JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

IMPROVE THE WORKABILITY AND STRENGTH OF CONCRETE BY USING SUPERPLASTICIZER

[1]Parmeshwar, [2]Pushpendra kumar sahu, [3]Gargi danda de
[1]MTech scholar, [2]Assistant professor, [3]Assistant professor
Department of civil engineering,
Shri Rawatpura Sarkar University, Raipur, India

Abstract: *In this study super plasticizers admixtures were used for the grades of concrete 15 N/mm^2 to improve the properties of fresh and harden concrete in hot weather to achieve these properties in the summer season:*

- *Increase the workability*
- *Increase the compressive strength by adoption super plasticizers admixtures which increase the workability and hence the strength is increased through the reduction of water content.*
- *Reduce the cement content and hence cost saving.*

The experimental work was divided into two phases:

1. *Tests on basic materials (cement, aggregate, sand, water) and the effect of recommended dose of admixture on the properties of fresh and hardened concrete.*
2. *Concrete testing program for the grade which contain four mixes for each grade.*

The results of tests for the basic materials were carried to ensure that their results conforming to their standards and can be used.

- *Ordinary reference mix*
- *Same mix with admixture to increase strength*
- *Same mix with admixture to reduce water content and hence increase strength.*
- *Same mix with admixture to reduce the cement content keeping same workability and strength.*

I. INTRODUCTION

1.1. General

Concrete is a composite manmade material and most widely used building material in the construction industry. It is a mixture of binding material such as lime or cement, well graded coarse and fine aggregate, water and sometimes admixtures. Most of the ancient structure and historical buildings had been constructed with lime concrete but with the invention of cement, use of lime concrete is limited to making bases of concrete foundations and roof terracing.

1.2. Admixtures

Admixtures are chemical compounds other than water, aggregates, hydraulic cement and additives like fine pozzolana and fibre reinforcement used as an ingredient of concrete or mortar. It is immediately added before or during mixing to modify one or more properties of concrete in plastic and hardened state. It is either organic and inorganic combination of both. Admixtures are liquid state because liquid can be more rapidly dispersed in uniform manner during mixing of concrete. Admixtures should never be regarded as a substitute for good mix design, good workmanship or use of good materials.

1.3. Types of Admixtures

Normally, admixtures are categorized according to their effects:

1. Plasticizers
2. Superplasticizers
3. Air entrainers
4. Accelerators
5. Retarders
6. Others

1.4. Strength

The strength of an aggregate limits the attainable strength of concrete only when its compressive strength is less than or of the same order as the design strength of concrete. In practice the majority of rock aggregates used are usually considerably stronger than concrete. While the strength does not normally exceed 80 N/mm^2 and is generally between 30 to 50 N /mm^2 the strength of aggregate commonly used is in the range 70 to 350 N/mm^2**.** In general 1gnious rocks are very much stronger than sedimentary and metamorphic rocks. Because of irregular size and shape of aggregate particles a direct measurement of their strength properties is not possible.

1.5. Workability

Workability of concrete has never been precisely defined. For practice purposes it generally implies the ease with which concrete mix can be handled from the mixer to its finally compacted shape. The three main characteristics of the property are:

Consistency: is a measure of wetness or fluidity.

Mobility: the ease with which a mix can flow into and completely fill the formwork or mould.

.

II. LITERATURE REVIEW

1. **Mario Collepardi, Enco, Engineering Concrete, Ponzano Veneto (Italy);** Studied that super plasticizer are the most important admixtures enhancing concrete performance. The development of new superplasticizers during the last decades has determined the most important progress in the field of concrete structures in terms of higher strength, longer durability, lower shrinkage and safer placement in elements with very congested reinforcement. The progress from sulphonated polymer to polycarboxylate has resulted in higher water reduction at a given workability and lower slump loss. More recently poly-functional superplasticizers have been developed which are able to completely keep the initial slump for at least 1 hr. without any retarding effect on the early strength. Moreover, multi-purpose and poly-functional superplasticizers have been invented which are able to reduce drying shrinkage. The recent progress of superplasticizers was examined in this paper.
2. **Jiang Jiabiao –PhD W. R. Grace (Singapore) Pte. Ltd., Singapore:** This paper discusses new generation poly-carboxylate (PC) based admixture technologies and its application in high performance concrete for infrastructure building. With the powerful dispersion capability and flexibility in molecular design, PC admixtures enable the production of concrete at low water cementitious ratio with high workability, use of more blending materials, and to cater to different challenging requirements, such as high strength, high durability, high workability and long workability retention, etc. Some cases of advanced admixture application in high performance concrete infrastructural construction, such as marine bridges, high-rise buildings, water treatment plants in Asia, are presented as well.
3. **M. Palacios, F. Puertas:** This paper shows how several superplasticizers (polycarboxylates, vinyl copolymers, melamine and naphthalene-based) and shrinkage reducing (polypropylenglycol derivatives) admixtures affect the mechanical and rheological properties and setting times of alkali-activated slag pastes and mortars. Two activator solutions, waterglass and NaOH, were used, along with two concentrations—4% and 5% of Na2O by mass of slag. All admixtures, with the exception of the naphthalene-based product, lost their fluidifying properties in mortars activated with NaOH as a result of the changes in their chemical structures in high alkaline media. The difference in the behaviour of these admixtures when ordinary Portland cement is used as a binder is also discussed in this paper.

