An Experimental Analysis on Performance Studies on Utilisation of Recycled Waste Materials In Concrete

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Abstract- *Waste glass is a major component of the solid waste stream in many countries. It can be found in many forms, including container glass, flat glass such as windows, bulb glass and cathode ray tube glass. Glass is a 100% recyclable material with high performances and unique aesthetic properties, which make it suitable for wide-spread uses. When mixed color waste glass, is crushed to about the particle size of cement and used in concrete as replacement for about 20% of cement, improves the moisture barrier qualities, durability, and mechanical performance of concrete. Glass is an inert material which could be recycled and used many times without changing its chemical property times without changing its chemical property India is the third largest producer of coconut products in the world. Coconut trees are widely cultivated in the southern states of India, especially Kerala. Kerala got is name itself derived from a word kera meaning coconut tree. Kerala is densely populated state and most of its population use coconut or it's by product in their daily activities coconut shells thus get accumulated in the main land without being degraded for around 100 to 120 years. Disposal of these coconut shells is therefore a serious environmental issue. In this structure, the study on use of coconut shell as a substitute or partial replacement of coarse aggregate in concrete is gaining importance in terms of possible reduction of waste product in environment and finding a sustainable alternative for non renewable natural aggregates. In the present investigation Waste Glass Powder and Coconut Shell powder were replaced from 0%, 5%, 10%, 15%, 20% and 25% with fine aggregate by the use of M30 mix design. It is concluded that the Coconut Shells are more suitable for lightweight aggregate when used to replace normal coarse aggregate in concrete production by 15% of aggregates. The tests give an idea how the strength of concrete varies when the waste glass powder and coconut shells are partially replaced as fine aggregates. Results shows that with the replacement of 15% gives accurate compressive strength as similar as 0% and which is noted as 34 N/mm^2*

Keywords- Concrete, Coarse Aggregate (CA), Coconut Shell (CS), Recycled Waste and Compressive Strength.

I. INTRODUCTION

Recycled Aggregate Concrete is concrete that using Recycled Aggregate (RA) as partially or fully replacement in coarse and fine aggregate. It is believed RA have been used from 1945 in concrete producing and started when World War II damaged a large quantity of concrete structures and the high demand of aggregate to rebuild the structures. They recognized the factors like depletion of natural aggregates, tightly environmental law and waste disposal problems which influenced the application of RA. RA had such a possible application in certain area have summarized it. They have conducted some experimental investigations and found that RA had a potential functioning as aggregate that can be applied in concrete roads, drainage work, shallow storage tanks, culverts and sewage or treatment plants. Waste materials such as plastics and glass, which present possible environmental hazards and are often land filled, are often used in concrete for different applications. Globally, the use of plastics had seen an astronomical increase since 1920, when it was first developed for industrial use. The many advantages of plastics have caused the increase in its production by plastic industries. Compared to other materials such as glass and metal, plastics have lower cost, a higher strength-to-weight ratio, are more durable (resistant to deterioration), easy to work and shape, and have a low density. Some staggering statistics have shown that in 2013, 299 million tons of plastic were produced globally, exceeding the estimated consumption for 2015 by about 2 million tons. However, waste plastics are generally a threat to the global environment. While the production of plastics in its varied forms cannot be halted, recycling may be a solution to the threat waste plastics pose to the environment.

II. MATERIALS AND METHODS:

Concrete, a Versatility of making concrete with locally available materials, ease in moulding it into any shape and size and economy in its making has made concrete the 2nd largest consumed material on earth. Far more concrete is produced than any other man-made material. Annual

production represents one ton for every person on the planet. It is incredibly versatile, and is used in almost all major construction projects. Aggregates are used in concrete for very specific purposes. Aggregates typically make up about 60 % to 75 % of the volume of a concrete mixture, and as they are the least expensive of the materials used in concrete, the economic impact is significant. 80 % of buildings CO_2 emissions are generated not by the production of the materials used in its construction, but in the electric utilities of the building over its life-cycle. Compared to other comparable building materials, concrete is less costly to produce and remains extremely affordable. CSAC, which is produced using CS aggregates, was the main concrete studied in this investigation. CS is discarded at coconut industries as half-shell rounds. CS was collected from the local coconut oil mills to analyze the properties of CS in this study. CS have maximum thickness in range of 2-8mm, they were crushed to the required sizes (Shown in Figure) in the range 3-12 mm in length using the specially developed crusher. According to sustainability has become a critical issue in the construction industry, especially sustainability of construction materials. Of recent, research efforts have been invested on using concrete as a means of managing solid waste, and from the studies of it was reported that concrete provide a real potential means of reusing large quantities of solid waste materials like glass, fly ash and rice husk as substitute for concrete constituents. Moreover, reported that reusing of waste materials in the construction industry is among the most effective options to manage waste because a significant quantity of these waste materials can be reuse in concrete with or without high conditions of quality. Reusing waste glass in production of fresh concrete is attracting an increasing. In the present investigation Waste Glass Powder and Coconut Shell powder were replaced from 0%, 5%, 10%, 15%, 20% and 25% with fine aggregate by the use of M30 mix design

III. RESULTS AND DISCUSSIONS:

Here we conduct different tests on cement, coarse aggregates, fine aggregates, Replaced Materials and water. The test results are given in tabular columns. The tests include fineness, specific gravity, impact, crushing, workability, sieve analysis, compaction factor and Compressive Strength Tests. The mix design grade M30 was estimated, the M30 mix concrete is considered to perform the various tests for the comparison of present construction and sustainable construction. First of all M30 mix concrete is modified by replacing 0%, 5%, 10%, 15 %, 20% of Fine Aggregate by Waste Glass and Coconut Shell.

