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EXPERIMENTAL INVESTIGATION ON SELF COMPACTING CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH ALCCOFINE

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Abstract:

Concrete is among the most fundamental and most widely used materials in the construction industry and it is, therefore, necessary to continuously investigate further improvements to it such as concrete structures with improved durability and mechanical properties. In the last years, the introduction of self-compacting concrete (SCC) has brought huge technological advances. The use of SCC has facilitated the placing of concrete between the rebar without need of external vibration, just by means of the weight of concrete itself. Self-compacting concrete development must ensure a good balance between deformability and stability. Also, compatibility is affected by the characteristics of materials and the mix proportions; it becomes necessary to evolve a procedure for mix design of SCC. The paper presents an experimental procedure for the design of self-compacting concrete mixes. Locally available coarse aggregate of size 20 mm and 12.5 mm, M sand as fine aggregate used in this experimental work. Water binder ratio was fixed as 0.31. Alccofine used as cementitious material in addition of cement. Furthermore, compatibility is influenced by material properties and mix proportions, necessitating the development of a process for SCC mix design. An experimental technique for the design of self-compacting concrete mixtures is presented in this work. The test results for self-compacting concrete acceptance features such as slump flow, J-ring, V-funnel, and L-Box. The cube specimens of size 150mmX150mmX150mm are prepared for compressive strength concrete mixes. The strengths were determined at the age of 7, 14 and 28 days of curing period.In this study, the suitability and performance of SCC by using different brands of Mineral Admixture (Alccofine)s will be checked by conducting various fresh concrete tests and also a check on compressive strength will be done. Keywords: Self-compacting concrete, Alccofine, Mix design, Compressive strength

1.INTRODUCTION:

General The term compatibility refers to the desired effect on performance when a specific combination of cement and chemical admixtures is used. The complex interaction between cement and chemical admixtures in concrete mixtures sometimes leads to unpredictable performance of concrete in the field which is generally defined as concrete incompatibilities. Common problems during concreting include flash setting, delayed setting, rapid slump loss, improper strength gain, inordinate cracking etc arise due to incompatibility between cement and chemical admixtures. These issues in turn affect the hardened properties of concrete, primarily strength and durability. Modern concretes i.e. Ready Mix Concrete, High Strength Concrete, High Performance

Concrete; Self Compacting Concrete etc almost always possess some additives, either in the mineral form or chemical form. The use of chemical admixtures has become very common in India. There has also been a proliferation in the number of brands of cement and in the types of cement available. It is very difficult to ensure that an admixture that produces all the desired effects with one type of cement would do the same with other type cement. Users, who are unaware of compatibility issues, often, suffer when the supply of cement and/or admixture is changed midway through a project. In concrete mix design the Mineral Admixture (Alccofine) dosage are fixed based on the composition of the paste (cement, water and chemical admixtures) with the maximum fluidity for a given water/cement ratio and a given chemical admixture/cement ratio. The characteristics of the fresh paste mostly govern the properties of the fresh concrete and this procedure will yield a concrete with the desired workability for a given aggregate content. The only variable in this process is the Mineral Admixture (Alccofine)/cement ratio. Admixture manufacturers try to overcome compatibility problem by formulating project-specific chemicals. Obviously, this is only a short term solution. For a more comprehensive approach, the optimum dosage of chemical admixture is decided for each batch of cement and each admixture. To formulate this objective, a test known as “Marsh Cone Test” is performed. In this test, for particular w/c ratio, cement and admixture dosage, an optimum dose of that chemical admixture is found out. At optimum dose of admixture, cement-admixture paste is the most compatible to each other. Today concrete is most widely used construction material due to its good compressive strength and durability. Depending upon the nature of work cement, fine aggregate, coarse aggregate 2 and water are mixed in specific proportions to produce plain concrete. To make durable concrete structures, sufficient compaction is required. The use of self-compacting concrete (SCC) is spreading worldwide because of its very attractive properties in the fresh state as well as after hardening. The use of SCC will lead to a more industrialized production, reduce the technical costs of in situ concrete constructions, improve the quality, durability and reliability of concrete structures and eliminate potential for human error.The ultimate objective of design and construction of reinforced concrete structures is to produce a robust and durable product. The structural capacity, durability and physical appearance of any structural element are directly associated with the construction quality and the effective interaction between concrete and the embedded reinforcement. A key parameter with a strong influence on concrete–steel interaction is the effectiveness of fresh concrete compaction, which will allow the extraction of entrapped air and the full encasement of reinforcement bars so that the two materials can act compositely.However, it is recognized that, regardless of design quality and construction planning. Poor compaction is often identified as the major cause of some of the most common defects found in construction, including cold joints and surface imperfections, such as honeycombing and various blemishes, and unfilled cavities, including both surface

