EXPERIMENTAL STUDY ON DURABILITY CHARACTERISTICS OF POLY- VINYL ALCOHOL TREATED OIL PALM SHELL CONCRETE

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Abstract – *Concrete is one of the most widely used construction materials in the world. It is an important and versatile material in modern construction. Oil palm shell (OPS) could be used in rural areas and places where oil palm shell is abundant and may also be used where the conventional aggregate arecostly. This paper presents the results of an experimental studyonthe durability characteristics of light weight concrete produced from agricultural waste oil palm shell (OPS) pretreated with polyvinyl alcohol (PVA) as partial replacement material (10%,20%,30% etc..) for conventional coarse aggregates. The tests conducted to assess the durability characteristics of PVA- treated OPS concrete are water absorption, sorptivity, compressive strength, volume of permeable voids,saltponding test. The effects of different curing conditions on the durability characteristics of PVA treated OPS concrete arediscussedand the results obtained are compared with conventional mix.*

Key Words: Concrete, OPS (Oil Palm Shell), Poly Vinyl-Alcohol (PVA), Sorptivity, Salt ponding test

1. INTRODUCTION

Utilization of agricultural wastes in construction field has been investigated for many years but the impacts have been found to be varying degrees of success. In many countries agricultural wastes can be used as a replacement material in construction industry. The OPS is a waste product discharged from palm oil mills. Waste disposal is growing and it leads to environmental pollution if no control measures were organized in the regions involved. OPS is lighter than the conventional coarse aggregate. Consequently, the resulting concrete will be lightweight. Lightweight concrete using OPS as coarse aggregate is able to produce concretes with compressivestrengthsof more than 25 MPa. In addition, the durability performanceis also another important aspect that determines the viability of OPS concrete to be used in practical applications because during the service life of a concrete structure, it will be affected by exposure toan environment and may deteriorate under this exposure. Improve properties of recycled concrete aggregates (RCA) by their impregnation with polyvinyl alcohol (PVA). The effects of PVA on the development of strength and durability properties of the recycled aggregate concrete were calculated. Currently there is also an increasing demand for low-cost houses in Malaysia and therefore OPS can be used as an alternative to the conventional aggregates in fulfilling this demand. Structural LWC offers design flexibility and cost savings due to self-weight reduction, improved seismic structural response, and lower foundation costs. This Oil palm shell can be used as a coarse aggregate in the production of LWC. Oil palm shell Concrete (OPSC) could be used in rural areas and places where Oil palm is abundant and may also be used where the conventional aggregates are costly. In this study, the important mechanical properties of OPSC , namely compressive strength ,waterabsorption, sorptivity, salt ponding test, volumeofpermeablevoids to assess its durability as a lightweight aggregate.

2. SCOPE AND OBJECTIVE

1. By replacement of coarse aggregate by Oilpalmshell, the durability of concrete gets increased.
2. By introducing Oil palm shell a light weight concrete can be achieved. Oil palm shells are economic since it is an agricultural waste.
3. By using Oil palm shell as aggregate in concrete a proper method for reducing natural wastages can be achieved.

2.1 OBJECTIVE OF THE PROJECT

1. To study the waste minimize techniques
2. Introduction of new construction material
3. To find mix ratio which gives good strength whilereplaced with polyvinyl alcohol treated oil palm shell.
4. To study the Oil palm shell concrete and its effect as waste management in constructions.
5. To compare the mechanical properties of normal concrete and Oil palm shell replaced concrete.
6. Cost effective construction.

3. METHODOLOGY

1) To replace the coarse aggregate by oil palm shell with 0%, 10%, 20%, 30% in M25 grade concrete. To compare the normal concrete with partially replaced concrete at 28 days strength. To improve thedurability of concrete in terms of water absorption, sorptivity, volume of permeable voids, salt ponding test. The experimental programme should be conducted in the following steps: material properties; material testing; mix design; casting of cubes; testing of cubes; result and discussion.