Take Sand content as percentage of total aggregates = 35%
Select Water Cement Ratio = 0.4 for concrete grade M30 (From I.S. 10262- 1982)
Select Water Content = 191.6 lit
For 20mm nominal size of aggregates Maximum Water Content = 186 Kg/ m^3
Cement Content = 478.95 Kg /m^3
Fine Aggregate = 501.238 Kg /m^3
Coarse Aggregate = 1301.061 Kg /m^3
Fine Aggregate Zone III
Mix Proportions: 1:1.04:2.71:0.4

Table.1. Properties of Fine Aggregates and Glass Powder

Property	Fine aggregate(sand)	Glass powder
Specific gravity	2.6	2.4-2.8
Bulk density	1.46	2.49
Moisture content (%)	1.5	Nil
Fine particles<0.075mm (%)	0- 6	10-15
Sieve analysis	Zone 2	Zone 2

Table.2. Aggregate Crushing Value on Coarse Aggregate (CA) and Coconut Shell (CS)

S.No.	Details	Trail Number		Average CA	Trail Number		Average CS
		1(g)	2(g)		1(g)	2(g)	
1	Weight of aggregate sample in the cylindrical measure, W1gm	3000	3000	3000	3000	3000	3000
2	Weight of crushed aggregates after passing through 2.36 mm sieve, W2 gm	620	670	645	141	141	141
3	Aggregate crushing value:(W2/W1)*100	20.6	22.3	21.45%	4.77	4.77	4.77%

Table.3. Impact Value on Aggregates and Coconut Shell

S.NO	Details	Trail Number		Average	Trail Number		Average
		1	2		1	2	
1	Weight of aggregate sample in the cylindrical measure, W1gm	500	500	500	500	500	500
2	Weight of crushed aggregates after passing through 2.36 mm sieve, W2 gm	180	220	200	55	60	57.5
3	Aggregate impact value: (W2/W1)*100	36	44	40%	11	12	11.5

Table.4. Test on Compaction Factor and Workability

% of WG & CS replacement	W/C ratio	Mix Ratio	Compaction factor	Slump (mm)
0	0.4	1:1.04:2.71:0.4	0.8	30
5	0.4	1:1.04:2.71:0.4	0.8	30
10	0.4	1:1.04:2.71:0.4	0.8	30
15	0.4	1:1.04:2.71:0.4	0.8	30
20	0.4	1:1.04:2.71:0.4	0.8	30
25	0.4	1:1.04:2.71:0.4	0.8	30

Table.5. Compressive Strength in N/mm^2

% of WG & CS replacement	0	5	10	15	20	25
7 days	22.99	22.11	22.22	22.44	22.77	20.77
14 days	26.88	25.44	25.88	26.22	26.77	22.44
28 days	35.23	28.5	30.16	35.2	31	28.5

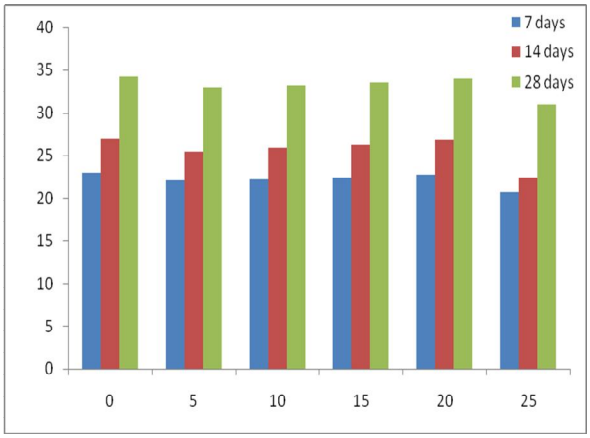

Figure.1. Compressive Strength Results

IV. CONCLUSION

From the experimental results and discussion, the waste glass powder and coconut shell has potential as lightweight aggregate in concrete and the compressive strength of concrete with glass powder is more than the conventional concrete. The increase in compressive strength is the interlocking properties of particles in the glass powder. Also, using the waste glass powder and coconut shell as aggregates in concrete can reduce the material cost in construction because of the low cost and abundant agricultural waste. Waste glass powder and Coconut Shell Concrete can be used in rural areas and places where coconut is abundant and may also be used where the conventional aggregates are costly. Coconut shell concrete (M30) is also classified as structural lightweight concrete. It is concluded that the Coconut Shells are more suitable for lightweight aggregate when used to replace normal coarse aggregate in concrete production by 15% of aggregates. The tests give an idea how the strength of concrete varies when the waste glass powder and coconut shells are partially replaced as fine aggregates and coarse aggregate. Results shows that with the replacement of 15% gives accurate compressive strength as similar as 0% and which is noted as 35 N/mm^2

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