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Experimental Study on Replacement of Fine Aggregate by Quarry Waste and Partial Replacement of Cement by Artificial Pozzolans.

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ABSTRACT

Sand is one of the constituents used in the production of concrete. Become expensive and also a scarce materials. In view of this there is a need to identify suitable alternative material waste in place of river sand. The utilization of quarry dust which is a waste material has been accepted as building materials in many countries for the past three decades. Recycling involves processing used materials into new products in order to control the waste of potentially useful materials, reduce the consumption of fresh raw materials. Reduce energy usage, reduce air and water pollution for waste disposal. Concrete traditionally consist of cement, fine aggregate, coarse aggregate and water. The use of pozzolanic materials is as old as that of art of concrete construction. That the suitable pozzolans used in the appropriate amount, modify the certain property of fresh and hardened mortars and concrete. Specimens of concrete made by lime and volcanic ash from mount Vesuvius were used in the construction of Caligula wharf build in the time of Julius Caesar nearly 2000 years ago is now existing if a fairly good condition. A number of structures stand today as evidence of the superiority of pozzolanic cement over lime.

Key words:

Pozzolanic Admixtures, Quar Dust, hardened mortars and concrete.

1. INTRODUCTION

In a construction industry a concrete play a very important role. It is widely used due to its workability, durability, versatility and low cost. Now a day's demand of natural sand in the field of construction is increasing day by day due to extensive use of concrete. The developing country like India facing storage of good quality of natural sand and particularly in India, natural sand deposits are being used up and causing serious threat to environment as well as the society. Pozzolanic materials are siliceous and aluminous materials, which in themselves possess little or no cementations value, but will in finely divided form and in the presence of moisture, chemically react with calcium hydroxide liberated on hydration, at ordinary temperature, to form compounds, possessing cementitious properties. Generally amorphous silicate reacts much more rapidly than the crystalline form. It is pointed out that cementitious materials by the reaction of pozzolanic materials. C-S-H (gel) is pozzolanic reaction. The pozzolanic reaction is initially slow the reduction of $Ca(OH)_2$ improves the durability of cement paste by making the paste dense and impervious. The use of pozzolanic materials used in concrete as to improve the strength and durability and workability of pozzolanic concrete.

2. MATERIALS USED

2.1 Quarry Dust

Quarry waste is a very fine rock particle. It is found when boulders are broken in to small pieces quarry waste is formed. In a concrete production it could be used as a partial or full replacement of natural river sand. The applications of quarry dust in construction industry are, building materials, plastering, road construction and foundation engineering.

Table 1: physical properties of quarry waste

Property	Quarry Rock Dust%
Specific gravity	2.60
Bulk relative density	170
Absorption	1.29
Moisture content	Nil
Fine particles	14
Sieve analysis	Zone III

Table 2: Chemical properties of quarry waste

constitutions	Quarry Rock Dust%
SiO_2	62.48
Al_2O_3	18.72
Fe_2O_3	6.54
Cao	4.83
Mgo	2.56
Na_2o	NIL
K_2o	3.18
Tio_2	1.21
Loss of ignition	0.48

2.1 Coarse Aggregate

Aggregate are the important constitutions in concrete. They give body to the concrete, reduce the shrinkage and effect economy. To know more about the concrete it is very essential that one should know more about the aggregate which constitute major volume of concrete. Without the study of the aggregate in depth and range. Almost all natural aggregate materials originated from bed rocks. The largest maximum size of the aggregate practicable to handle under the given set of condition to be used. Perhaps 80mm size is the maximum size that could be convenient making. The shape of aggregate is an important characteristic since it affects the workability of concrete. For this project 20mm size of aggregates are used.

2.2 Cement

The cementing material is as old as the history of engineering construction. The cements to give bonding to the concrete 43 grade of cement used in this project.

2.3 Artificial pozzolans

2.3.1 Fly ash

Fly ash is finely divided residue resulting from the combustion of powered coal and transported by the flue gases and collected by electrostatic precipitator. Fly ash is the most widely used pozzolanic material all over the world likely as a gray color. In the recent time the importance and use of fly ash in concrete has grown so much that it has almost become a common ingredients in concrete. Particularly for making high strength and high performance concrete. In India total production of fly ash is more than 100 million tons. But our country utilization of fly ash is only about 20% of production.

Class F: Class F fly ash normally produced by burning anthracite or bituminous coal. Class F fly ash has pozzolanic properties only.

Class C: Class C fly ash normally produced by burning lignite or sub bituminous coal. Class F fly ash has pozzolanic properties and also a cementitious property.

In this research we use class C fly ash.

2.3.2 Metakaolin

Metakaolin is a white pozzolanic additive made by heating kaolin clay, also known as china clay. Metakaolin is used as supplementary cementitious materials in concrete, replacing 8-20% of Portland cement by weight. This is can lead to a concrete to improved strength, density, and durability. it is also help a ASR reaction (alkali silica reaction).

