EXPERIMENTAL INVESTIGATION ON THE EFFECT OF AIR ENTRAINED ADMIXTURES IN M40 GRADE CONCRETE

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ABSTRACT

The Present paper highlights on the strength, durability, and density of air entrained concrete using admixtures. The main objective is to produce high- density concrete with a normal grade of concrete. For this reason, the air entrained admixture is used in the concrete preparation i.e. MICR 720. The dosage of admixtures chosen in the concrete mixing as 0.2%, 0.4%, 0.6%, 0.8%, 1% by the weight of cement. By the addition of air into the concrete, Workability has been increased and density of the concrete decreased. MICR 720 is one such air entrained agent to increase the workability by not reducing the compressive strength. It improves the freeze-thaw resistance of concrete. Using the result of this study we have proposed a mix design of M 25 air entrained concrete.

KEYWORDS – *MICR720, Durability, Density, Air entraining agent, Workability.*

1. INTRODUCTION

Air-entrained concrete is produced by the institution of air-entraining agents. Air bubbles provide durability for the concrete. Due to air entrainment, the amount of water is decreased to a get higher grade of concrete without affecting workability. Drying shrinkage of concrete can be reduced. Bleeding of concrete is minimized to half by entrained air. Air also produces stickier, more cohesive concrete; as a result, more attractive surfaces are achieved.

2. OBJECTIVES

- To study the effect of introduction of air entrained admixture into concrete mixes by varying doses in increments of 0.2%,0.4%,0.6%,0.8%,1.0%.
- The main objective is to compare its density and workability.
- Also to design M25 grade air entrained concrete

3. SCOPE

- This study is limited to the performance based only on Ordinary Portland Cement 53 grade.
- This study is confined to a single air entraining agent that is MICRO AIR 720 from BASF.
- The study is done for the introduction of air into concrete mixes and to know their performance increase in workability.

- The percentage of air entraining admixture is limited to five categories that 0.2%,0.4%,0.6%,0.8%, and 1.0%.
- Water- cement ratio of 0.4 is used in mortar mix.
- Designing M25 grade air entrained concrete from derived dosage from the above finding to reduced density.

4. METHODOLOGY

The following methodology is the study of air entrained concrete. Title confirmation was done and collection of material then proceeded. A Preliminary test for coarse and fine aggregate is done for 20 mm & 12.5 mm coarse aggregate and fine aggregate respectively. After that concrete mix design was calculated and casting of the specimen was done along with that fresh concrete test. Then air entrainment and density were compared and mix design of M25 air entrainment concrete was proposed.

5. MATERIALS

The materials used are
Portland cement [53 grade]
Fly ash
Coarse aggregate [20 mm and 12.5mm]
Crushed stone
Water

5.1. Cement:

Cement acts as an irrevocable agent for materials. Cement is a combination of calcareous, siliceous, aluminous substance and crushing the clinkers to sublime powder.

5.2. Coarse aggregate:

Concrete is made of many ingredients but is predominantly made up of materials known as the coarse sum. Coarse totally have a wide diversity of construction applications because they have similar standard rock particles, as opposed to a fine total which more closely reflects sand. Coarse totally are an integral part of many construction applications, sometimes used on their unique, such as a gritty base placed under a slab or pavement or as a component in a combination, such as asphalt mixtures.

5.3. Fly Ash:

Fly ash can significantly improve the workability of concrete. It is environment-friendly when compared with ordinary Portland cement.

Fig -1: Fly Ash

Table -1: Physical Properties of Fly Ash

Physical properties	Values obtained
Average particle size (µm)	6.92
Moisture (%)	3.14
Bulk density (g/cm^3)	0.994
Specific gravity	2.288
Colour	Whitish grey

[1] Journal of Nuclear and related technology vol 4. Special Edition 2007, 47-51

5.4. Crushed Stone Sand:

Crushed stone or angular rock is a form of construction aggregate, produced from an apt rock deposit and breaking the removed rock down to the desired size using crushers. The physical properties of crushed stone sand are given below.

Fig- 2: Crushed Stone Sand

Table -2: Physical Properties of Crushed Stone Sand

Physical Properties	Value obtained
Bulk density (kg/cm^3)	18.18
Bulking of sand (%)	4.91
Fineness Modulus	2.84
Specific gravity	2.71
Water absorption (%)	6.2

[2] International Journal of Enhanced Research (Vol. 3 issue June 2014, 119-121)

5.5. Water:

In cement, the water used for mixing concrete should be clean and appropriate for construction purpose, the water of pH uniform or greater than 7 and free from foreign material.

