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EFFECT ON PROPERTIES OF CONCRETE USING AGRICULTURE WASTE

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ABSTRACT

The agricultural and industrial wastes known as oil palm shell (OPS) or palm kernel are accessible in significant numbers in India and other tropical nations. A series of laboratory experiments, including tests for workability, compressive strength, and water absorption, were carried out on concrete constructed with varying percentages of coconut shell and palm kernel replacement, ranging from 5% to 15% with 5% increments. The tests were carried out in order. The concrete mix used is grade 20, and the ratio used is 1:21.5:3. For the curing age, each sample was immersed for a period of 7 and 28 days. The findings demonstrated that a genuine decline had taken place across the board for the sample. In a similar manner, the compressive strength tends to decline to a level much lower than the standard strength as the amount of replacement material grows.

KEYWORDS: *Agricultural Waste, Concrete, Properties, Effect, Agro-Waste Concrete.*

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INTRODUCTION

Concrete is generally considered to be the building material that is employed throughout the majority of the world in the greatest quantity. Concrete is not only one of the most frequently used materials in the contemporary world, but it is also one of the most widely consumed materials overall, second only to potable water (Aitcin, 2000). Its manufacture requires vast volumes of natural resources. It is vital to adopt the use of different non-conventional and renewable resources in the manufacturing of cement and concrete. This is a step that may be taken to ensure that the ecological balance is maintained. It has been shown that a significant portion of waste products from residential, commercial, and agricultural settings may be recycled and used in place of cement or aggregate in concrete (Mehta and Monteiro, 2006). It is estimated that aggregates account for between 70 and 80 percent of the entire volume of concrete (Alexander and Mindess, 2005). The lack of sustainability of natural coarse aggregates as a resource leads to a number of additional environmental issues, which is one of the primary factors that discourages their usage (Mo et al., 2016). As a result, the usage of alternative aggregates has evolved into an important phase in the current building scenario as a result of the economic advantages, environmental benefits, and technical benefits that are generated from their use. In order to achieve sustainable development in the manufacturing of concrete, the use of waste and by-product materials as an alternative to natural resources is the most effective strategy (Pelisser et al., 2011; Raman et al., 2011).

Additionally, lightweight concretes have a lower stiffness, which leads to a reduction in microcracks. Additionally, lightweight concretes have better endurance in harsh environments thanks to a more uniform distribution of microcracks (Shafigh et al., 2014). When compared to concrete of standard weight, lightweight concrete made using coconut shell coarse aggregate has a sound absorption coefficient that is much higher (Umoh and Ekop, 2013).

Because of the substantial amounts of energy and carbon dioxide (CO2) that are used in their manufacture, the industries that produce cement and concrete are also generally considered to be among the most significant contributors to the phenomenon of global warming. Because of the large quantity of cement that is required for the manufacturing of concrete, it is almost difficult to create concrete as a material that is carbon neutral. It is possible for a meter cube of concrete to have anything from 200 to 1,200 kilos of cement mixed into its composition. The manufacturing of cement accounts for no less than five percent of the anthropogenic emissions that come from the industrial sector's share of the overall twenty-five percent of world CO2 emissions. In addition, studies have revealed that the manufacture of cement is directly responsible for 85 percent of the total CO2 emissions that are produced during the life cycle of buildings made of concrete (Lim et al., 2018; Habert and Roussel, 2009). Incorporating locally available by-products as supplemental cementitious material in addition to other materials with a low carbon footprint into the manufacturing of concrete is one method that may be used to lessen the dependency on cement in the production of concrete. In this particular research project, fly ash, which is a kind of industrial waste that is produced when coal is burned in thermal power production units, is put to use as a partial substitute for cement?

Over the course of the last several decades, a significant number of studies have been conducted in order to investigate the impact that natural additives have on the characteristics of conventional bitumen. The idea of making changes to bitumen is not a novel one. In point of fact, a great number of research have been conducted in various parts of the globe to modify bitumen by adding mineral addition in order to improve the qualities of bitumen and to improve the overall performance of asphalt mixture. Researchers are starting to pay greater attention to the possibility of using coconut shell as a modifier in bitumen or as a substitute for aggregate in asphalt mixture in modern times. However, in Malaysia, the use of charcoal derived from coconut shells as a modifier in bitumen is not nearly sufficient. The reason for this is because there haven't been many studies done on the possibility of coconut shell to be utilized as a bitumen modifier in order to enhance the qualities of bitumen.