3. EXPERIMENTAL PROGRAMME

3.1 Workability of concrete

Concrete workability is the ease with which fresh concrete can mix with the percentage mixed. And placed in to the slump cone, compacted without losing its homogeneity ensuring a high quality structurally sound outcome with a good surface finish. The true slump value can measure by a slump rod. Also measured compaction factor and flow value.

Fig-1: slump cone

3.2 compressive strength test

The freshly mixed concrete was filled the mould of size 150x150x150mm then concrete kept for curing. Test for hardened cube was carried out in 7 days and 28 days. Using compression testing machine the sample of cubes was kept between the hardened steel bearing plates on a compression and load was applied and measure a load also draw a graph.

Fig-2: concrete cube

Fig-3: finding compression strength by compression testing machine

4. PREPARATION OF CONCRETE MIXES

Replacement of fine aggregate and partial replace of artificial pozzolanic materials (fly ash + Meta kaolin) can done by following ways

Table 3: Mix Proportion

S NO	MIXES	PROPRTIONS
1	MIX - 1	5% Of Quarry Waste & 5% Of Fly Ash , Metakaolin
2	MIX - 2	10% Of Quarry Waste & 10% Of Fly Ash , Metakaolin
3	MIX - 3	20% Of Quarry Waste & 20% Of Fly Ash , Metakaolin
4	MIX- 4	25% Of Quarry Waste & 25% Of Fly Ash , Metakaolin
5	MIX- 5	30% Of Quarry Waste & 30% Of Fly Ash , Metakaolin

5. RESULTS AND GRAPHS

5.1 compressive strength test results

Table 4: compressive strength in Mpa.

Quarry waste : fly ash: meta kaolin	7 days	28 days
5%	13.50	17.80
10%	15.80	20.30
20%	16.55	22.35
25%	17.60	22.76
30%	19.10	24.65

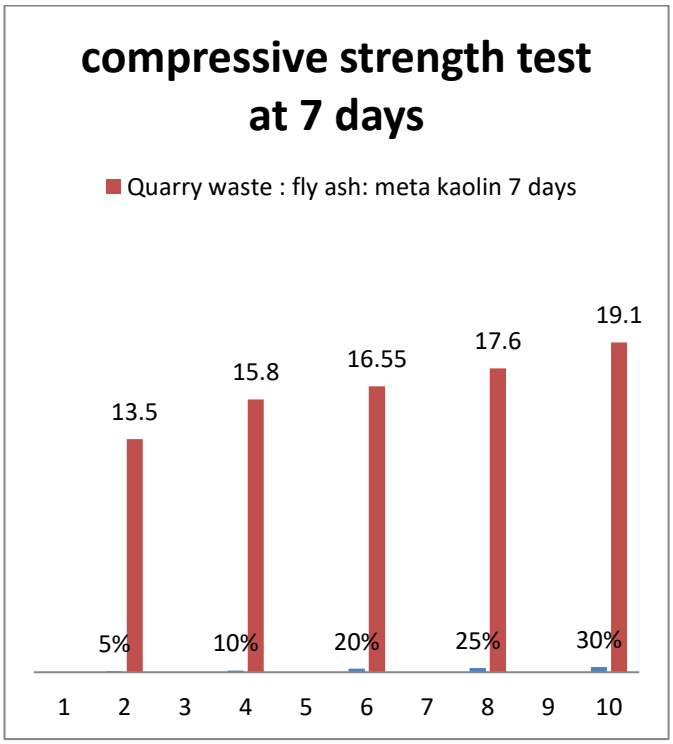

Fig-4: compressive strength test chart at 7 days

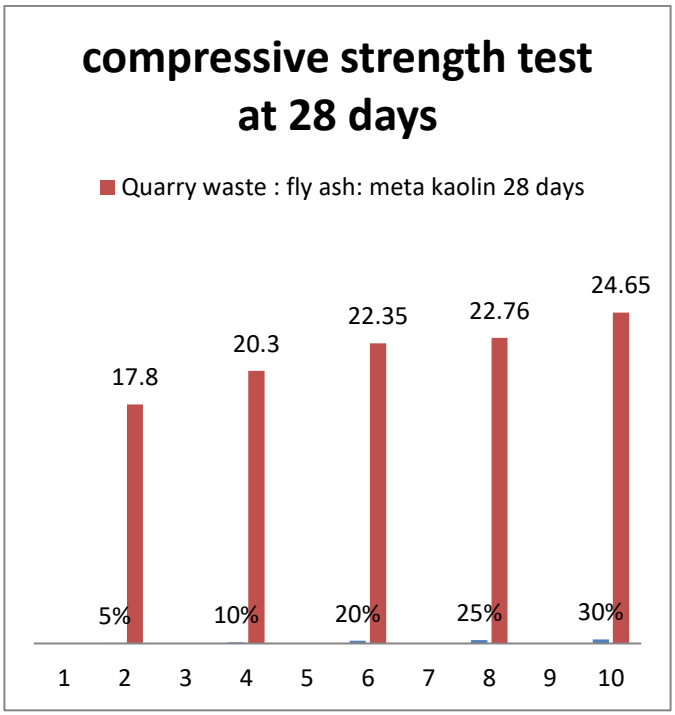

Fig-5: compressive strength test chart at 28 days

5.2 Split tensile strength test results

Table 5: Split tensile strength in Mpa.