6. PRELIMINARY TEST RESULTS

Table -3: PRELIMINARY TEST RESULTS

S.no	TEST DONE	MATERIALS	RESULT
1	**Fineness Modulus**	Cement	1.2%
2	**Specific Gravity**	Cement	3.15
		20mm coarse aggregate	2.71
		12.5mm coarse aggregate	2.71
		Crushed Stone Sand	2.715
3	**Water Absorption**	20mm coarse aggregate	0.27%
		12.5mm coarse aggregate	0.45%
		Crushed Stone Sand	2.67%
4	**Standard Consistency**	Cement	32%
5	**Initial Setting Time**	Cement	30minutes
6	**Final Setting Time**	Cement	600minutes

7. MIX DESIGN

A mix M40 grade was designed as per IS 10262:2009 and the same was used to prepare the test samples. The design mix proportion is shown in below table.

Table -4: Total Quantity of Material for Casting

S.no	Description	For 1 m^3 kg	For cube kg
1.	Cement	350	12.25
2.	Fly ash	100	3.5
3.	20mm Coarse Aggregate	645	22.58
4.	12.5 mm Fine Aggregate	430	15.05
5.	Crushed Stone Sand	717	25.1
6.	Total water	202.83	7.1

8. SLUMP CONE TEST

Slump cone test is to determine the workability or consistency of the concrete mix. The slump cone test is easy; it consumes less money and time.

Fig -3: Slump cone test

Table -5: Slump Value Results

S.No	Concrete	SlumpValue (mm)	Types of Slump
1	Control Mix`	50	True
2	0.2 % Admixture	85	Shear
3	0.4 % Admixture	90	Shear
4	0.6 % Admixture	95	Shear
5	0.8 % Admixture	130	Shear
6	1.0 % Admixture	170	Collapse

9. CASTING OF SPECIMEN

The Cube specimens were prepared for the mix. For casting the concrete cube cast iron mould of size 150 x 150 x 150 mm standard cubes for compressive strength. The mould was oiled before casting of panels. They were poured into the mould by three layers. Each layer was compacted well by using the tamping rod. Then the excess concrete is removed with the trowel and the top surface is finished to smooth level.

Fig- 4: Casting of Specimen

10. CURING OF SPECIMEN

Curing plays an important role on strength and durability of concrete. It takes place instantly after concrete placing and finishing, and involves preservation of desired moisture and temperature state, both at depth and near the surface. Properly cured concrete reduces the freeze-thaw effect.

11. RESULTS AND DISCUSSIONS

11.1. RESULTS

Compression Test on Cube:

The test was conducted as per **IS 516-1959**. In **Compression Testing Machine (CTM)**.The cubes of standard size 150mm x 150mm x 150mm were used to find the compressive strength. The concrete cube was tested after the period of the 7th and 28th day of curing.

11.1.1. CONTROL MIX:

TABLE -6:
AVERAGE COMPRESSIVE STRENGTH OF CONTROL MIX FOR VARIOUS AGES OF DAYS

Age of Days	Weight [Kg]	Load [Kn]	Load [N/Mm^2]	Average [N/Mm^2]
7	8.16	718.4	31.93	31.47
	8.15	710.2	31.56	
	8.18	695.7	30.92	
28	8.19	983.2	43.70	43.93
	8.20	990.7	44.03	
	8.22	992	44.08	

11.1.2. 0.2 % ADMIXTURE OF MICR 720:

Admixture 0.2% = (12.5 + 3.5) x 2 = 15.75 x 2 = 31.5 g.

