EXPERIMENTAL STUDY OF SELF COMPACTING CONCRETE ON INDUSTRIAL WASTE

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ABSTRACT

Self-compacting concrete (scc) is a modern and innovative concrete that does not need vibration for placement and compaction. It is also known as flowable, self- consolidating, and non-vibration concrete. It is enormously consistent and highly flowable, without the loss of stability, and moreover it can flow due to its weight, fill the formwork and achieve complete compaction even in the presence of crowdedreinforcement. After solidification, it is hard, consistent, and has similar engineering characteristics, including strength, as conventional concrete that has been vibrated. Therefore after hardening, its function is like normal (vibrated) concrete.

Self-consolidating concrete (scc) has a fast rate of concrete placement, with a swift flow close to the congested reinforcement region. This enables the achievement of rapid construction. The resistance to segregation and high fluidity ensures homogeneity, minimum voids, and a consistent concrete strength. These characteristics provide excellent durability and finish to the building. The mixture is produced with a low ratio ofwater and cement that makes the concrete have a high strength. Furthermore, the exclusion of vibrating machinery assists in a clean environment near the construction site.The workers also do not have to bear the uncomfortable noise created due to vibration [1].

Some areas where concrete is poured have spaces that are congested with reinforced bars, and placing normal concrete in such locations is difficult. Self- compacting concrete can conveniently be used for complex shapes, narrow shells, and where conventional vibration may not be possible. Use of normal concrete at such places can cause voids that are undesirable. Self-compacting concrete(scc) is especially useful for structures that require a high quality, with no deviation in color, texture, and smoothness. However, the use of this type of concrete is limited due to its high cost [2-3].

NEED FOR SCC

For several years, the problem of the durability of concrete structures has been a major problem posed to engineers. To make durable concrete structures, sufficient compaction is required. Compaction for conventional concrete is done by vibrating. Over vibration can easily cause segregation. In conventional concrete, it is difficult to ensure uniform material quality and good density in heavily reinforced locations.

If steel is not properly surrounded by concrete it leads to durability problems. Thisis the problem mainly with heavily reinforced sections where a very high congestion of reinforcement is seen. In this case, it becomes extremely difficult to compact the concrete. Then what can be done to avoid honeycombing?

The answer to the problem may be a type of concrete which can get compacted into every corner of form work and gap between steel, purely by means of its own weightand without the need for compaction. The SCC concept was required to overcome these difficulties [4].

Self compacting concrete must be able to flow into all the spaces within the formwork under its own weight. This is related to workability, as measured by slump flow or Orimet test. The filling ability or flowability is the property that characterizes the ability of theSCC of flowing into formwork and filling all space under its own weight, guaranteeing of the reinforcement. The mechanisms that govern this property are high fluidity and cohesion of the mixture.

NEED FOR STUDY

Self compacting concrete only has the some fresh properties like filling ability, passing ability and flow ability at congested concrete. To add one more advantage into it by preparing Self Compacting concrete with Industrial waste, which helps to increase its strength in the row of its benefits. Concerning about the current environmental status this experiment is done. Many industries dispose many of their waste every year for tones. In some waste which have engineering material content which helps to increase the strength of the concrete.

By doing this experiment following can be achieved:

- Safe environment
- Additional strength to Self compacting concrete
- To study the comparativeness between normal SCC and industrial waste mixed SCC

OBJECTIVE OF THE STUDY

Objective of this project is to:

- To study about the industrial waste which helps to increase the strength of self compacting concrete.
- To improve the properties of self compacting concrete
- Concerning on current environmental status this project is done
- Utilization of industrial waste in engineering materials

METHODOLOGY

The step by step methodology for the work to be carried out and the future work to be done further has been provided as a theory explaining the whole process. The flow chart has also been included in the form of a process chart for the better understanding of the process in a precise manner. A collection of literature review was done to understand the concept of current development and properties of self compacting concrete in construction field. How the workability and usage is have also been studied. The next part from my side isto study about some of the industrial waste which is been exposed in big volumes, collectdata and studying about their characteristics which should help gaining strength in theself compacting concrete [5].

