure development the demand of the construction material is rising day by day in every country. As we know the concrete is the main binding material which is used in the construction industry worldwide. Concrete production is mainly depends upon the ingredients which we are using in the concrete i.e. Coarse aggregates, fine aggregates, cement, water and admixtures etc. Due to rapid growth in the infrastructure development the demand of the natural aggregates is increasing very drastically, so in this case this is the question of worry that if we use the natural aggregates at the same rate of growth then what will happen to its natural sources. Being an Engineer it's our prime duty to provide the sustainable infrastructure where ever it is needed. In this case we can use the other alternative materials as the coarse aggregates which are durable and makes the infrastructure sustainable and economical. In this research work we are replacing the coconut shells as the partial replacement of the coarse aggregates. As we know India is the one of the coconut production country on very large scale and the use of coconut is very vast in the India. On the other side it is the main contributor the pollution problem in the form of solid waste. The coconut shell becomes useless after the use of the coconut. Waste coconut shell are also a big problem for the disposal. In some countries where the coconut shells are discharged in large amount they are using it for the replacement of the construction material, by this way they are reducing the cost of the construction and they have an alternate solution for the coconut shell disposal. In this work, the Coconut shells are tested for the Specific Gravity, Dry Density and Sieve analysis. The mechanical properties for the concrete with coconut shells such as compressive strength, split tensile strength and flexural strength are tested for 7 and 28 days as per BIS (Bureau of Indian Standards) procedure. A bridged from all the calculated results, it is concluded that waste coconut shells can be used in place of natural coarse aggregate.Reuse of Coconut shells in concrete as a construction and building material converts the waste into useful products that can solve the disposal problem of coconut shells in the developing countries.

Keywords: - Abundant, Coarse aggregate, Concrete, recycle, waste coconut shell

I. INTRODUCTION

Coconut plays an important role in the national economy of India. According to figures published in December 2009 by the Food and Agriculture Organization of the United Nations, India is the world's third largest producer of coconuts, producing 10,894,000 tonnes in 2009. Coconut production usually occurs in Kerala, Tamilnadu, Andhra Pradesh and andman & Nicobar islands. Concrete is one of the most important building construction materials used now a days, as its consumption comes on second number after water consumption. As we can say

that the concrete is very vast product as different types of materials was used for increasing its tensile as well as compressive strength also to make it economical. Using of coconut shell as coarse aggregate really brings a drastic change in concrete properties because the rigidity and impact strength of coconut shell is very high when checked as per usual test of concrete cube of 150 mm *150 mm size after 28 days curing. if we use coconut shell as coarse aggregate that means the waste of coconut shell will be reducing in India also the concrete cost will reduce upto very high amount which makes it very economical.

II. COARSE AGGREGATE AS COCONUT SHELL

The coconut shells were collected from the local market through some shops. Then the coconut shells were crushed in to the range of aggregate size and then mixed with the natural coarse aggregates with the proportions of 0%, 10%, 20%, 30%, 40% and 50%. The designed concrete is tested for the Compression strength, Flexural Strength and Split tensile strength.

III. OBJECTIVE OF RESEARCH

- To decrease the depletion of natural resources to keep ecological balance.
- To determine the optimum level of replacement of coarse aggregates with the coconut shell aggregates.
- To achieve the sustainable issues in the construction field by changing the percentage of natural aggregates with the coconut shell aggregates.
- To reduce the structural cost by using the coconut shell aggregates as the coarse aggregates.
- To determine the suitability of coconut shell aggregates as the coarse aggregates with respect to strength and durability.

IV. MATERIAL PROPERTIES AND EXPERIMENTAL PROGRAM

In this section, we are discussing about the effects on concrete when the coconut shells and Natural Coarse aggregates are mixed together to form a fresh concrete. Before designing the concrete it is very necessary to compare the properties of the coconut shells with the properties of the Natural coarse Aggregates. The coconut shells collected from the local market is crushed in to the coarse particles with the help of rammer and Los Angles Abrasion testing machine. After the crushing of the coconut shells, it further pass through the sieves and used in the concrete mix. The Coconut shells aggregates and the Natural coarse aggregates are mixed together in a different proportions so that we can check its feasibility. The properties of both Coconut shells particles and natural coarse aggregates are tested experimentally to compare with each other for the Specific gravity, Sieve Analysis, Moisture content etc. After the experimental observations of both, the concrete mix will be designed. For the design mix of concrete we have to follow the IS-10262-2009. In this research work we have partially replaced the Natural coarse aggregates with Coconut shells to the extent of 0%, 10%, 20%,30%,40%and 50%. The compressive strength for the each proportional percent will be checked after 7 days and 28 days, the flexural strength will be checked after 7 days and 28 days, similarly the split tensile strength will be checked after 7 days and 28 days.

