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EXPERIMENTAL STUDIES ON CONCRETE CONTAINING CEMENT KILN DUST AND FLY ASH

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ABSTRACT

India is a country which uses tonnes of cement in production of concrete and it generally emits carbon di-oxide on hydration as the process is exothermic in nature. The use of fly ash which is a residue obtained from combustion of coal is used to reduce this environmental impact. Kiln dust is a waste material obtained from the manufacture of cement and it has similar fineness as of cement and reduces the heat of hydration. In this paper a detailed experimental study is carried on various compositions of fly ash and Cement Kiln dust. The most important mechanical property of concrete is compressive strength and it is evaluated on 100X100X100 mm cubes by both destructive testing and non destructive tests such as Ultra sonic pulse velocity. The compressive strength is obtained for 28 day strength and results are analysed.

Keywords: cement kiln dust, fly ash, Ultra sonic pulse velocity.

1. INTRODUCTION

But considering the use of cement on the environmental impact and their production cost, it is required to reduce its usage in the concrete. Hence cement replacement materials are required to attain better concrete properties and at the same time, the use of cement replacement material should be better economically viable. There are many minerals admixtures like fly ash,silica fume, slag, rice husk ash, metakaolin, bentonite slag which are used as cement replaced material and studies have proven their positive impact on the properties of the concrete with few drawbacks.

This paper presents the impact of CKD as a cement replacement material on the properties of concrete. Cement Kiln Dust is a by-product obtained during manufacturing of cement, which shall be replaced with cement in the concrete.CKD is generally reused in the production of cement. However the quantity of CKD reused is less due to the impurities present in it which restrict its reusability in the production of cement. Hence CKD is mostly land filled for disposal which causes considerable economic losses to the cement plant in terms of cost of processing and disposal. By effectively using this waste material without affecting the properties of the concrete, the environmental impact and the cost for the production of the concrete is reduced.

However the usage of CKD is limited due to the presence of free lime and raw feed mineral which is not effective producing better strength. Also usage of CKD hasnegative effective on the durability due to the presence of alkalis, sulphates and chloride which causes alkalis-aggregate reaction. There is considerable strength reduction by usage of CKD in the concrete, thus restricting its replacement to cement by 10%. The durability properties can be enhanced by using pozzolanic minerals admixtures. In this study fly ash is also introduced in the concrete to enhance the durability

of concrete and the mechanical properties are not much affected with replacement of 30%.

2. EXPERIMENTAL PROGRAM

Materials Used: The various material used in the preparation of concrete are sand, cement coarse aggregates, fly ash,CKD and water.

Cement: Ordinary Portland Cement (53 Grade). – The brand name zuari which is available in market is used.

Fine Aggregate: The natural river sand available in local market is used conforming to Zone II.

Coarse Aggregate: Crushed granite conforming to IS 383 – 1987 was used in this study. Coarse aggregate passing through 20mm and retained on 16 mm sieve was used.

Water: Water is an important ingredient of concrete as it actively participated in chemical reaction with cement, clean portable water which is available in our college campus is used.

Mix Proportion: The mixture proportion for the controlled concrete of M30 grade was arrived from the trial mix as per IS 10262-2009.

Table1. M30 Mix Proportion

Cement	425.733 kg/m^3
Fine Aggregate	6657.82 kg/m^3
Coarse Aggregate	1152.57 kg/m^3
Water Content	191.5 lit/m^3

Test specimens: The ingredient of the concrete mixtures were mixed and cast into moulds. After 24 hrs, the samples were remoulded and cured in water. For compressive strength and ultra sonic pulse velocity 10cm size moulds were used.

Compressive strength: Compression test conducted on hardened concrete using a compression testing machine of 2000 KN capacity available in structures lab. The compressive strength of result at the age 28 days.

Ultra sonic pulse velocity: In this method ultrasonic pulse is produced by transducer which is held in contact with one surface of concrete member after travelling to known path in concrete the vibration is converted to an electric signal by transducer held in contact with other surface of concrete member and at electronic circuit enable the transducer to transmit time of pulse to be measured.