When two or plus wastes are found it will be blended into the Self compacting concrete and the cube samples are made. Then after it crosses the curing stage, all the cube samples will be tested for compression test in the lab. By this I find which sample performance the best by showing its durability. Based on the test results, it will be planned in which area of construction will it be suitable. Also by this experiment the main task gets satisfied, that is huge amount of industrial waste which is been exposed to environment by the industries creates a harmful atmosphere. But by this experiment it will be solved when it is implemented in the mixing of self compacting concrete.

Self Compacting Concrete And Measurement Of It's FlowProperties

It is important to appreciate that none of the test methods for SCC has yet been standardized and the tests described are not yet perfected or standardized. The methods presented here are descriptions rather than fully detailed procedures. They are mainly ad-hoc methods, which have devised specifically for SCC. Hence for the validation of concrete these tests have not been considered [6].

In considering these tests, there are number of points which should be taken into account:

- One principal difficulty in devising such tests is that they have to assess three distinct, though related, properties of fresh SCC – its filling ability (flowability), its passing ability (free from blocking at reinforcement), and its resistance to segregation (stability). No single test is so far derived which can measure all the three properties.
- There is no clear relation between test results and performance on site.
- There is little precise data, therefore no clear guidance on compliance limits.
- Repetition of the tests is advised.
- The test methods and values are stated for maximum aggregate size upto 20 mm; different test values and/or different equipment dimensions will be appropriate for
- other aggregate sizes.
- Different test values may be appropriate for concrete being placed in vertical and horizontal elements.
- Similarly, different test values may be appropriate for differentreinforcement densities.

TEST METHODS

SLUMP FLOW TEST

This is simple, rapid test procedure, though two people are needed if the T50 time is to be measured. It can be used on site, though the size of the base plate is somewhat unwieldy and level ground is essential. It is most commonly used test, and gives a good assessment of filling ability. It gives no indication of the ability of the concrete to pass between reinforcement without blocking, but may give some indication of resistance to segregation. It can be argued that the completely free flow, unrestrained by any boundaries, is not representative of what happens in practice in concrete construction, but the test can be profitably be used to assess the consistency of supply of ready-mixed concrete to a site from load to load.

U BOX TEST METHOD

This is a simple test to conduct, but the equipment may be difficult to construct. It provides a good direct assessment of filling ability-this is literally what the concrete has to do-modified by an unmeasured requirement for passing ability. The 35 mm gap between the sections of reinforcement may be considered too close. The question remains open of what filling height less than 30 cm. is still acceptable [7].

L BOX TEST METHOD

This is widely is used test, suitable for laboratory, and perhaps site use. It assesses filling and passing ability of SCC, and serious lack of stability (segregation) can be detected visually. Segregation may also be detected by subsequently sawing and inspecting sections of the concrete in the horizontal section. Unfortunately there is no agreement on materials, dimensions, or reinforcing bar arrangement, so it is difficult to compare test results. There is no evidence of what effect the wall of the apparatus and the consequent 'wall effect' might have on concrete flow, but this arrangement does, to some extent, replicate what happens to concrete on site when it is confined within formwork. Two operators are required if times are measured, and a degree of operator error is inevitable.

V FUNNEL TEST

Though the test is designed to measure flow ability, the result is affected by concrete properties other than flow. The inverted cone shape will cause any liability of the concrete to block to be reflected in the result – if, for example there is too much coarse aggregate. High flow time can also be associated with low deformability due to high paste viscosity, and with high inter-particle friction.

While the apparatus is simple, the effect of the angle of the funnel and the wall effect on the flow of concrete are not clear.

