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Utilization of Coconut Shell as a Partial Replacement of Coarse Aggregate: A Review

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Abstract *As we know that in today's world the most concern problem generally occurred is increasing of wastes. Waste generally increases at very fast rate same as our population increases which is one of the biggest issues. It affects our environment and our health which increases various problems. To use waste in a best way a lot of ideas has been generated that how to utilize waste in different industries. The most prominent use of waste as an alternative in todays world is in construction industries. Various wastes like brick waste, rice husk ash, sugarcane bagasse ash waste and various other wastes are used now a days as a partial replacement in constructional industry. Coconut shell is among the one which is mostly used now a days. Coconut shell is used as an alternative to coarse aggregates. Coconut shell is that material which is easily available around the world. Various researches showed that coconut shell have good properties so that it can be used as a replacement of coarse aggregate. In this paper we generally review the previous researches of the use of coconut shell as a partial replacement of coarse aggregate for producing concrete and also used in road construction.*

Key Words **Coconut shell, Coarse aggregate, Compressive strength**

1. INTRODUCTION

These days, solid waste administration is being thought of as a grave worry in India due to a huge population, which is a significant issue. Since the consequences of that a tremendous heap of waste produced, some of the causes are increment in population, fitness and ever-changing ways of life in India, the ecological limitations are authorized including the severe administration of waste removal destinations, asset limitations and highlighting the consciousness of the overall population with respect to the exhaustion of common assets. Yearly creation speaks to near 1.5 ton for every individual on the world. Aggregates are the greatest constituent inside the concrete and in the road construction. As to 80% of the level of structural concrete is involved by aggregates, inside which 25–30% is involved by fine blend and 40–half is involved by coarse mix. Amount and properties of coarse blend has weighty effect on shifted qualities and properties of concrete. By and large, rocks which had been squashed are utilized as aggregate alongside stream sand. Because of rise of construction activities, standard combination sources are depleting in no time resulted in inadequacy of resources. For property development, these materials ought to be used sagely and at a similar time different material have to be compelled to be searched to interchange standard combination. Besides, these crushed aggregates could contain a proportion of irrespirable crystalline silicon dioxide or free silicon dioxide that releases throughout the assembly and handling and will cause health issues or skin irritation. The population will increment quickly and the strong wastes are likewise delivered at a quicker rate which is a major issue at the present and for future. For this part of strategies has been grown with the goal that the strong wastes are utilized as an option in development industry. In present days coconut shell is one of the genuine waste removal issue all around the globe. At the point when we consume coconut shell it discharges hurtful gases like carbon dioxide and methane which will legitimately affect on our environment. Now a days, coconut shell is utilized as an option of coarse aggregate. From the past investigates it has been demonstrated that coconut shell can be utilized as light weight aggregate and it can likewise decrease the material expense in development.

2. Coconut shell as an alternative to coarse aggregate

As previous researches shown that the coconut shell can be used as a mild weight aggregate in structural concrete and it can also be used in the road construction. With the usage of coconut shell material cost can also be reduced. In light of the smooth surface

on one side of the shells concrete made with coconut shell presents better functionality. Coconut shell solid shows great effect obstruction. When contrasted with traditional aggregate, water engrossing and dampness holding limit of coconut shell is more. The nearness of sugar in the coconut shell, doesn't influence the setting and quality of cement since it isn't in a free sugar structure. It is discovered that wood-based materials being hard and of natural root, won't sully or filter to deliver poisonous substances once they are bound in solid framework. There are various characteristics of coconut shell which includes: (i)Several looks at have been given to the usage of important regular fillers in composites recently, and the coconut shell filler may be a normal up-and-comer by virtue of the most recent composites in light of the essential for high caliber and modulus properties, close by the additional favorable position of high polymer content. (ii) The high polymer limits make the composites delivered with these fillers progressively atmosphere safe and accordingly the Coconut shell is one of the most significant biological fillers made in tropical countries, for instance, Malaysia, Indonesia ,Thailand and Sri Lanka.(iii) The assessment furthermore attempts to evaluate how coconut shell segments are powerful in giving customary epoxy-bracing saps to improve their flexible modulus as building materials as a result of their low polysaccharide levels.