V. MATERIALS

.CEMENT

As we know the cement is the binding material in the concrete which provides strength to the concrete by holding all the materials together. In this research work Ordinary Portland Cement of 43 grade is used. The cement is that material, which can easily come in to the contact of the moisture or water content. So to prevent the cement from the moisture contact the cement was kept in to the air tight area with plastic bags. All the cement properties were checked as per the guidelines of the IS 4031:1988. The physical properties of the concrete are mentioned as per the IS 8112: 1989.

VI. FINE AGGREGATES

For the good strength of concrete the ingredients of the concrete should be good quality and they should satisfy the conditions of the Indian Standards. In this research work we have used the sand from local river having the water absorption of 2.10%, a coarseness modulus of 1.43 and Specific gravity of 2.56 was used as the coarse aggregates. The sand to be use is free from the lumps and moisture. Before the use of sand in to the concrete, the impurities included in to it should be removed with the help of sieves.

VII. COCONUT SHELL

As we are using the coconut shells as the partial replacement of the coarse aggregates, so it is necessary to compare it with the properties of the natural coarse aggregates. The coconut shells which don't pass through the 4.75 mm sieve is used as the coarse aggregates. The coarseness modulus of the coconut shells is 5.40 and the water absorption is 17 %. The coconut shells are collected from the local market.

VIII. CASTING DETAILS & TEST PROCEDURES

.MIXING

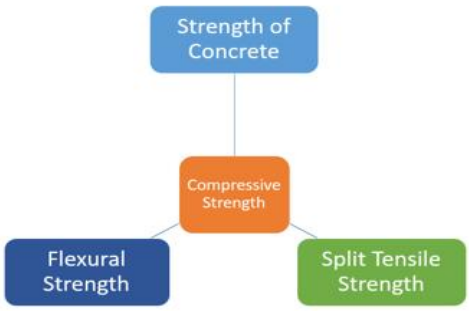
Before the mixing for the casting of specimens, each and every material is kept ready i.e coarse aggregates, natural coarse aggregates, Coconut shells coarse aggregates cement and water. The mix proportions of natural coarse aggregates and the coconut shells coarse aggregates are also kept ready as 0% , 10% , 20%, 30%,40%and 50% coconut shells with natural coarse aggregates by weight. Make sure that the mixer drum should be clean from lumps and the other material before mixing of the concrete. After the cleaning of the mixer drum, the ingredients put in to the drum one by one so that it can mix with each other properly. The mixing process is

continued for the 4-5 minutes. After the mixing of all the ingredients, the concrete is placed in to the different-different moulds.

.COMPACTION & CURING

After the production of the concrete it is placed in to the moulds of cubes, beams and cylinders one by one. For the casting of specimens, the concrete is filled in to the moulds by 3 layers. After the every layer 35 blows of tamping rod is provided or the vibration can be provided using the Vibration table apparatus. For the large quantity of the concrete, the mechanical vibrator can be used. After the 4-5 hours of casting of the specimens the date and name or sign on the specimens can be engraved. The cubes can be open after the 24 hours of casting and then immediately put in to the water tank for the curing of specimens till the testing time. The specimens are tested after 7 days and 28 days in this experimental study.

IX. STRENGTH PROPERTIES OF THE DESIGNED CONCRETE



X. RESULTS AND DISCUSSIONS

.Compressive strength at 7 days

The graphical analysis will tell us the relation between compressive strength and type of mix i.e if compressive strength(MPa) is varying from 0,5,10,15,20,25 gives the results as 21.25, 18.67, 16.93, 15.97, 14.83, 10.15 for the type of mix of NCAC, CSAC 10%, CSAC 20%, CSAC 30%, CSAC 40%, CSAC 50% respectively.