TABLE -7:
AVERAGE COMPRESSIVE STRENGTH OF 0.2% ADMIXTURE FOR VARIOUS AGES OF DAYS

Age of Days	Weight [Kg]	Load [Kn]	Load [N/Mm^2	Average [N/Mm^2]
7	7.73	404.9	18.00	18.41
	7.53	422.2	18.76	
	7.68	415.8	18.48	
28	7.68	594.7	26.43	26.56
	7.65	598.3	26.59	
	7.66	600	26.66	

11.1.3. 0.4 % ADMIXTURE OF MICR 720:

Admixture 0.4% = (12.5 + 3.5) x 4 = 15.75 x 4 = 63 g**.**

TABLE -8:
AVERAGE COMPRESSIVE STRENGTH OF 0.4% ADMIXTURE FOR VARIOUS AGES OF DAYS

Age of Days	Weight [Kg]	Load [Kn]	Load [N/Mm^2]	Average [N/Mm^2]
	7.38	338.7	15.05	
	7.36	319.9	14.22	

7	7.37	330.5	14.69	14.65
28	7.40	398.3	17.70	17.78
	7.42	400.5	17.80	
	7.44	402	17.86	

11.1.4. 0.6 % ADMIXTURE OF MICR 720:

Admixture 0.6% = (12.5 + 3.5) x 6 = 15.75 x 6 = 94.5g.

TABLE -9:

AVERAGE COMPRESSIVE STRENGTH OF 0.6% ADMIXTURE FOR VARIOUS AGES OF DAYS

Age of Days	Weight [Kg]	Load [Kn]	Load [N/Mm^2]	Average [N/Mm^2]
7	7.33	280.8	12.48	12.76
	7.27	292.0	12.98	
	7.30	288.7	12.83	
28	7.27	350.0	15.55	15.69
	7.29	355.5	15.80	
	7.30	354.2	15.74	

11.1.5. 0.8 % ADMIXTURE OF MICR 720:

Admixture 0.8% = (12.5 + 3.5) x 8 = 15.75 x 8 = 126 g.

TABLE -10:

AVERAGE COMPRESSIVE STRENGTH OF 0.8% ADMIXTURE FOR VARIOUS AGES OF DAYS

Age of Days	Weight [Kg]	Load [Kn]	Load [N/Mm^2]	Average [N/Mm^2]
7	7.03	195.8	8.70	8.71
	7.02	198.5	8.82	
	7.05	193.9	8.62	
28	7.03	245.5	10.91	11.07
	7.05	250.6	11.37	
	7.06	246	10.93	

11.1.6. 1.0 % ADMIXTURE OF MICR 720:

Admixture 1% = (12.5 + 3.5) x 10 = 15.75 x 10 = 157.5 g.

TABLE -11:

AVERAGE COMPRESSIVE STRENGTH OF 1.0% ADMIXTURE FOR VARIOUS AGES OF DAYS

Age of Days	Weight [Kg]	Load [Kn]	Load [N/Mm^2]	Average [N/Mm^2]
7	6.65	110.2	4.90	4.84
	6.70	108.5	4.82	
	6.69	107.7	4.79	
28	6.79	126.9	5.64	5.70
	6.80	128.2	5.70	
	6.82	130	5.77	

11.2. DISCUSSION

- For every 0.2 % addition of MICR 720 admixture in the concrete mix, there is 5% increase in the air content of concrete.
- This dramatically reduces the density of concrete.
- So, water cement ratio of 0.35 and 0.15% of admixture is obtained for the proposal of new mix design.

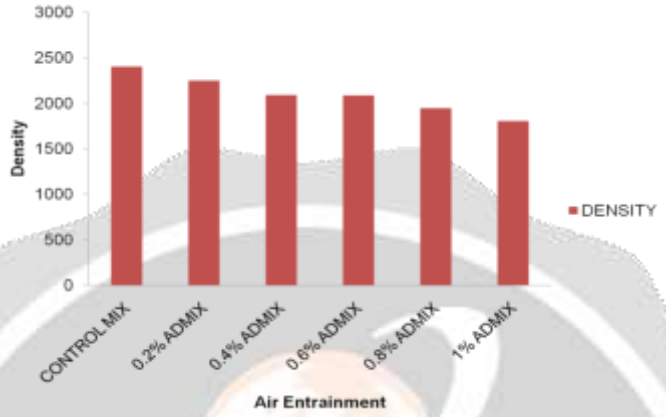

Chart -1: Comparison of air entrainment and density

12. CONCLUSION

Due to air entrainment, the density of concrete drops and every increase of 0.2% air entrained admixture dosage reduce the density of concrete by 3% from control mix.

Every one percentage of air in concrete also reduces the strength of concrete by approximately 6 to 8 % when the dosage increases to 1.0%

SP23 table 32 permits an air entrainment of 6 % for 20mm maximum size aggregate. Considering the same and to get the benefit of thermal comfortness and structural weight reduction mix design with M25 grade concrete has given a reduction of 16% reduction in density of concrete.

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