

# An Experimental Study on Partial Replacement of Cement with Kota Stone Slurry Powder and Coal Ash in High Performance Concrete

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**ABSTRACT:** Recent advances in the concrete technology are aiding in minimizing the use of conventional materials by substituting by-products of various industries and energy sources. A large amount of stone waste i.e., dust and slurry form both are being originated during natural stone processing and causing deadly effects on the environment. The disposal problem of stone waste can be resolved effectively by using waste in construction industries. In this paper present Kota stone slurry powder, as a substitution of cement was used along with Coal ash as additives, to study their impact on various properties of the concrete mixtures.

**Keywords:** Kota Stone Slurry Powder, Coal Ash, Concrete, Cement.

## I. INTRODUCTION

Cement is a blend of concrete, sand, coarse total and water. Assess the presentation of cement containing strengthening cementations materials such smaller scale fine GGBS. Bond supplanted with Mineral admixtures can recoup the quality and toughness of cement. The test for structural designing network to improve the properties of concrete and cement has eco-accommodating condition.

## II. AGGREGATES

Here two type aggregates, first coarse aggregate (size more than 4.75mm) and second fine aggregate (size less than 4.75mm).Aggregate give the strength and durability for the structure. Aggregates are pure brittle material.

- A. Coarse Aggregate
- B. Fine Aggregate

### A. Coarse Aggregate

It is the total the greater part of which is held on 4.75 mm IS strainer and contains just so a lot better material as is allowed by detail.

As per estimate coarse total is depicted as reviewed total of its ostensible size for example 40 mm, 20 mm, 16 mm and 12.5 and 10 mm and so on for instance a reviewed total of ostensible size 20 mm methods a total the vast majority of which passes 20 mm IS sifter.



Fig 1: Coarse Aggregate(10mm & 20mm)

Table 1: Properties of Coarse Aggregate 10mm &20mm

Properties	Coarse Aggregate	
	10mm	20mm
Density (SSD)	1478 kg/m <sup>3</sup>	1560 kg/m <sup>3</sup>
Sp. Gravity (SSD)	2.65	2.65
Water Absorption	0.46%	0.46%

### B. Fine Aggregate

It is the total the greater part of which passes 4.75 mm IS sifter and contains just such a great amount of coarser as is allowed by determination. As indicated by source fine total might be depicted as: According to measure the fine total might be portrayed as coarse sand, medium sand and fine sand. IS details characterize the fine total into four sorts as indicated by its evaluating as fine total of reviewing Zone-1 to evaluating Zone-4. These evaluating zone named per percentage passing material from different sifters and there are predominantly four zones and they all have distinctive passing rate



Fig 2 : Fine Aggregate (Natural Sand)

The fine aggregate is taken from Banas, Tonk, Rajasthan and designated IS- Sieve for the material passing through Zone-II is found.

**Table 2: Properties of Fine Aggregate**

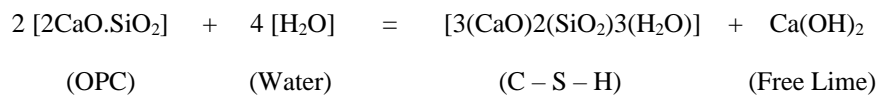
Properties	Natural fine aggregate
Density (SSD)	1675 kg/m <sup>3</sup>
Sp. Gravity (SSD)	2.65
Water Absorption	1.15

### III. CEMENT

A concrete is a cover, a substance that sets and solidifies and can tie different materials together. Cements utilized in development can be portrayed as being either pressure driven or non-pressure driven, contingent on the capacity of the bond to be utilized within the sight of water. In development work bond assume significant job in cement and Portland pozzolana concrete is progressively utilized now daily's contrasted with the Ordinary Portland bond since it has eco-accommodating on its utility 25% Coal-ash.

PPC is very much contrasted with OPC in light of the fact that during of hydration in OPC it produces calcium silicate hydrate and free calcium hydroxide however PPC isn't creates free calcium hydroxide on the grounds that PPC has Marble slurry in bond it respond calcium hydroxide and produces calcium silicate hydrate. Calcium silicate hydrate gives quality and sturdiness and makes eco-accommodating.

Synthetic response of OPC and PPC in OPC



**Table 3: Properties of Cement (OPC 43 grade)**

Chemical Composition	Value
CaO	62%-67%
SiO <sub>2</sub>	17% - 25%
Al <sub>2</sub> O <sub>3</sub>	3% - 8%
Fe <sub>2</sub> O <sub>3</sub>	3%-4%
MgO	0.1%-3%
SO <sub>3</sub>	1%-3%
Na <sub>2</sub> O	0%-0.5%
Gypsum (CaSO <sub>4</sub> ·2H <sub>2</sub> O)	2.5%
Specific Gravity	3.15



Fig 3: OPC 43-Grade (Cement)

#### IV. COAL ASH

Coal ash conforming to IS: 3812-2003 is a fine inorganic material with pozzolanic properties, which can be added to improve the properties of self-compacting concrete.