XI. CONCLUSION OF TEST RESULTS

Compressive Strength of the Designed Mix concrete: It has been observed that the compressive strength of the concrete is getting decrease with the increase in the percentage of the coconut shells as partial replacement of the natural coarse aggregates. Results of the compressive strength at 7 days shows that the compressive strength of the designed concrete with 0% coconut shell aggregates is 21.25 Mpa, with 10% coconut shell aggregates is 18.17 Mpa, with 20% coconut shell aggregates is 16.93% Mpa , with 30% coconut shell aggregates is 15.97 Mpa, with 40% coconut shell aggregates is 14.83 Mpa and with 50% coconut shell aggregates is 10.15 Mpa. At 7 day . The decrease in compressive strength of the designed concrete as compare to the NCAC with the use of CSAC 10 is 11%, with use of CSAC 20 is 20.32 %, with the use of CSAC 30 is 24.84%, with the use of CSAC

40 is 30.21% and with use of the CSAC 50 is 52.23%. Results of the compressive strength at 28 days shows that the compressive strength of the designed concrete with 0% coconut shell aggregates is 28.54 Mpa, with 10% coconut shell aggregates is 25.47 Mpa, with 20% coconut shell aggregates is 21.74% Mpa , with 30% coconut shell aggregates is 18.27 Mpa, with 40% coconut shell aggregates is 16.57 Mpa and with 50% coconut shell aggregates is 14.63 Mpa. The decrease in compressive strength of the designed concrete as compare to the NCAC with the use of CSAC 10 is 11%, with use of CSAC 20 is 26.69%, with the use of CSAC 30 is 31.16%, with the use of CSAC 40 is 37.60% and with use of the CSAC 50 is 45.25%..Hence we can say that the coconut shell aggregates can be used in the concrete with the controlled design mix.

- Flexural Strength of the Concrete: From the experimental analysis it has been concluded that the Flexural strength of the concrete is getting decrease with the increase in the quantity of the coconut shell aggregates as partial replacement of the natural coarse aggregates. Results of the flexural strength at 28 days shows that the flexural strength of the designed concrete with 0% coconut shell aggregates is 7.97 Mpa, with 10% coconut shell aggregates is 7.15 Mpa, with 20% coconut shell aggregates is 6.59 Mpa, with 30% coconut shell aggregates is 6.27 Mpa, with 40% coconut shell aggregates is 5.35 Mpa and with 50% coconut shell aggregates is 4.74 Mpa. The decrease in flexural strength of the designed concrete as compare to the 0% coconut shell aggregates is 0%, with 10% coconut shell aggregates is 10%a, with 20% coconut shell aggregates is 17.31%, with 30% coconut shell aggregates is 21.32%, with 40% coconut shell aggregates is 32.87% and with 50% coconut shell aggregates is 40.52%.Hence we can say that the with the increase in the percentage of the coconut shell aggregates in concrete the flexural strength of the concrete is also falling.
- **Compressive Strength of the Designed Mix concrete:** It has been observed that the compressive strength of the concrete is getting decrease with the increase in the percentage of the coconut shells as partial replacement of the natural coarse aggregates. Results of the compressive strength at 7 days shows that the compressive strength of the designed concrete with 0% coconut shell aggregates is 21.25 Mpa, with 10% coconut shell aggregates is 18.17 Mpa, with 20% coconut shell aggregates is 16.93% Mpa , with 30% coconut shell aggregates is 15.97 Mpa, with 40% coconut shell aggregates is 14.83 Mpa and with 50% coconut shell aggregates is 10.15 Mpa. At 7 day . The decrease in compressive strength of the designed concrete as compare to the NCAC with the use of CSAC 10 is 11%, with use of CSAC 20 is 20.32 %, with the use of CSAC 30 is 24.84%, with the use of CSAC 40 is 30.21% and with use of the CSAC 50 is 52.23%. Results of the compressive strength at 28 days shows that the compressive strength of the designed concrete with 0% coconut shell aggregates is 28.54 Mpa, with 10% coconut shell aggregates is 25.47 Mpa, with 20% coconut shell aggregates is 21.74% Mpa , with 30% coconut shell aggregates is 18.27 Mpa, with 40% coconut shell aggregates is 16.57 Mpa and with 50% coconut shell aggregates is 14.63 Mpa. The decrease in compressive strength of the designed concrete as compare to the NCAC with the use of CSAC 10 is 11%, with use of CSAC 20 is 26.69%, with the use of CSAC 30 is 31.16%, with the use of CSAC 40 is 37.60% and with use of the CSAC 50 is 45.25%..Hence we can say that the coconut shell aggregates can be used in the concrete with the controlled design mix.
- SPLIT TENSILE TEST**:** From the experimental work it has been observed that the split tensile strength of the concrete is getting decrease with the increase in the percentage of the coconut shells as partial replacement