Quarry waste : fly ash: meta kaolin	7 days	28 days
5%	1.53	2.42
10%	1.60	2.49
20%	1.64	2.65
25%	1.80	2.76
30%	1.96	2.98

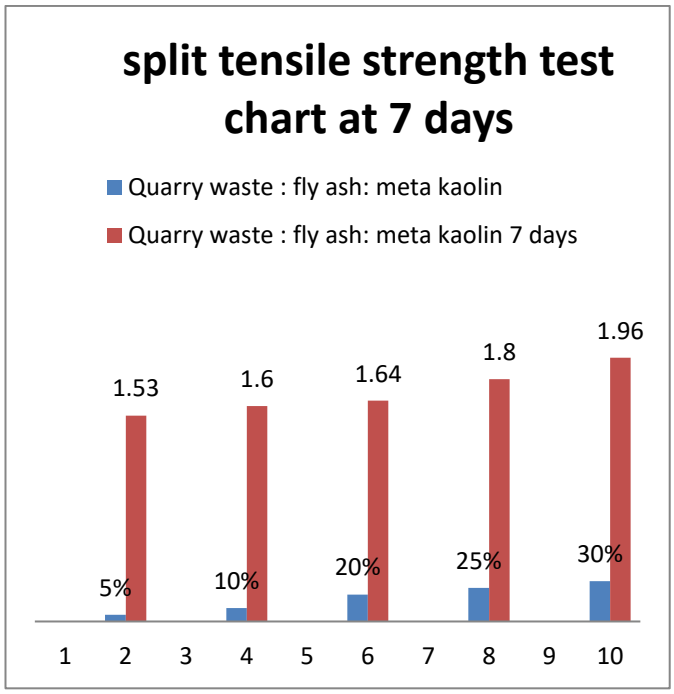

Fig-6: split tensile strength test chart at 7 days

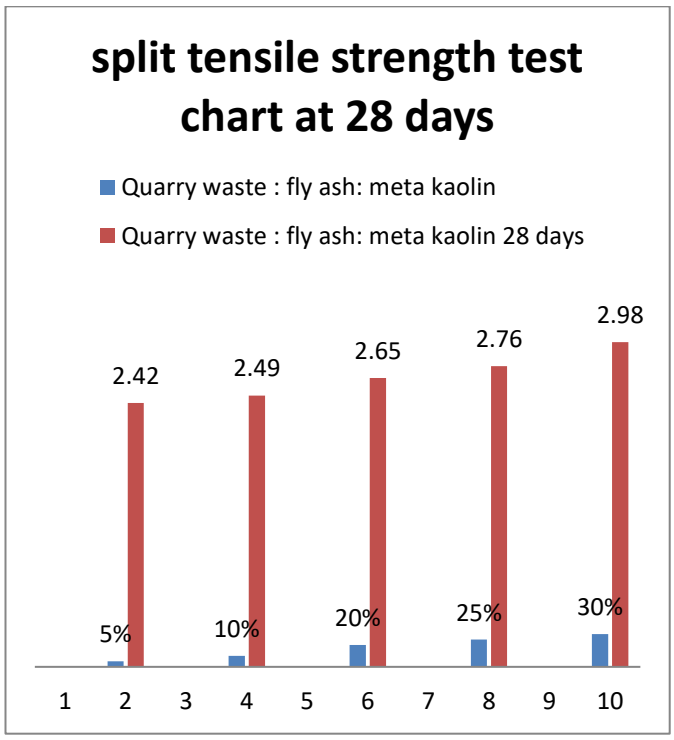

Fig-7: split tensile strength test chart at 28 days

6. RESULTS AND DISCUSSIONS

According to the results and conclusion the following results were founded

1. In this analysis we found replacement of quarry waste as a fine aggregate and partial replacement of artificial minerals relatively good as compared as river sand.
2. The compressive strength will accordingly increases with the percentages mixed at 30%.
3. Also a split tensile strength was increased 30% mixed with replacement of artificial minerals.
4. In the presence of fly ash, quarry dust can be suitable for the replacement of materials produce concretes with good ranges of compressive and split tensile strength.
5. In this analysis when compared the nominal mix to replacement mix it was slightly more strength to the concrete.
6. Artificial admixtures are the best to replacement in the concrete.

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