In most cases, the kind of environment that will be experienced at the destination is taken into consideration while choosing the grade of bitumen to use. The softer grade of bitumen is more appropriate for use in cold country climates, whereas the harder grade is recommended for use in hot country climates. In order for certain bitumen to conform to the specifications, it has to be modified. However, due to the fact that each mineral modifier has its own unique chemical makeup, not all modifiers are suitable for use in all applications. In general, bitumen should be altered in order to lessen its sensitivity to temperature, as well as to increase its adhesive and cohesive properties.

As a result, it is anticipated that this method will not only have a significant influence on the recycling of agricultural waste material, but that it will also have the ability to lower the cost of bitumen while simultaneously improving its overall performance.

This investigation focuses primarily on the use of a regional by-product derived from an agricultural crop as an additive to alter bitumen. Instead of importing other types of material from outside the country, coconut shells have shown a great capacity to change bitumen, which has allowed for the improvement of the substance's qualities. In addition to this, this study serves to produce more trustworthy and valid data from experimental work since there has been very little research done on the use of coconut shell as a modifier in bitumen. The information and data gathered from this study may be used for future research and can be of use to authorities in establishing specifications for the building of roads utilizing modified bitumen and coconut shell charcoal. In addition, if waste material is utilized as a modifier in bitumen to enhance the performance of the road, then the cost of creating flexible pavement may be reduced. This would result in cost savings.

RESEARCH METHODOLOGY

A methodical approach to learning the steps involved in producing the cube of concrete is known as research methodology. It is a branch of science that studies how the findings of research are gathered and analyzed. In academic parlance, the process by which researchers identify, evaluate, determine, describe, and draw conclusions about all of the data involved in generating a cube of concrete is referred to as study design. It is also possible to describe it as the study of the accumulation of knowledge.

Preparation of Material

This investigation will be carried out in the form of an experiment, and the dimensions of the cube that we will use are 150 millimeters on each side, and 150 millimeters on the top and bottom. The ready-mixed concrete will be molded into the shape of a cube using the same mold that was previously used. Each cube will be tested according to the needed tests, which are necessary in order to accomplish the study goals. The additive material that was employed is an example of a kind of material that is appropriate for the creation of concrete.

Ordinary Portland Cement

The cement is purchased from a building supply shop that is located close to NIT Srinagar. A cement must be characterized in accordance with IS 8112 and meet all of its requirements.

Palm Kernel Shell

The palm kernel shell that was used in this study was taken from Srinagar. The production of palm oil as well as its cultivation is two of the services offered by this facility. Saturated Surface Dried (SSD) aggregates are obtained by first air-drying the palm kernel shell either naturally or in an oven and then soaking it for a few days at room temperature. This produces the aggregates. The grading size of the palm kernel shell that was utilized to replace coarse aggregates ranged from 10.0 to 12.5 millimeters, and it was used to replace coarse aggregates at a value of 5, 10, and 15% total.

Outer Shell of a Coconut

The coconut husk that was used in this study was acquired at the Srinagar. At the rear of the shop where shredded coconut is sold, the empty coconut shells are thrown away. We made sure that the coconut shell that we had obtained was completely dried out by exposing it to the sun. The shell of the coconut was then ready to use. To achieve the desired particle size for incorporation into concrete, the coconut husk was broken up with a hammer and smashed into smaller bits.

Slump Test

The slump test is used to measure the workability of concrete. The protocol for the slump test is as follows: i. Themold for the slump test is a frustum of a cone with a height of 300 millimeters or 12 inches. The diameter of the base is 200 millimeters (8 inches), while the top has a smaller hole that is 100 millimeters (4 in).

Compression Cube Test

This is the most significant test for determining the quality of concrete. The ability of a material or structure to support loads on its surface without cracking or deforming when subjected to compression. When the load is applied to the concrete, the purpose of the test is to determine the compressive strength as well as the tensile strength of the material. The findings of this test will demonstrate a concrete mix that produces concrete with a high strength. When a material is subjected to compression, its size tends to decrease, and when it is subjected to tension, its size tends to increase. The size mold for a cube is 150 millimeters on each side.

