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Experimental Study on Strength Properties of Metacolin Concrete

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Abstract:

Concrete is the most versatile material due to the persistent and continuous demands made on concrete, Engineers are continually pushing the limits to improve its performance. Since concrete is a composite material made from cement, Fine aggregate , Coarse aggregate but present researches are interest of finding new cement material by waste material or waste products produced from industries which are harmful to environment. Partial replacement of cement is carried out with Metakaolin which are having silica used as admixture for making concrete,. Cement replaced with beneficial value of Metakaolin as constant, 2.5%, 5.0%, 7.5%, 10.0%, 12.5% Metakaolin was made in partial replacement of cement and results were calculated that Metakaolin usage in partial replacement to cement can be made.

Introduction:

The cost of concrete made up of the cost of materials plant and labour the variation in the cost of material arise from the fact that the cement is several times costly than the aggregates thus the aim is to produce a mix as possible from the technical point of view the rich mixes may lead to high shrinkage and cracking in the structural concrete and to evolution of high heat of hydration is mass concrete which may cause cracking. The actual cost of concrete is related to cost of materials required for producing a minimum mean strength called characteristic Strength that is specified by designer of the structures. Metakaolin is refined kaolin clay that is fired (calcined) under carefully controlled conditions to create an amorphous alumina silicate that is reactive in concrete. Like other pozzolans (flyash and silica fume are two common pozzolans), metakaolin reacts with the calcium hydroxide (lime) by products produced during cement hydration.Calcium hydroxide accounts for up to 25% of the hydrated Portland cement, and calcium hydroxide does not contribute to the concrete strength or durability. Metakaolin combines with the calcium hydroxide to produce additional cementing compounds, the material responsible for holding concrete together. Less calcium hydroxide and more cementing compounds means stronger concrete.

Physical Properties of Metakaolin:

Properties	Value
Density (gm/cm^3)	2.17
Bulk density (gm/ cm^3)	1.26
Particle shape	Spherical
Colour	White
Specific gravity	2.7

Chemical composition of Metakaolin:

Constituents	Values
Silica	53%
Alumina	43%
Iron oxide	0.5%
Sulphate	0.1%
Calcium oxide	0.1%
Sodium oxide	0.05%
Potassium oxide	0.4%

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MIX DESIGN

NOMINAL MIX DESIGN

Mix proportion
For M30=1:1.64:2.45
Cement=21.864Kg
Fine aggregate=35.85Kg
Coarse aggregate=53.56Kg
W/c ratio=8.736liters

M30 WITH 25% QUARRY DUST

Cement: 20.92kg
Quarry dust: 5.228kg
Fine aggregate: 36.32kg
Coarse aggregate: 54.05kg
Water: 8.356lit

M30 WITH 25% QUARRY DUST AND 2.5% OF METAKAOLIN

Mix proportions are
Cement: 14.55kg
Quarry dust: 5.01kg
Metakaolin: 0.5016kg
Fine aggregate: 36.681kg
Coarse aggregate: 54.55kg
Water cement ratio: 8.026lit

M30 WITH 25% QUARRY DUST AND 5% METAKAOLIN

Mix proportions are
Cement: 13.75kg
Quarry dust: 4.913kg
Metakaolin: 0.9826kg
Fine aggregate: 36.65kg
Coarse aggregate: 54.798kg
Water cement ratio: 7.8612lit

M30 WITH 25% QUARRY DUST AND 7.5% OF METAKAOLIN

Mix proportions are
Cement: 12.95kg
Quarry dust: 4.799kg
Metakaolin: 1.43965kg
Fine aggregate: 37.0265kg
Coarse aggregate: 55.057kg
Water cement ratio: 7.6784lit

M30 WITH 25% QUARRY DUST AND METAKAOLIN OF 10%

Mix proportions are
Cement: 12.1951kg
Quarry dust: 4.688kg
Metakaolin: 1.8759kg
Fine aggregate: 37.206kg
Coarse aggregate: 55.3498kg
Water cement ratio: 7.4948lit

M30 with 25% quarry dust and metakaolin of 12.5%

Mix proportions are
Cement: 11.4127kg
Quarry dust: 4.565kg
Metakaolin: 2.2825kg
Fine aggregate: 37.376kg
Coarse aggregate: 55.6531kg
Water cement ratio: 7.304lit

CASTING AND TESTING DETAILS:

9 cubes, 9 cylinders conforming to IS: 516-1964 are casted After 24 hours the moulds were demoulded and subjected to water curing. Before testing the cubes were air dried for 2 hours. Crushing loads, split tensile strength, flexural strength were noted and average of 3 specimens was determined at 7days and 21days, 28days.

TEST RESULTS

No.of days(n)	Compressive strength (N/mm^2)						
	Normal M30	M_{30}+30% quarry dust (QD)	M_{30} +30% (QD)+2.5% metakaolin	M_{30}+30% (QD)+5% metakaolin	M_{30} +30% (QD)+7.5% metakaolin	M_{30} +30% (QD)+10% metakaolin	M_{30} +30% (QD)+12.5% metakaolin
7 days	21	28	31.7	33.5	35.2	36.7	27
14 days	26	33.4	47.2	43.2	46.2	47.2	32
28 days	32	37.4	43.5	41.2	42.2	43.4	36

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CONCLUSION:

Compare with nominal concrete (M30) with adding of quarry dust the concrete is give more strength. In the concrete the replacement of cement with quarry dust with 25% of cement is give good result, like the cement was replaced with 25% quarry dust and 5% metakaolin and tested in laboratory. The quarry dust percentage was constant (25%) and the metakaolin was increing like 2.5%, 5%,7.5%,10%,12.5% . From the mix like quarry dust with 25% and metakaolin was at 12.5% was the streangth was going to decrease. Nominal concrete (M30) with adding of quarry dust the concrete is give more strength. In the concrete the replacement of cement with quarry dust with 30% of cement is give good result, like the cement was replaced with 30% quarry dust and 5% metakaolin and tested in laboratory. The quarry dust percentage was constant (25%) and the metakaolin was increing like 2.5%, 5%,7.5%,10%,12.5% . From the mix like quarry dust with 25% and metakaolin was at 12.5% was the streangth was going to decrease. Compare with The nominal concrete mix, quarry dust25% and 30% replacement with cement with constantly changeing the metakaolin the 25% of quarry dust is got good strength for 28 days.

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