3. RESULT AND DISCUSSION

Ultra Sonic Pulse Velocity

The quality of the concrete is determined by the use of non destructive machine such as UPV at the age of 14-days and 28-days.The determined vaules are given in the table2

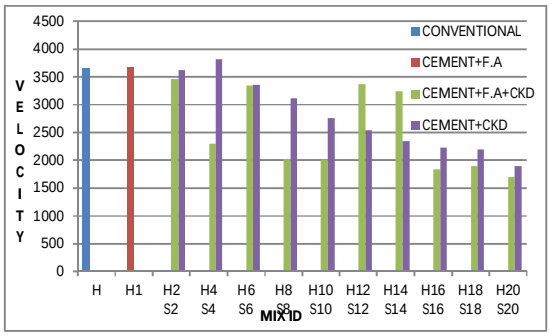

Figure 1 shows the UPV result at the age of 14-days

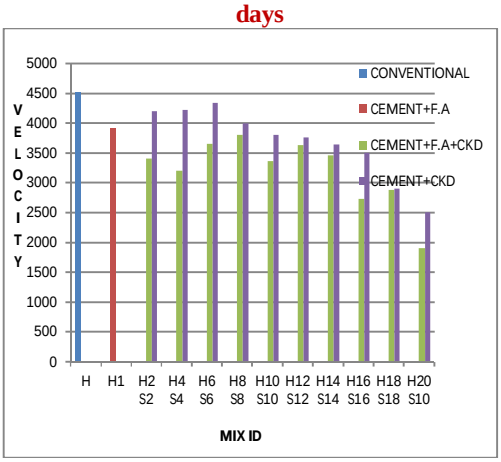

Figure 2 shows the UPV result at the age of 28-days

Compressive Strength

Compressive strength of concrete mixes made different with the combination of determined at 28days. The compressive strength by different types of concrete mix with respect to their compressive strength at the age of a 28-days varies. The compressive strength of concrete gains maximum strength at early age was observed for conventional and other mixes.

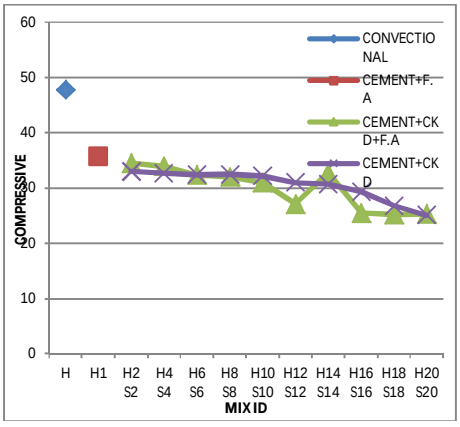

Figure 3 show the compressive strength at the age of 28-days

Table 2 for UPV and Compressive Strength

S.No	Mix proportion	Mix Id	Velocity		Compressive Strength
			14 Days	28 Days	
1	Cement 100%	H	3650	4510	47.8
2	Cement70%+F.A30%	H1	3670	3915	35.76
3	Cement 68%+F.A 30%+CKD 2%	H2	3465	3410	34.77
4	Cement 66%+F.A 30%+CKD 4%	H4	2295	3200	33.93
5	Cement 64%+ F.A 30%+CKD 6%	H6	3350	3650	32.4
6	Cement 62%+F.A 30%+CKD 8%	H8	2030	3800	32.03
7	Cement 60%+F.A 30%+CKD 10%	H10	2020	3370	31
8	Cement 58%+F.A 30%+CKD 12%	H12	3370	3625	27.13
9	Cement 56%+F.A 30%+CKD 14%	H14	3235	3455	32.8
10	Cement 54%+F.A 30%+CKD 16%	H16	1840	2730	25.53
11	Cement 52%+F.A 30%+CKD 18%	H18	1900	2880	25.23
12	Cement 50%+F.A 30%+CKD 20%	H20	1700	1990	25.37
13	Cement 98%+CKD 2%	S2	3625	4205	33
14	Cement 96%+CKD 4%	S4	3820	4220	32.7
15	Cement94%+ CKD 6%	S6	3355	4330	32.4
16	Cement 92%+CKD 8%	S8	3120	3995	32.46
17	Cement 90%+CKD10%	S10	2760	3800	32.23
18	Cement 88%+CKD 12%	S12	2543	3760	31
19	Cement86%+ CKD 14%	S14	2342	3640	30.76
20	Cement84%+ CKD 16%	S16	2234	3500	29.33
21	Cement82%+ CKD 18%	S18	2200	2900	26.83
22	Cement80%+ CKD 20%	S20	1900	2500	25.1

4. CONCLUSION

1. From the UPV test results it is observed that the integrity of the concrete is found good for all the mix.

2. Hence the addition of CKD and Fly ash does not affect the integrity of the concrete to a greater extent.

3. From the compressive strength test results, it is found that the higher strength is observed for the conventional concrete.

4. There is strength reduction with the addition of CKD due to the impurities present in CKD like free lime and raw feed minerals.

5. However the strength attained with the mix with CKD complies with the target strength up to a replacement of 10%

6. When the CKD addition is greater than 10%, the strength produced by the concrete gets reduced than the target strength.

7. The durability properties of the concrete with CKD is compensated by the addition of fly ash and it is also found that the compressive strength is unaltered by incorporating fly ash by 30%.

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