Water Absorption

The movement of liquids through porous substances owing to the action of surface tension in capillaries is referred to as sorbtivity. Another term for this phenomenon is capillary suction. It depends on the viscosity of the liquid, the density of the liquid, and the surface tension of the liquid, as well as the pore structure of the solid, which includes the radius, tortuosity, and continuity of the capillaries. A concrete is an example of a porous material that engages in conversation with the environment around it. As a measure of concrete's resistance to the effects of contact with hostile surroundings, sorvtivity is becoming an increasingly popular choice. Sorptivity is a term that may be used to describe the process by which unsaturated, hardened concrete absorbs water.

RESULTS AND DISCUSSION

Slump Test

In order to conduct the slump test, the bottom of the slump cone was required to be placed on a level surface. After that, the cone was filled with wet concrete, which was layered three times. Every level performed the tempered with 25 times, using a normal 16mm rod. When the concrete had entirely filled the cone, the top surface was knocked off using screening and a rolling action with the temping rod.

The results of the slump test that was performed on the sample that was utilized in the concrete are shown in Table 1. The purpose of the slump test is to determine the consistency of freshly mixed concrete just before it hardens. According to the findings, a genuine slump was achieved with a replacement of coarse aggregate at percentages of 5%, 10%, and 15% respectively. This demonstrates that each % has reached a high level of workability in concrete.

Table1 Slump value of concrete

Percentage concrete (%)	Slump (mm)	Slump type
0	40	True slump
5	55	True slump
10	55	True slump
15	72	True slump

Compressive Strength

The compression cube test is used to measure the mechanical strength of concrete to determine whether or not it can withstand the axial force that is exerted on the surface of the concrete. In order to manufacture the high strength concrete, three different grades of concrete were mixed together in a ratio of 1:1.5:3 to determine the average compressive strength. One set of concrete including three samples, which are denoted by the letters A, B, and C respectively.

Table 2Compressive strength of concrete at 7 days

Replacement	Specimens A	Specimens B	Specimens C	Average compressive strength (N/mm^2)
0%	18.48	19.58	18.61	18.55
5%	24.60	22.80	21.58	23.00
10%	16.85	18.50	17.40	17.53
15%	17.55	15.00	15.72	16.08

When the load is applied to the concrete and the replacement, the purpose of this test is to identify whether material has a greater maximum compressive strength and tensile strength. The findings of this test will reveal a concrete mixture that, when used, produces concrete with a high strength, meeting the requirements set out by Indian standard (IS 516).

The compressive strength of concrete containing varying amounts of palm kernel shell and coconut shell was measured and reported. For every one percent, there are three samples included in the production of the concrete. The data shown in table 2 reveals that the concrete with a percentage of 5% has a value of 18.55 N/mm^2, which is the greatest compressive strength value among the other samples. The compressive strength, on the other hand, has a value as low as 15%, which is equivalent to 16.08 N/mm^2. Following that, the compressive strength of 5% and 10% is respectively 23.00N/mm^2 and 17.53N/mm^2, respectively. The compressive strength value that was recorded reveals that the difference between the highest and the lowest values is 16.08N/mm^2, which indicates that the greatest value is stronger than the lowest value. The conclusion that can be drawn from this is that the value of compressive strength for concrete will decrease when the proportion of concrete including palm kernel shell and coconut shell is high. In order to meet the requirements of the Indian Standard (IS 456), the compressive strength of concrete must reach or exceed 18 N/mm^2 after 7 days.

The results of the compressive strength test at age 28 are shown in table 3. The data shown in table 4.2 reveals that the concrete with a percentage of 5% has a value of 32.43 N/mm^2, which is the greatest compressive strength value among the other samples. The compressive strength, on the other hand, has a value as low as 15%, which is equivalent to 21.55 N/mm^2. Following that, the compressive strength of 5% and 10% is respectively 32.43N/mm^2 and 25.83 N/mm^2, respectively. The compressive strength value that was recorded reveals that the difference between the highest and the lowest values is 32.43 N/mm^2,when compared, the best and lowest values of compressive strength have a difference of 21.55 N/mm^2 between them. A number of 5% is considered to be the value that is closest to the standard, which is 32.43 N/mm^2.

Table 3 Compressive strength of concrete at 28 days

Replacement	Specimens A	Specimens B	Specimens C	Average Compressive strength (N/mm^2)
0%	27.62	26.90	28.00	27.50
5%	30.8	34.6	32.7	32.43
10%	24.05	26.54	26.90	25.83
15%	19.58	23.08	22.0	21.55

The compressive strengths of 0%, 5%, and 15% after 7 days and 28 days are shown in Figure 4.3. The information may be found in tables 4.2 and 4.3 respectively. It is clear that after 7 days, the compressive strength is greatest at 5%, followed by 15% and then 10%. The result of this study shows that the compressive strength of concrete reduces when a large proportion of concrete additives is applied. In order to meet the requirements of the Indian Standard (IS 516), the compressive strength of concrete must reach or exceed 20 N/mm2 after 28 days of curing.