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and hidden voids. Inadequate compaction is usually attributed to lack of workforce training and poor onsite quality control, but also to subjective difficulties, such as form-work complexity and reinforcement congestion. These factors do not allow correct application of compaction and restrict concrete from flowing freely throughout the form and effectively encasing reinforcement bars.

2.OBJECTIVE OF PROJECTS:

➢ To determine optimum dosage of Mineral Admixture (Alccofine).

➢ To develop an economical mix design for M30 grade SCC with optimum dosage of different brands Mineral Admixture (Alccofine).

➢ To analyse fresh properties of SCC with different brands of Mineral Admixture (Alccofine). ➢ To analyse hardened properties of SCC with different brands of Mineral Admixture (Alccofine).

3.METHODOLOGY:

To check the feasibleness of SCC, U-box, L-box, V-funnel test and flow table assessments are the tests done for SCC in its fresh state. U-box and L-box experiment inspects the packing ability and it consists of U-shaped section, ratio of height gives the result. The setup consists of moulding and examination of 5 cubes, with the size of 150mm x 150mm x 150mm.coarse aggregate of size 20mm and 12.5 mm, M sand as fine aggregate used in this experimental work. Water binder ratio was fixed as 0.31. Alccofine used as cementitious material in addition of cement. After 7 days curing, cubes were placed in the kiln and succeeded temperature, after 28 days healing specimens were placed under compression testing machine to check its compressive strength

Fig-1

Trial No.	Wt of empty bottle(W1) gm	Wt of bottle+1/3rd cement(W2) gm	Wt of bottle+1/3rd of cement+kerosene (W3) gm	Wt of bottle+kerosene (w4) Gm	Specific gravity
1	47	73	145	125	3.25
2	47	78	148	125	3.06
3	47	77	147	125	2.9

Sl. No	% of water	Initial Reading (mm)	Final Reading (mm)	Height generated (mm)
1	25%	40	20	20
2	26%	40	16	24
3	27%	40	10	30
4	28%	40	11	29
5	29%	40	7	33

4.IMPLEMENTATION:

Replace the initial setting time needle of the vicat apparatus by the needle with an annular attachment (i.e. setting time needle). The cement shall be considered as finally set when, upon applying the needle gently to the surface of the test block, the needle makes an impression thereon, while the attachment fails to do so, shall be the final setting time. In the event of a scum forming on the surface of the test block, use the underside of the block for