3. Research Findings

Lack of standard resources and coconut shell waste exchange issues made the investigates to analyze and research the probability of utilization it for development exercises. A couple of studies are done on coconut shells and the results of the explores are as following:-

Sanjay Kumar in 2019 published a paper that look at the examination of usage of coconut shell as mostly replacement of coarse aggregate. In his work compressive strength of M20 grade had been thought by trading normal coarse aggregate as 0%,5%,10%,20% and 30% by weight with the coconut shell. Compressive strength of coconut shell has been assessed on 7, 14, 21 and 28 days. On 10% trading of coarse aggregate with coconut shell the compressive strength has gotten 20.10Mpa at 28 days. On further replacement of coconut shell there is decrease in the compressive strength. This outcome shows that coconut shell concrete can be utilized as a light weight concrete.

R Prakash in 2017 published a paper that deals with the assessment on the properties of coconut shell aggregate and compressive nature of coconut shell concrete. There were different tests performed on the coconut shell. Crushing value and impact value is exceptionally low if there should be an occurrence of utilization of coconut shell which demonstrates that concrete made of coconut shell is astonish retentive in nature and utilized in seismic zone. Value of slump is reasonable with the usage of coconut shell and it demonstrates that concrete made of coconut shell can be operated in intensely fortified area. Compressive quality of coconut shell is around 22.4Mpa at 7 days. Abrasion value is low which demonstrates that the concrete made of coconut shell can be utilized for asphalt concrete.

Apeksha Kanojia et al in 2017 published a paper on execution of coconut shell as coarse aggregate in concrete. This preliminary assessment was expected to assess the halfway supplanting of coarse aggregate with coconut shell to make concrete. It was found that with growing degrees of coconut shells there is decrement in compressive strength. Results revealed that 40% replacement of normal coarse aggregate by coconut shell, 7 days compressive strength of concrete lessened by 62.6% whereas decrease in 28 days was simply 21.5%. 40% replacement makes the concrete lighter by 7.47%.

A.Anbuvel et al in 2016 published a paper that inspects the assortment of properties of coconut shells as aggregate substitution. A concrete sample with Natural aggregate substitution of 0-20% was provided. There were two plan blends for example fly debris and coconut shell that were researched for properties, for example, water assimilation, compressive strength, dampness substance and split elasticity. It was accounted for that as % shell expands density diminishes. . Both the compressive quality and spilt rigidity likewise diminishes. The porous voids and ingestion were recorded more than the example with traditional aggregates. Fly-debris substitution had no striking impact.

Amrita Agnihotri et al in 2015 published a paper that reflects worries towards the expanding costs of building materials and its impact on expanding costs of houses in the world. The paper manages similar investigation of ordinary aggregate and granular coconut as fractional swap for aggregate casted beams as for their flexural and compressive strength for M20

grade of concrete. There was little contrast in the properties yet enormous difference in the cost and consequently it recommended the designers to energize the elective materials.

Lopa M. Shinde et al in 2015 published a paper that surveys the useful utilization of the rural waste as trades for development materials so as to drop down the expense of development. It is additionally prescribed to advance economic improvement of the structure so as to bring down the effect on nature. It exceptionally gives the worry about reusing the material so as to bring down the weight on characteristic assets. The papers depict how expanding utility of farming waste abatements contamination as well as diminishes the expense of development. This has been appeared by testing coconut shell as aggregate incomplete substitution from a wide range writing survey.

Chandraul Kirti et al in 2015 published a paper that manages exploring the concrete for a structure blend of 1:1.51:3.06 as a control sample and squashed coconut shells were utilized as trade for crushed granite aggregates. In general, 36 cubes were casted with water/cement proportion as 0.5. The coconut substitution that was utilized in study were 10%, 20%, 40%, 60%, 80% and 100%. As we increment the level of coconut shell the density decreases. There is a splendid side that the 20% substitution can be utilized generally in development and can be a reasonable swap for normal sourced aggregates along these diminishing the expense of development and weight on common assets.

Shamjith K M et al in 2015 published a paper that makes reference to that as Natural River sand and coarse total are being exhausted there is a critical prerequisite to search for some elective material. The reasonable choice was picked as coconut shell as swap for aggregates and afterward the examination was directed with halfway supplanting of coarse aggregates with coconut shell as 5%, 10%, 15%, 20%, 25%, 30% and 35%. The water/cement proportion is 0.5. There was a sum of 24 cubes, 21 cylinders and 21 beams tested and is was discovered that coconut shell aggregates with 15% substitution were having properties practically identical to that of ordinary materials.