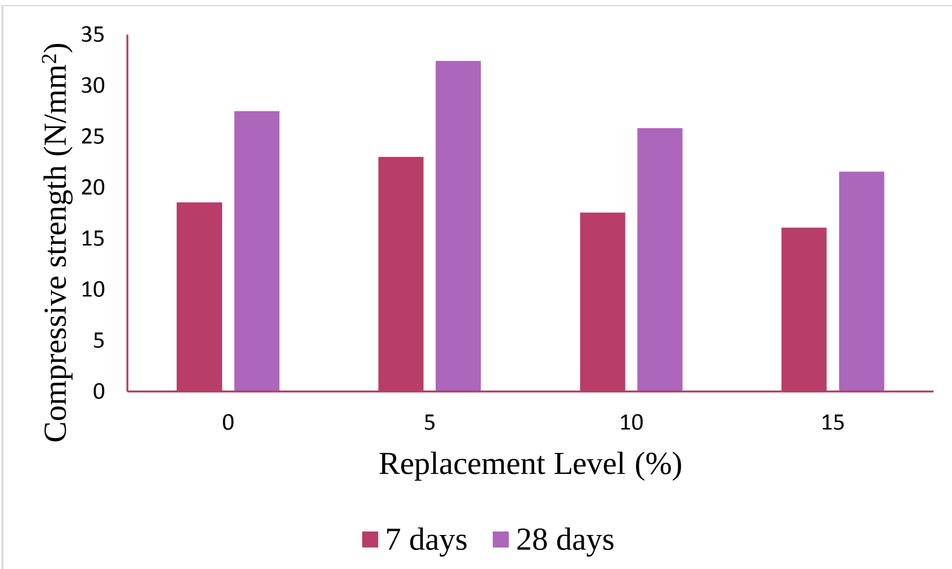

Figure 1 Compressive Strength of concrete at 7 days and 28 days

4.4 Water Absorption

According to Tables 5 and 6, the additives concentration of 5% has the least absorption of water compared to any other percentage, followed by 10% and 15%. Concrete that includes additives making about 15% of its volume has the greatest potential for allowing harmful substances to permeate. Below 4% or 5% is the water absorption threshold that has been met, indicating that the concrete is of the highest quality. According to the results of water absorption tests, the best concrete composition is one that has 15% replacement. The greater the amount of water that the concrete is able to absorb, the greater the possibility that it may get contaminated by dangerous compounds.

Table 5 Water Absorption at 7 days

Percentage (%)	Specimens	Dry mass(kg)	Wet mass(kg)	Water Absorption (%)	Average water absorption (%)
5	A	8.495	6.972	1.523	1.565
	B	8.682	7.074	1.608	
	C	8.595	7.030	1.565	
10	A	8.158	6.453	1.705	1.732
	B	8.674	6.909	1.765	
	C	7.956	6.228	1.728	
15	A	8.674	6.316	2.358	2.390
	B	8.438	5.990	2.448	
	C	8.346	5.980	2.366	

Table 6 Water Absorption at 28 days

Percentage (%)	Specimens	Dry mass(kg)	Wet mass(kg)	Water Absorption (%)	Average water absorption (%)
5	A	7.486	6.074	1.412	1.369
	B	7.568	6.272	1.296	
	C	7.756	6.357	1.399	
10	A	7.254	5.695	1.559	1.584
	B	7.335	5.629	1.706	
	C	7.208	5.719	1.489	
15	A	7.635	4.881	2.754	2.783
	B	7.346	4.537	2.809	
	C	7.856	5.070	2.786	

CONCLUSION

The findings of the concrete strength test and the subsequent discussion have led us to the conclusion that our project was not successful in reaching the standard for the concrete's strength. Because we used the coconut shell in a large size, we determined that our project was a failure because the size of the coconut shell that we used was not suitable. This is due to the fact that we used the coconut shell in a large size, which is the reason why we were unable to achieve maximum strength. Other than that, we feel that we still have the potential to acquire a good outcome from this material by implementing certain modifications to the way by which concrete is produced or by developing a new idea. This project is straightforward and does not need a significant financial investment.

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