Table 4: Physical and Chemical Properties of Coal ash

Properties	Range
	Coal ash
SiO <sub>2</sub>	53.39%
Al <sub>2</sub> O <sub>3</sub>	16.07%
Fe <sub>2</sub> O <sub>3</sub>	13.05%
CaO	6.33%
MgO	5.48%
Na <sub>2</sub> O	0.7%
K <sub>2</sub> O	0.7%
SO <sub>3</sub>	0.5%

#### V. KOTA STONE SLURRY POWDER

Rajasthan is driving maker of dimensional stone contributing about 90% of nation's absolute Marble, Sandstone and Kota stone generation . Mining and cleaning of dimensional stones produce huge amounts of waste and fine residue, which makes a genuine ecological issue .this stone waste is indestructible and destructive to normal man , creatures and vegetation, making feel issues. Kota stone asis better known in structure stone wording, is essentially , a calcareous sedimentary shake accessible in number of hues and surface . Present degree of Kota stone creation is around 80 lakh MT for each annum and ensuing to its mining and handling a fine residue waste to the tune of 12 lakh MT is produced each year, out of which around 4-5 lakh MT of residue is arranged to mined out territory and rest all the waste is released into helpful spots, as close-by water streams, horticulture land, government field land, timberland land, street side and so forth.

**Table 5 : Chemical Properties of Kota Stone Slurry Powder**

Properties	Range
	Kota Stone Slurry Powder
SiO <sub>2</sub>	24.90%
Al <sub>2</sub> O <sub>3</sub>	1.37%
Fe <sub>2</sub> O <sub>3</sub>	0.86%
CaO	37.30%
MgO	4.13%
Na <sub>2</sub> O	1.21%
K <sub>2</sub> O	0.40%

**Table 6 : Physical Properties of Kota Stone Slurry Powder**

Properties	Range
Specific Gravity	2.58-2.65
Bulk Density	1568-1743 kg/m <sup>3</sup>
Water absorption	2.4%
Maximum particle size	0.2mm
Fineness module	3900-4123 cm <sup>3</sup> /gm
Colour	White

## VI. PROPORTION OF COAL ASH AND KOTA STONE SLURRY POWDER WITH CONTROL MIX

In this blend of control mix, the variations had been made with cement. Replace few percentage of cement with Coal ash and Kota stone slurry powder which varies from (Coal ash 0% to 10% at interval of 2.5%) and (Kota stone 5% to 20 % at interval of 5%) for both concrete mixes of M45 & M50.

**Table 7 : Replacement of OPC by Coal Ash & Kota Stone Slurry Powder for M45**

S. No	Mix Name	Cement (Kg)	Kota stone slurry powder (kg)	Coal ash (Kg)	Coarse Aggregate (Kg)		Fine Aggregate (Kg)	Water (Kg)	Admixture (Kg)
					20mm	10mm			
1	OPC+ Kota stone slurry powder + Coal ash (100+0+0)	479.9	0.00	0.00	680.1	400	722	168	3.844
2	OPC+ Kota stone slurry powder + Coal ash (92.5+5+2.5)	443.9	23.99	11.99	680.1	400	722	168	3.844
3	OPC+ Kota stone slurry powder+ Coal ash (85+10+5)	407.91	47.99	23.9	680.1	400	722	168	3.844
4	OPC+ Kota stone slurry powder + Coal ash (77.5+15+7.5)	371.92	71.98	35.99	680.1	400	722	168	3.844

5	OPC+ Kota stone slurry powder + Coal ash (70+20+10)	335.93	95.98	47.99	680.1	400	722	168	3.844
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**Table 8 : Replacement of OPC by Coal ash & Kota stone slurry powder for M50**

S. N O	Mix Name	Cement (Kg)	Kota stone slurry powder (kg)	Coal ash(Kg)	Coarse Aggregate(Kg)		Fine Aggregate (Kg)	Water (Kg)	Admixture (Kg)
					20mm	10mm			
1	OPC+ Kota stone slurry powder + Coal ash (100+0+0)	525.2	0.00	0.00	665.8	391.1	706	168	4.21
2	OPC+ Kota stone slurry powder + Coal ash (92.5+5+2.5)	485.81	26.26	13.13	665.8	391.1	706	168	4.21
3	OPC+ Kota stone slurry powder + Coal ash (85+10+5)	446.42	52.52	26.26	665.8	391.1	706	168	4.21
4	OPC+ Kota stone slurry powder + Coal ash (77.5+15+7.5)	407.03	78.78	39.39	665.8	391.1	706	168	4.21
5	OPC+ Kota stone slurry powder + Coal ash (70+20+10)	367.64	105.04	52.52	665.8	391.1	706	168	4.21

## VII. CONCLUSION

This examination is for assessing, mineral admixture, such as , Coal ash and Kota stone slurry powder , influence in solid when it is blended in bond concrete for usefulness, solidness and quality of solid utilizing OPC (43 grade). Coal ash is strengthening cementations material and Kota stone slurry is pozzolanic materials that can be used to make profoundly sturdy solid composites. A large amount of stone waste i.e., dust and slurry form both are being originated during natural stone processing and causing deadly effects on the environment. The disposal problem of stone waste can be resolved effectively by using waste in construction industries. In this paper presented the Kota stone slurry powder, as a substitution of cement was used along with Coal ash as additives, to study their impact on various properties of the concrete mixtures.

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