Table 1. Suggested value of acceptance for different test methods of SCC

Sl. no	**Methods**	**Unit**	**Typical range values**	
			Minimum	**Maximum**
1	Slump flow by Abrams cone	mm	600	800
2	V-funnel	sec	6	12
3	L-box	(h2/ h1)	0.8	1.0
4	U-box	h2-h1	0	30

Test Results Of Scc Containing The Combination Of Admixtures (Sp+Vma) With Various Industrial Wastes

The following tables give the test results of effect of addition of industrial waste inself compacting concrete containing an admixture combination (SP+VMA)

Compressive strength test results of self compacting concrete containing the combination of admixtures (SP+VMA) with 10% industrial wastes.

Table 2. Compressive strength of SCC at with 10% of Tanning waste and with combination of admixtures (SP+VMA)

Specimen identification	Weight of specimen (N)	Density (N/cum)	Failure Load (K/N)	Compressive strength (MPa)	Test Days
T1	60.8	2020	430	19.10	7th day
T2	66.6	2020	580	25.8	14th day
T3	73.5	2020	620	27.60	24th day

Table 3. Compressive strength of SCC with 10% of Lathe waste and withcombination of admixtures (SP+VMA)

Specimen identification	Weight of specimen (N)	Density (N/cum)	Failure Load (K/N)	Compressive strength (MPa)	Test days
L1	65.7	2020	540	24.0	7th day
L2	68.6	2020	670	29.8	14th day
L3	72.5	2020	900	31.20	24th day

Table 4. Compressive strength of SCC with 10% of Granite powder and with combination of admixtures (SP+VMA)

Specimen identification	Weight of specimen (N)	Density (N/cum)	Failure Load (K/N)	Compressive strength (MPa)	Test days
G1	74.5	2020	780	19.10	7th day
G2	78.4	2020	823	36.6	14th day
G3	85.3	2020	900	40.4	24th day

OVERALL RESULTS OF COMPRESSIVE STRENGTH

The following table no 5 gives the overall results of compressive strength of self compacting concrete containing the combination of admixtures (SP+VMA) for various Industrial wastes

Table5. Overall Results of compressive strength

Specimen identification	Average compressive strength
Tanning waste T1,T2,T3	24.16
Lathe waste L1,L2,L3	28.6
Marble powder G1,G2,G3	24.61

The variation of compressive strength can be depicted in the form of graph as show in figure:

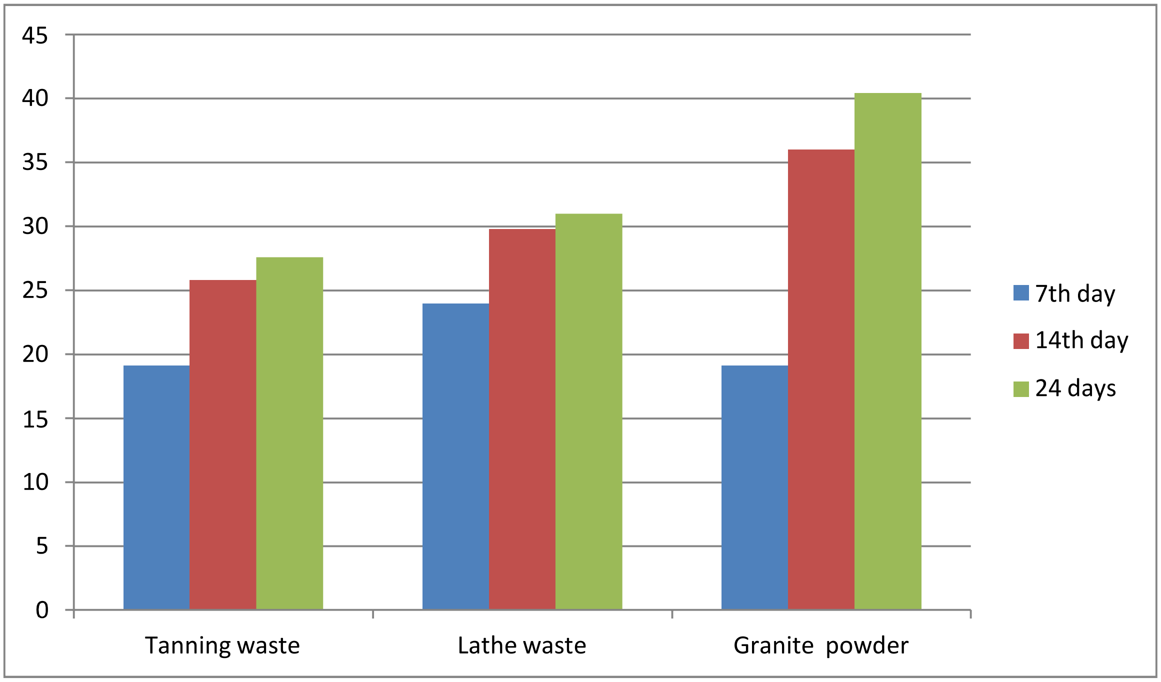

Fig 1 Compressive strength variation graph

Tensile Strength Test Results Of Self Compacting Concrete Containing The Combination Of Admixtures (Sp+Vma) With Various Industrial Wastes

Table 6 Tensile strength of SCC with combination of admixture and 10% Tanning waste

Specimen Identification	Failure Load (KN)	Tensile strength $F=2P/\pi DL$
T1	250	3.53
T2	240	3.39
T3	220	3.11

Table 7. Tensile strength of SCC with combination of admixture and 10% of Lathewaste

Specimen identification	Failure load (KN)	Tensile strength F=2P/πDL
L1	250	4.52
L2	240	3.11
L3	320	3.53

Table 8. Tensile strength of SCC with combination with admixture and 10% of Marble powder

Specimen identification	Failure load (KN)	Tensile strength F=2P/πDL
M1	330	4.95
M2	300	4.24
M3	350	4.67

OVERALL RESULTS OF TENSILE STRENGTH

The following table no 9 gives the overall results of compressive strength of self compacting concrete containing the combination of admixtures (SP+VMA) for various Industrial wastes [8]

Table 9 Overall Results of Tensile strength

Specimen identification	Average tensile strength (mpa)
Tanning sludge waste (T1,T2,T3)	3.34
Specimen identification	Average tensile strength (mpa)
Lathe waste (L1,L2,L3)	3.72
Granite powder (G1,G2,G3)	4.5

The variation of Tensile strength can be depicted in the form of graph as show in figure:

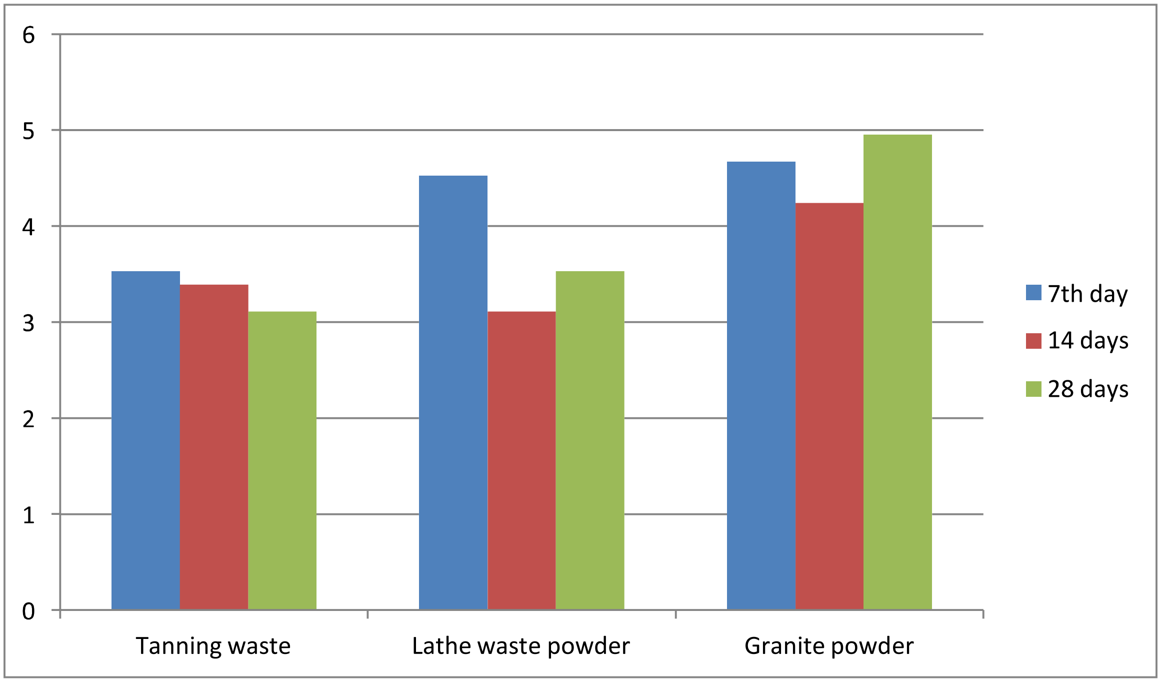

Fig 2 Tensile strength variation graph

FLOW TEST RESULTS

The following tables give the flow test results of effect of addition of industrial wastes on the properties of self compacting concrete containing an admixtures combination of (SP+VMA)

Table 10. Slump flow test results

Percentage of different industrial waste	Slump flow (mm)	Time in sec
10% of Tannery sludge waste	560	13.2
Percentage of different industrial waste	Slump flow (mm)	Time in sec
10% of Lathe powder waste	480	15.6
10% of Granite powder	680	5.8

Table 1.12 V – Funnel test results

Percentage of different industrial waste	Flow time in sec
10% of Tannery sludge waste	33.6
10% of Lathe powder waste	38.12
10% of Granite powder	25.1

Table 1.13 U – Box test results

Percentage of different Industrial wastes	Height of conc. In 1st compartment H1 (mm)	Height of conc. In 2st compartment H2 (mm)	Filling height H_1-H_2 (mm)
10% of Tannery sludge waste	290	270	10
10% of Lathe powder waste	290	285	15
10% of Granite powder	290	290	22

Table 1.14 L – Box test results

Percentage of different industrial wastes	Height H1	Height H2	Blocking ratio H2/H1	Time taken for conc. To reach a distance of 200 mm	Time taken for conc. To reach a distance of 400 mm
10% of Tannery sludge waste	80	76	0.96	3.80	6.5
10% of Lathe powder waste	70	60	0.85	4.60	8.8
10% of Granite powder	82	48	0.70	6.30	13.4

CONCLUSION

In present scenario there is a greater need for self compacting concrete due to sickness of member and architectural requirement, also to improve durability of the structure. Now the world is going to facing greater need of high performance concrete, durability point of view and SCC where the conventional way of compacting may not be always useful under different site condition. So instead of going for the conventional concrete let us mix the concrete compacting on its own which is called as self compacting concrete. Now due to industrialization there is greater increase in the industrial wastes like Tannery sludge, Lathe powder waste, Granite quarry powder etc in and around Chennai.

It has been observed that the compressive strength of self compacting concrete produced with the combination of admixtures such as (SP+VMA) goes on increasing upto 15 % of industrial waste . After 15% addition of industrial waste , the compressive strength starts increasing, i.e. the compressive strength of self compacting concrete produced with (SP+VMA) is maximum when 15 % industrial waste. The percentage increase in the compressive strength at 15% addition of industrial waste. Thus, it can be concluded that maximum compressive strength of self compacting concrete with the combination of admixtures (SP+VMA) may be obtained by adding 15% of industrial waste.

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