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Study on Strength of M25 Concrete by Partial Replacement of Aggregate with Clay Waste Products

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Abstract: **Clay waste products have in the past been disposed by either land dumping or filling depressions on roads. The scenario is common among the manufacturing industries. . Clay waste products chips when crushed to the required nominal sizes such as 10mm, 15mm, 20mm, 40mm etc. provide a rough and irregular surface which aids in bonding of cement paste and the aggregate. Therefore the bond strength of concrete is likely to be increased when these aggregates are used.**

***Keywords*: Clay waste, Strength, workability**.

1. INTRODUCTION

From the last few decades there is a major problem dispose of waste material. Dispose of waste in land filling is economically high due to transport charges & tipping fees. This waste material can be used as aggregate in concrete to reduce the cost of concrete and environment impact. Building bricks, roofing tiles and clay chips are some the example of clay products.

1.1 Introduction about Clay:

Clay is a fine-grained natural rock or soil material that combines one or more clay minerals with traces of metal oxides and organic matter. Clays are plastic due to their water content and become hard, brittle and non–plastic upon drying or firing.

1.1. 1 Formation:

Clay minerals typically form over long periods of time from the gradual chemical weathering of rocks, usually silicate-bearing, by low concentrations of carbonic acid and other diluted solvents. These solvents, usually acidic, migrate through the weathering rock after leaching through upper weathered layers.

2. LITERATURE SURVEY

- **Marek, C. R. Gallaway, B. M. and Long, R. E (1971**) Investigated that the (recycling is a process to change materials (waste) into new products to prevent waste of potentially useful materials
- **Khan and Choudhry (1978)** studied on Economic conditions and lack of suitable natural aggregates seems to have resulted in brick being used as aggregate in developing nations before being used in developed ones.
- **Hansen T.C. (1986)** studied on the use of recycling of concrete as aggregate & found that the density, compressive strength and modulus of elasticity of recycled concrete is less than normal concrete.
- **K.M Brook (1990**) Concluded that the Clean broken brick of good quality can provide satisfactory aggregates, the strength and density of concrete depending on the type of brick; engineering and allied bricks when crushed make quite good concrete of medium strength (Leonard John Murdock 1991).

- **Leonard John Murdock (1991)** studied on LECA is a special type of clay that has been palletized and fired in a rotary kiln at a very high temperature. As it is fired, the organic compounds in the clay burn off forcing the pellets to expand and become honeycombed while the outside surface of each granule melts and is sintered. **L.J. Murdock (1991)** studies on Pulverized fuel or fly ash (PFA**)** concluded that the residue of the combustion of pulverized coal used in the manufacture of lightweight aggregates in Germany and Great Britain to reduce dead loads of high rise structure.

- **Devenny and Khalaf (1999)** studied that the earliest use of crushed brick in cementitious materials using Portland cement occurred in Germany in 1860). He said that in Europe, many of the buildings damaged or destroyed by bombs during World War II included brick masonry.

- **Brar M (1999)** concluded that the methods of crushing of parent concrete has significant effect on recycled aggregate and partial shape of recycled aggregate is more irregular than normal concrete, recycled aggregate need more water than normal aggregate for same workability.

- **Sglavo et al. (1999)** investigated two different clays used as basic materials, the former being currently employed for the production of bricks by extrusion, the second is almost pure Kaolin for high quality ceramic manufacturing.

- **N NARAYANAN (2000)** studied on widely use of aerated concrete & concluded that it has high flow ability, low self-weight, controlled new strength, excellent thermal insulation and fire resistance.

- **Kutegeza and Alexander (2004)** studied the standpoint of sustainability; use of recycled materials as aggregates provides several advantages. Landfill space used for disposal is decreased, and existing natural aggregate sources are not as quickly depleted.

- **Koyuncu H (2004)** studied on use of recycled aggregate from the ceramic industry waste in the construction of land fill, sub based course on secondary road, concrete block and manufacture of concrete.

- **Tam and Tam (2006)** studied on Use of recycled waste materials as aggregates in concrete which can provide a number of advantages to stake holders including owners, contractors, and the ready-mixed concrete and precast concrete industries.

3. METHODOLOGY

3.1 Preparation of aggregates:

It is important to determine the properties of different types of aggregates through effective testing and measurement.

3.2 Laboratory testing of the properties of aggregates:

3.2.1 Particle size distribution:

Introduction:

This test consists of dividing up and separating by means of a series of test sieves, a material into several particle size classifications of decreasing sizes

3.2.3 Flakiness index:

Introduction:

This test is used to determine the quantity of aggregate particles that are elongated, instead of cubicle in shape. It is important in certain applications, such as concrete, where an elongated shape has a larger surface area and therefore will require greater quantities of cement in order to produce concrete of the required strength

3.3 Design of concrete mixes:

This is the process of selecting the correct proportions of cement, fine and coarse aggregate, water and sometimes admixtures to produce concrete having the properties specified and desired i.e. workability, compressive strength, density and durability requirements by means of specifying the minimum or maximum water/cement ratio.

3.3.1 Principles of design:

Strength margin:

Due to variability of concrete strengths, the mix must be designed to have higher mean strengths than the characteristic strength. The difference between the two is the Margin. The margin is based on the variability of concrete strengths from previous production data expressed as a standard deviation.

Workability:

The workability of the concrete mix was determined by the slump test which is more appropriate for higher workability mixes.