4. PROPERTIES OF MATERIALS

4.1 CEMENT

Ordinary Portland cement (OPC) 43 gradeconfirming to IS 8112. Hydraulic cement, more commonly known as cement (also referred to as Portland cement or Ordinary Portland cement), is one of the most extensively used basic materials in almost all civil engineering construction. The Ordinary Portland cement has specific gravity 3.15

4.2 AGGREGATE

Fine aggregate with a specific gravity ranging from 2.63-

2.67. Coarse aggregate as a size of 20mm and normal continuous grading can be used.

Table 1: Properties of Coarse Aggregate

Sl. No.	Properties	Values
1	Specific Gravity	2.60
2	Size Of Aggregates	Passing Through 20 mm and retained on 10 mm Sieve
2	Fineness Modulus	7.88

4.3 OIL PALM SHELL

The OPS is a waste product derived from palm oil mills. The OPS is a one of the huge waste producing from palm oil extraction process .The OPS can be used in the concrete mix to replace the aggregate in order to produce concrete. Oil palm shell (OPS) with size, it is s passing through 12.5mm sieve and retained on 4.75 sieve.

4.4 POLYVINYL ALCOHOL

Polyvinyl alcohol (PVA) is a water-soluble synthetic polymer. It has the idealized formula [CH2CH(OH)]n. It is used in papermaking, textiles, and a variety of coatings. It is white (colourless) and odourless. It is sometimes suppliedas beads or as solutions in water. Polyvinyl alcohol is used as an emulsion polymerization aid, as protective colloid, to make polyvinyl acetate dispersions.

Fig 1: Polyvinyl alcohol

4.5 WATER

Water having PH Value 7 is used for manufacturing and curing the concrete. The concrete is tested for 28 days strengths if 90% result is obtained it can be considered to be suitable. The cubes shall be prepared, cured and tested in accordance with the requirements of IS 516.

5. EXPERIMENTAL INVESTIGATION

5.1 COMPRESSIVE TEST

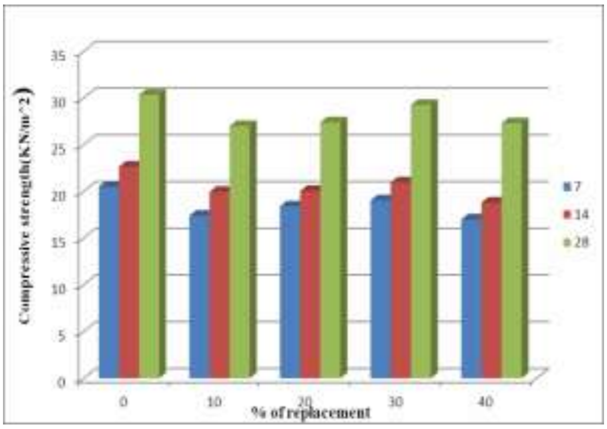

Chart 1: Compressive strength analysis

At the end of curing period take the cubes from the curing tank and wipe than clean with cloth or waste cotton. Measure the dimensions of the compression face onebyone. Place the cubes between the compression plates of the Universal Testing Machine (U.T.M) or the compression testing machine. After the initial adjustments are over apply the load gradually over the cube. Note the load scale reading at the time of first crack and at the time of failure; report the procedures testing for other cubes. Optimum strength is obtained when coarse aggregate is replaced by 30% of PVA treated OPS.

5.2 SORPTIVITY TEST

After the specific curing age, the concrete sampleswereoven dried to the same condition as were the water absorption samples and left to cool to room temperature. Four sides of the concrete samples then were sealed with waterproofing sealant in order to maintain uniaxial water flow during the test. The contact surface (bottom face of concrete) was immersed in a tray containing water to a depth of 1–2 mmby resting the samples on steel rods to allow free access of water to the inflow surface. The mass gain attributable to sorption was measured at set intervals of 3, 5, 7, 9, 16 and 25min. The sorptivity coefficient was determined from the slope of the best-fit line to the plot of the cumulative weight of water absorbed per unit area of concrete surface against the square root of predefined interval time.