of the natural coarse aggregates. Results of the split tensile strength at 7 days shows that the split tensile strength of the designed concrete with 0% coconut shell aggregates is 2.54 Mpa, with 10% coconut shell aggregates is 2.23 Mpa, with 20% coconut shell aggregates is 1.89 Mpa , with 30% coconut shell aggregates is 1.65 Mpa, with 40% coconut shell aggregates is 1.31 Mpa and with 50% coconut shell aggregates is 1.01 Mpa. The decrease in split tensile strength of the designed concrete with 0% coconut shell aggregates is 0%, with 10% coconut shell aggregates is 12%, with 20% coconut shell aggregates is 25.50%, with 30% coconut shell aggregates is 35%, with 40% coconut shell aggregates is 48.42% and with 50% coconut shell aggregates is 60.23%.. Results of the split tensile strength at 28 days shows that the split tensile strength of the designed concrete with 0% coconut shell aggregates is 3.12 Mpa, with 10% coconut shell aggregates is 2.87 Mpa, with 20% coconut shell aggregates is 2.35 Mpa , with 30% coconut shell aggregates is 1.97 Mpa, with 40% coconut shell aggregates is 1.65 Mpa and with 50% coconut shell aggregates is 1.35 Mpa. The decrease in split tensile strength of the designed concrete with 0% coconut shell aggregates is 0%, with 10% coconut shell aggregates is 8%, with 20% coconut shell aggregates is 24.60%, with 30% coconut shell aggregates is 36.85%, with 40% coconut shell aggregates is 47.11% and with 50% coconut shell aggregates is 56.73%. Hence we can say that the coconut shell aggregates can be used in the concrete with the controlled design mix.

Environmental Benefits: In India, coconut production is very high and large quantity of the coconut shell is collected every year, so it creates a big problem to dump the coconut shell in urban areas. With this research, the coconut shell can be used in the concrete as partial replacement of the coarse aggregates. By this, we can solve the problem of coconut shell disposal and we can save the natural coarse aggregates from the depletion. Concrete formed with the use of the coconut shell aggregates is in the group of the light weight aggregates due to the coconut shell aggregates weight. Hence we can use this concrete in flooring, partition and compound walls.

XII. FUTURE SCOPE OF THE RESEARCH

In this experimental work, we have concluded that the formed concrete is in the group of the light weight concrete, which can further study for the self-compacting light weight concrete. In this experimental work, we have design the concrete for M25. In further research work we can test the concrete for other Mix designs. The behaviour of the same concrete can be analysed for the seismic areas. The same research work can be extended along with the use of the other waste material and fibres.

XIII. LITERATURE REVIEW

The compressive & tensile strength of the concrete at 28 days is less as compare to the conventional concrete. Workability of the concrete also gets affected with the increase in the percentage of the coconut shell aggregates. Increase in the amount of coconut shell aggregates also increase the permeable voids and the water absorption. The compressive strength and flexural strength is acceptable up to some design limits of the concrete mix. According to this result the concrete with the 30% result shows the satisfactory result of the compressive strength, tensile strength and flexural strength as compare to the conventional concrete. With the use of the coconut shells in the concrete, it will reduce the cost of the construction.