Dewanshu Ahlawat and L.G.Kalurkar (2014) investigated the probability of creating M20 evaluation of cement by supplanting ordinary aggregate of granite by coconut shell. 45 cubes were casted. Level of substitution of ordinary coarse aggregate by coconut shell were 2.5%, 5%, 7.5%, 10%. Compressive strength was 19.71, 19.53, 19.08, 18.91 N/mm2 separately at 28 days. Workability and compressive quality had been assessed at 7, 14 and 28 days. The compressive quality of concrete diminished as the percentage increases. By these outcomes it very well may be presumed that coconut shell concrete can be utilized in reinforced concrete development.

Pravin V. Khandve1 et al in 2014 introduced a paper in which he proposed that the essential element of the concrete is coarse aggregate. These days, a few of the specialists are exploring the material which may reduce the estimation of development similarly as increment the worth. In creating nations, the possibility of utilizing some horticultural squanders in like manner as modern results from very surprising ventures as development materials will be alluring and has been found to possess numerous reasonable things. It had been found out that the coconut shell incorporates a pleasant potential as an incomplete substitution of the blend inside the concrete. The current work is simply partner degree amassing of information with respect to GFRGC and in this way the examination work that is as of now regulated by various analysts.

Daniel Yaw Osei et al in 2013 introduced a paper that paper worries with the investigation of M20 concrete with fractional supplanting of coarse aggregate with coconut shell in an expanding style which is 20%, 30%, 40% and half and 100% and compressive strength were discovered to be,17.57MPa ,16.65MPa and 9.29Mpa . This shows concrete supplanted by 20% gives the nearest value to desired value. Henceforth it could be utilized as a choice to concrete utilized in structural concrete just as lightweight materials.

Amarnath Yerramala et al in 2012 introduced a paper to exhibit on the how coconut shells can be mostly supplanted as traditional aggregates. The examination has replaced 10% to 20 % aggregates with coconut shell with 5% increase and a steady water/cement proportion of 0.6. The density of concrete declines as we increment coconut shell percentage as well as compressive quality. Ingestion rate and penetrable voids were additionally higher than the conventional samples.

P.S. Kumar et al in 2012 that manages the drawn-out exhibition of coconut shell as total aggregate which has been concentrated under scanning electron magnifying instrument (SEM) so as to decide the pore structure of the concrete. It was discovered that the pore structure goes about as a repository and consistent restoring created most elevated quality in concrete. The organic rot was not found in the example considerably following 365 days. Till the age of 90 days all the example shows improvement in beat speed with a minor drop. A definitive bond quality seems, by all accounts, to be acceptable between concrete glue and coconut shell as SEM shows that with time the crevice between them limits with time.

4. Conclusions

In this whole review we mainly focusing on the use of coconut shell as an aggregate. Coconut shell now also used in making roads by adding coconut shell up to some percentage. With the help of coconut shells, we can also reduce the cost of construction because at present, rising cost of building material is biggest concern. Coconut shell can be used as light weight aggregate as per previous researches.

- Generally, the dry density of coconut shell aggregate is less than 2000. But the actual density of coconut shell is in the range of 550-650kg/m^3.
- From the above researches it shows that in the most cases the compressive strength of concrete decreases above 15% or 20% which indicates that we use coconut shell only up to 20% as per previous researches.
- In other cases, it is found that the coconut shell has a very low abrasion, crushing and very low impact values which generally proves that the concrete which is made up of coconut shell aggregate is shock absorbent in nature and can be utilized in seismic zone. Coconut shell also generally exhibits a fineness value which is nearly closed to natural aggregates.
- From the previous researches it is also found that when we replaced full coconut shell with coarse aggregates, we find that the specific gravity of coconut shell is very low as compared to the specific gravity of conventional aggregates whereas the water absorption of coconut shell was very high as compared to the water absorption of the natural aggregates.
- With the usage of coconut shell the value of slump is fair as per previous researches so that it can be proved that concrete which is made of coconut shell aggregate can be generally used in heavily reinforced sections
- Coconut shell are also used in those places where coconut produce in bigger quantities and also in provincial regions and also in that areas where conventional aggregates are highly expensive.

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