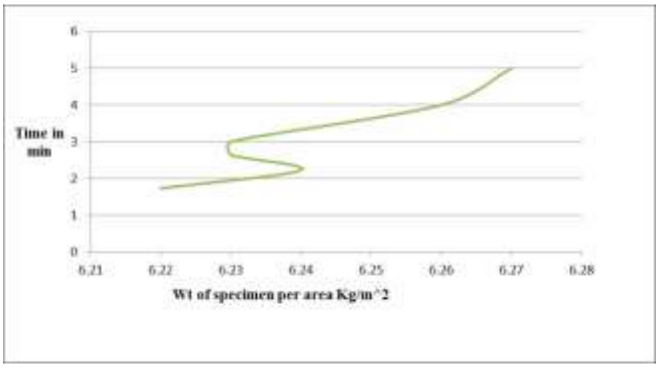

Chart 2: 28 days curing sorptivity of 30% replaced concrete

5.3 WATER ABSORPTION

The water absorption is performed accordingto ASTMC642. After the specified curing period, the concretesampleswere preconditioned in an oven at a temperature of 100 5°C until constant mass was obtained. The concrete samples then were allowed to cool to room temperature before commencing the test. The dry weight of concrete (A) was obtained and the samples were immersed in water for 7 and 28 days. After the specified time interval, the concrete samples were removed from the water, any excess water on the concrete surface was wiped off with dry absorbent cloth, and the samples were weighed (B). The water absorption can be calculated by following expression

Water absorption (%) = [(B-A)/A] X 100

Percentage of water absorption after 28 days of curing for normal concrete is 12.1%. Percentage of water absorption after 28 days of curing for 30% replacement PVA treated OPS concrete is 11.64%.

5.4 SALT PONDING TEST

Samples were cured in the respective curing conditions for up to 28 days. After curing, the concrete slabs were removed from their curing environments and subjected tocontinuous ponding with 3% weight:volume ratio sodium chloride solution to a depth of 20mm. After 90 days of exposure, the ponding solution was removed and the slabswereallowedto air dry. The surface of the concrete slabs was brushed to remove any salt crystal buildup. In order to obtain the chloride penetration profiles, powdered samples were collected from the concrete slabs and analyzed.

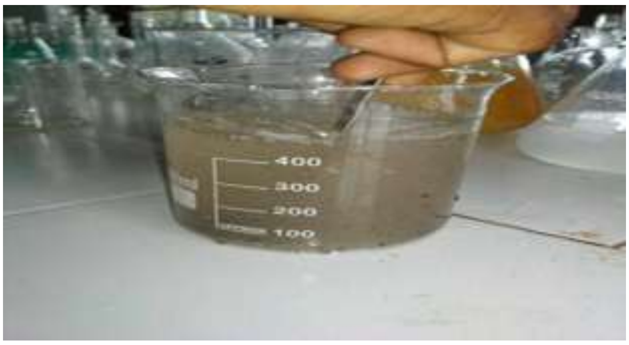

Fig 2**:** Sample for salt ponding test

5.5 VOLUME OF PERMEABLE VOIDS

The concrete samples with an immersion period of 72 hthen were continuously boiled in water for 5 h and allowed to cool by natural loss of heat for not less than 14 h. Thesurface moisture was removed with an absorbent cloth and the weight of the concrete samples was determined (C). After immersion and boiling, the concrete samples were suspended in water by wire mesh to determine the apparent weight (D). The VPV can be calculated using the following expression

Volume of permeable voids (%) = [(C-A)/(C-D)] X 100

6. CONCLUSION

This project investigated the durability characteristics of partially replaced PVA treated OPS concrete and normal concrete It is found that 30% replacement of coarse aggregate by PVA treated OPS give maximum result in strength and durability aspects. The results show that partially replaced PVA-treated OPS concrete demonstrated improved water absorption, VPV and sorptivity compared with normal concrete. The time for initiation of concrete containing partially replaced PVA-treated OPS aggregates was found to be prolonged. These results indicate that the serviceability of concrete can be improved by incorporating partially replaced PVA-treated OPS aggregates in concrete . As the value of chloride penetration is higher in partially replaced PVA treated OPS concrete than that of normal concrete , so PVA treated concrete is not suitable to construct marine structures. Using the PVA treated OPS as aggregate in concrete can reduce the material cost in construction because of the low cost and abundant agricultural waste. The experiments prove that PVA treated OPS fulfill the requirements for use as lightweightaggregate.

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