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determination. Observation and Calculations: Mass of cement taken=400gm Mass of water taken = 0.85 x P x 400 = 0.85*29*400 = 98.6 ml. Where "P" is the standard consistency of cement COMPRESSIVE STRENGTH OF CEMENT Procedure: 1. The material for each cube shall be mixed separately by taking quantities of cement; standard sand and water are as follows; 2. Cement: 200gms, standard sand: 600gms, 3. Water: (P/4 +3)% of combined weight of cement and sand 4. (Where 'P' is standard consistency) 5. Place on a non-porous plate a mixture of cement and standard sand in the proportion of 1:3 by weight as given above. 6. Mix it dry with a trowel for one minute and then add water until mix is of uniform colour. 7. Gauging time should not be less than 3 minutes and should not exceed 4 minutes.If it exceeds, mixture is rejected and operation is repeated. 8. Oil the interior faces of the mould. 9. Place the assembled mould on the table of the vibrating machine and firmly hold it in position by means of suitable clamps. Securely attach the hopper at the top of the mould to facilitate filling and this hopper shall not be removed until completion of vibration period. 10. Immediately after mixing the mortar as explained above, fill the entire quantity of mortar in the hopper of the cube mould and apply vibration. The period of vibration shall be two minutes at the specified speed of 12,000±400 cycles per minute. 11. Remove the mould from the machine and keep it at a temperature of 27±2oC in an 27 atmosphere of at least 90% relative humidity for 24hours after completion of vibrations. 12. At the end of this period, remove the cube from the mould and immediate submerge it in clean and fresh water and keep them until taken out just prior to breaking. The water in which the cubes are submerged shall be revealed after every 7 days and be maintained at a temperature of 27±2oC. keep the cubes wet till they are placed in machine for testing . 13. Test all three specimens after three days. The periods being record from the completion of vibration. The compressive strength shall be the average of the strengths of three cubes for each period. The cubes shall be tested on their sides , the load being applied at the rate of 35 N/mm2 /minute

Sl No.	3 days strength		7 days strength	
	Load KN	Strength N/mm^2	Load KN	Strength N/mm^2
1	122.5	27	181.[illegible]	3[illegible]
2	117.2	28	171.3	35
3	127.4	26	171.4	36
Avg	122.3	27	171.4	36

RESULTS:

Specific gravity of flyash = 1.83 ALCCOFINE Alccofine is a new generation, micro-fine material of particle size much finer than other hydraulic materials like cement, fly ash, ground granulated blast furnace slag (GGBS) silica fume, etc. being manufactured in India.Alccofine concrete was found to increase the compressive strength of concrete on all age.The fineness modulus and specific gravity are 3.35 and 2.7 respectively

S.No	Constituents	Composition (wt.%)
1	Silica (SiO_2)	35.30
2	Calcium oxide (Cao)	32.20
3	Alumina (Al_2O_3)	21.4
4	Magnesia (MgO)	8.20
5	Iron oxide (Fe_2O_3)	1.20

MINERAL ADMIXTURE 1. FLYASH Fly ash consists primarily of oxides of silicon, aluminum iron and calcium. Magnesium, potassium, sodium, titanium, and sulfur are also present to a lesser degree. When used as a mineral admixture in concrete, fly ash is classified as either Class C or Class F ash based on its chemical composition

CONCLUSION:

SCC has high potential for greater acceptance and wider applications in highway, bridge construction in the all over world. It has been verified that, by using slump flow , U- tube and other tests on fresh SCC , it can self - compact and self - flow under it's own weight. Based on above results and discussions the following conclusion are drawn: 1. Self Compacting Concrete technology can save time, cost, enhance quality, durability and moreover it is a green concept. 2. Since the concrete is capable of Self-consolidating and reaching the difficult areas in mould , manual variables in terms of placing and compacting concrete is nil. This factor ultimately yields defect less , betterquality concrete structures. 3. Experimental studies for M40 Grade of Conventional Concrete of Compressive Strength observed for 28 days is 38 N/mm2 4. The optimum compressive strength obtained is 37 N/mm2 at 7.5 and 10% alccofine replacement with cement for 28 days. 5. It was observed that percentage increase in strength increases with addition of alccofine in various concrete mixes. 6. Slump flow increases with the increase of water/ cement ratio. 7. L-box value increases with increase in w/c ratio & Compressive strength decreaseswith increase in w/c ratio. 8. V-funnel time, U-box values are decreases with the increase of w/c ratio. 9. Considering both fresh properties & hardened properties of SCC, the ranking of all four brands of Mineral Admixture (Alccofine) are done below: cflow251 sika viscocrete 5201ns fosroc conplast sp430 dissupaflo bn

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