3.4 Testing the properties of fresh concrete:

3.4.1Slump test:

Introduction:

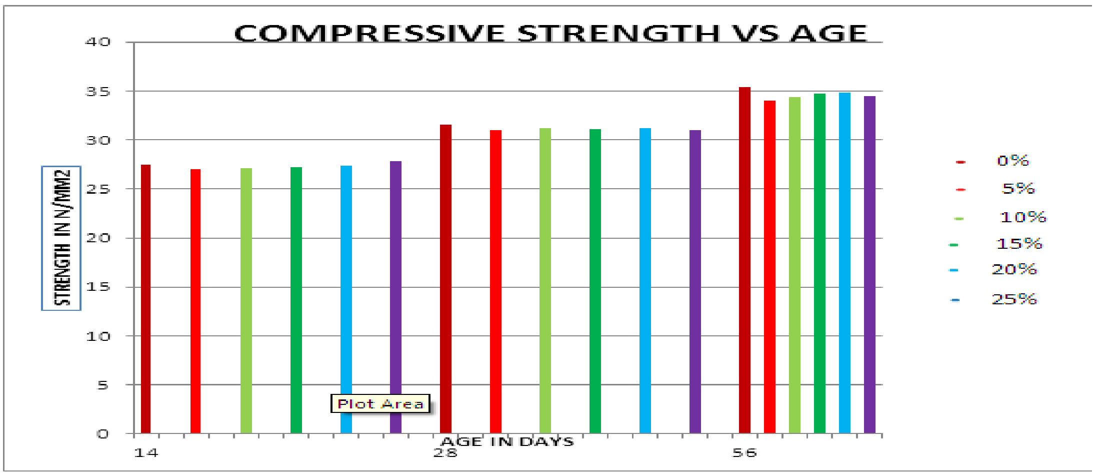
This test is performed at site to check the workability of concrete. If there is sudden change in slump value of concrete so it means there is something wrong with material used. If the slump value is not constant so we cannot use the concrete.

4. SIMULATION AND RESULT ANALYSIS

4.1 Laboratory test results:

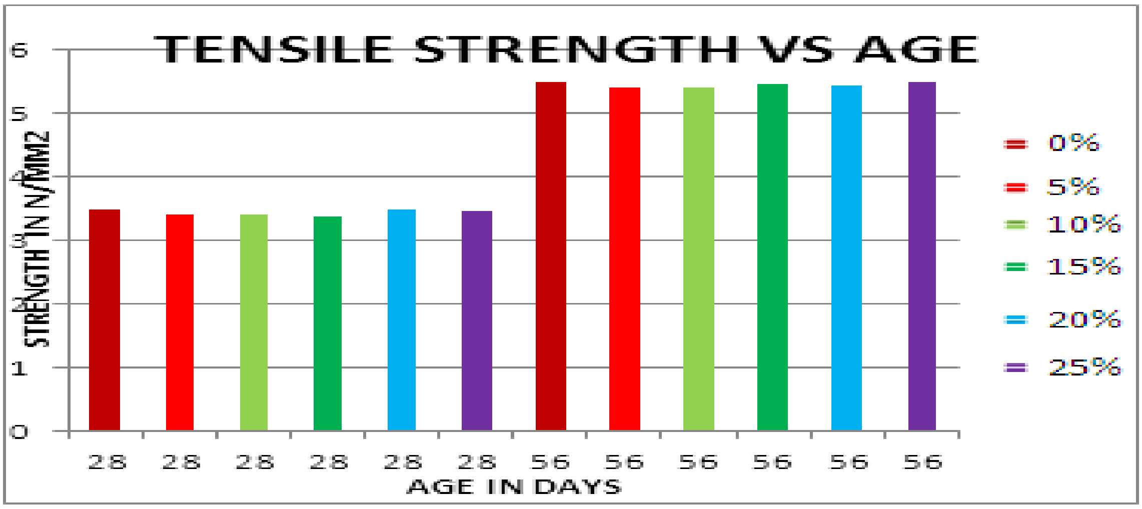
4.1.1 Compressive strength:

Type of mix	Concrete class (N/mm^2)	Age of curing (days)	Average compressive strength (N/mm^2)
Normal mix (Control)	25	14	27.5
		28	31.5
		56	35.41
Mix 1 (5% replacement)	25	14	27.0
		28	31
		56	34
Mix 2 (10% replacement)	25	14	27.10
		28	31.20
		56	34.40
Mix 3 (15% replacement)	25	14	27.20
		28	31.25
		56	34.70
Mix 4 (20% replacement)	25	14	27.40
		28	31.25
		56	34.80
Mix 5 (25% replacement)	25	14	27.80
		28	31
		56	34.5



4.1.2 Tensile Strength

Type of mix	Concrete class (N/mm^2)	Age of curing (days)	Average tensile strength (N/mm^2)
Normal mix (Control)	25	28	3.5
		56	5.5
Mix 1	25	28	3.4
		56	5.4
Mix 2 (10% replacement)	25	28	3.41
		56	5.42
Mix 3 (15% replacement)	25	28	3.37
		56	5.47
Mix 4 (20% replacement)	25	28	3.48
		56	5.44
Mix 5 (25% replacement)	25	28	3.46
		56	5.49



5. CONCLUSION

In the present work, clay waste products were used as coarse aggregates and the properties of resultant mix was studied and compared with the control mix having normal aggregates. The use of well Clean, crushed clay waste products provided good aggregate which can be used to produce a medium high strength concrete on replacing 25% of the aggregate by clay waste products the compressive strength found up to 35.5N/mm^2. Compressive strength for blended aggregates ranging from 95% to 100% of concrete made with normal aggregate can be achieved. This significant strength is attributed to the particle shape and roughness of the clay aggregates which provides satisfactory bond strength.

The use of these aggregates can offer benefits associated with both economy and sustainability.

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