REFERENCES

[1] Sangeetha G1, Nirmala P2, Pugazhselvi D3, Ramya K4, Er. K. Jegan Mohan5, Partial Replacement of Aggregate by Coconut Shell and Cement by Clay,International Journal of Engineering Science and Computing, April 2016

[2] Damre Shraddha1, Firake Hitali1, Dode Pradeep1,and Shrikant Varpe, Sustainable Concrete by Partially Replacing Coarse Aggregate Using Coconut Shell, Journal on Today's Ideas –Tomorrow's Technologies,Vol. 2, No. 1,June 2014pp. 1–14

[3] Siti Aminah Bt Tukiman and Sabarudin Bin Mohd, INVESTIGATE THE COMBINATION OF COCONUT SHELL AND GRAINED PALM KERNEL TO REPLACE AGGREGATE IN CONCRETE: A TECHNICAL REVIEW, National Conference on Postgraduate Research (NCON-PGR) 2009

[4] R. Ranjith, STUDY ON IMPACT AND TENSILE PROPERTIES OF CONCRETE WITH COCONUT SHELL AS COARSE AGGREGATE, INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

[5] Jyoti Kamal1, Proff. J.P. Singh, Experimental Study on Strength Characteristics of M25 Concrete with Partial Replacement of coarse aggregate with coconut shell and cement with Fly Ash, International Journal of Innovative Research in Science, Engineering and Technology, Vol. 4, Issue 6, June 2015

[6] Selwyn Babu J and Mahendran N, Coconut Shell as a Partial Replacement to Coarse Aggregate in Concrete, Australian Journal of Basic and Applied Sciences, 8(13) August 2014, Pages: 693-697

[7] Ajay Lone#1, Aniket Deshmukh#2 , Pandit Jadhav#3,Rahul Patil#4 ,Pritee Mistry#5, Test on Coconut Shell as Partial Replacement of Coarse Aggregate in Cement Concrete, International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169 Volume: 4 Issue: 4

[8] Dhanala Vinaya1, Gottala Anirudh, comparative study on m25 concrete with partial replacement of cement with fly ash and coarse aggregate with coconut shells in acid and water curing, International Journal For Technological Research In Engineering Volume 4, Issue 3, November-2016

[9] A.Santhiya1, N.Sakthieswaran2, G.Shiny Brintha3, O.Ganesh Babu, A Review of Experimental Investigation on Coconut Shell as Replacement on Concrete as Course Aggregate in their Strength, International Journal for Research in Applied Science & Engineering Technology (IJRASET)

[10] Dr. B. Rajeevan, A Study on the Utilization of Coconut Shell as Coarse Aggregate in Concrete, International Journal of Engineering Research & Technology (IJERT),ISSN: 2278-0181, IJERTV4IS070143

[11] Ajim S Shaikh1, Sagar B Thorat2, Rahul V Unde3, Prasad S Shirse, Advance Concrete-Aggregate replaced by Coconut Shell, International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 02 Issue: 05 | Aug-2015

[12] Vishwas P. Kukarni, Sanjay kumar B. Gaikwad, Comparative Study on Coconut Shell Aggregate with Conventional Concrete, International Journal of Engineering and Innovative Technology (IJEIT) Volume 2, Issue 12, June 2013

[13] Himanshu Dahiya, Naveen Dharni, CONCRETE WITH CRUSHED COCONUT SHELL AS COARSE AGGREGATE, IJRDO-Journal Of Mechanical And Civil Engineering.

[14] S.Abirami1 , K.Muniyammal1,K.Nandhini1, M.Pavithra1 , Ms A.Aarthi, A study on exploitation of coconut shell as coarse aggregate in concrete, International Journal of Advanced Research Trends in Engineering and Technology (IJARTET) Vol. 3, Special Issue 2, March 2016

[15] Daniel Yaw Osei, Experimental assessment on coconut shells as aggregate in concrete, International Journal of Engineering Science Invention ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726

[16] Chandraul Kirti1 , Singh Manindra Kumar 2 , Saxena Anil Kumar3 , Arora T. R., Experimental Study of Coconut Shell Concrete, International Journal for Research in Applied Science & Engineering Technology (IJRASET)

[17] Palak Patel, Experiments on Partial Replacement of Coconut Shell as Coarse Aggregate in Concrete, IJIRST –International Journal for Innovative Research in Science & Technology| Volume 2 | Issue 1 | June 2015 ISSN (online): 2349-6010