III. METHODOLOGY

3.1. Concrete Mix Design

Concrete mix design can be defined as the procedure by which, for any given set of conditions, the proportion of the constituent materials are chosen so as to produce a concrete with all the required properties for the minimum cost. The cost of the mix design includes

a. The materials
b. The cost of the mix design, of batching, mixing and placing the concrete and of side supervision

Two types of concrete mixes are available

3.1.1. Prescribe Mix

It is given in least form included:

a. Proportion of cement
b. Fine and coarse aggregate
c. Workability

3.1.2. Designed Mix

The basic requirements for concrete are conveniently considered at two stages in its life. In its hardened state the concrete should have adequate durability, the required strength and also the desired surface finish. In its plastic state, or the stage during which it is to be handle, placed and compacted in its final form, it should be sufficiently workable for the required properties in its hardened state to be achieved with the facilities available on site.

3.2. Compressive Strength

The compressive strength of concrete is taken as the maximum compressive load it can carry per unit area. Concrete strength up to 80 N/mm^2 can be achieved by selective use of the type of cement, mix proportion, method of curing conditions. Concrete structures, except for road pavements, are normally designed on the basis that concrete is capable of resisting only compression, the tension being carried by steel reinforcement. The standard method described in BS 1881:Part 3 requires that the test specimen should be cured in water at 20 ^{0}C and crushed immediately after it has been removed from the curing tank

3.3. Tensile Strength

The tensile strength of concrete is of importance in the design of concrete roads and runways. Concrete members are also required to withstand tensile stresses resulting from any restraint to contraction due to drying or temperature variation. Unlike metals, it is difficult to measure concrete strength in direct tension and indirect methods have been developed for assessing this property.

3.4. Cylinder Test

This is the simplest and most widely used. This test is fully described in BS 1881 Part 4 and entails diametrically loading a cylinder in compression along its entire length. This form of loading induces tensile stresses over the loaded diametrical plane and the cylinder split along the loaded diameter

3.5. Measurement of workability

3.5.1. Slump Test

This is a test used extensively in site work all over the world .the slump test does not measure the workability of concrete, although ACI 116R90 prescribe it as a measure of consistency. but the test is very useful in detecting variation in the uniformity of a mix of a given nominal properties. The slump test is prescribed by ASTM C 143-90a and BS 1881:part 102:1983.

3.5.2. Compacting Factor Test

This test measures the degree of compaction for standard amount of work and thus offers a direct and reasonably reliable assessment of the workability of concrete. The apparatus is relatively simple machine contrivance and is fully described in BS 1881: part 2.the test requires measurement of the weights of the partially and fully compacted concrete and the ratio of the partially compacted weight to the fully compacted weight, which is always less than 1, is known as the compacting factor. For the normal range of concretes the compacting factor lies between 0.8 and 0.92.the test is particularly useful for drier mixes for which the slump test is not satisfactory

$$\text{The compacting factor} = \frac{\text{weight of partially compacting concret}}{\text{weight of fully compacting concrete}}$$

IV. TEST RSULTS AND DISSCUSION

4.1. Preliminary Tests

Table (4.1) results of cement test

Test	Results	Requirements of BS12 1996
Consistency	30%	
Setting time 1) Initial 2) Final	 1 hrs: 40min 2 hrs: 40 min	 Not less than 60 min (-15 min) Not more than 10 hrs

Table (4.2) fine aggregate sieve analysis

Sieve size (mm)	Percentage retained	Percentage passing	BS 882 1992
10	0	100	100
5	2.33	97.7	90 – 100
2.36	5.5	94.5	75 – 100
1.18	19.47	80.5	55 – 90
0.6	46	54	35 – 59
0.3	79.5	20.5	8 – 30
0.15	96	4	0 - 10
Total weight	100	0	0

Table (4.3) coarse aggregate single size (10mm) sieve analyses

Sieve size(mm)	Percentage retained	Percentage passing	BS 882 1992
50	0	100	100
37.5	0	100	100
20	0	100	100
14	0	100	100
10	3.9	96.1	85 – 100
5	79.4	20.6	0 – 25
2.36	100	0	0 – 5

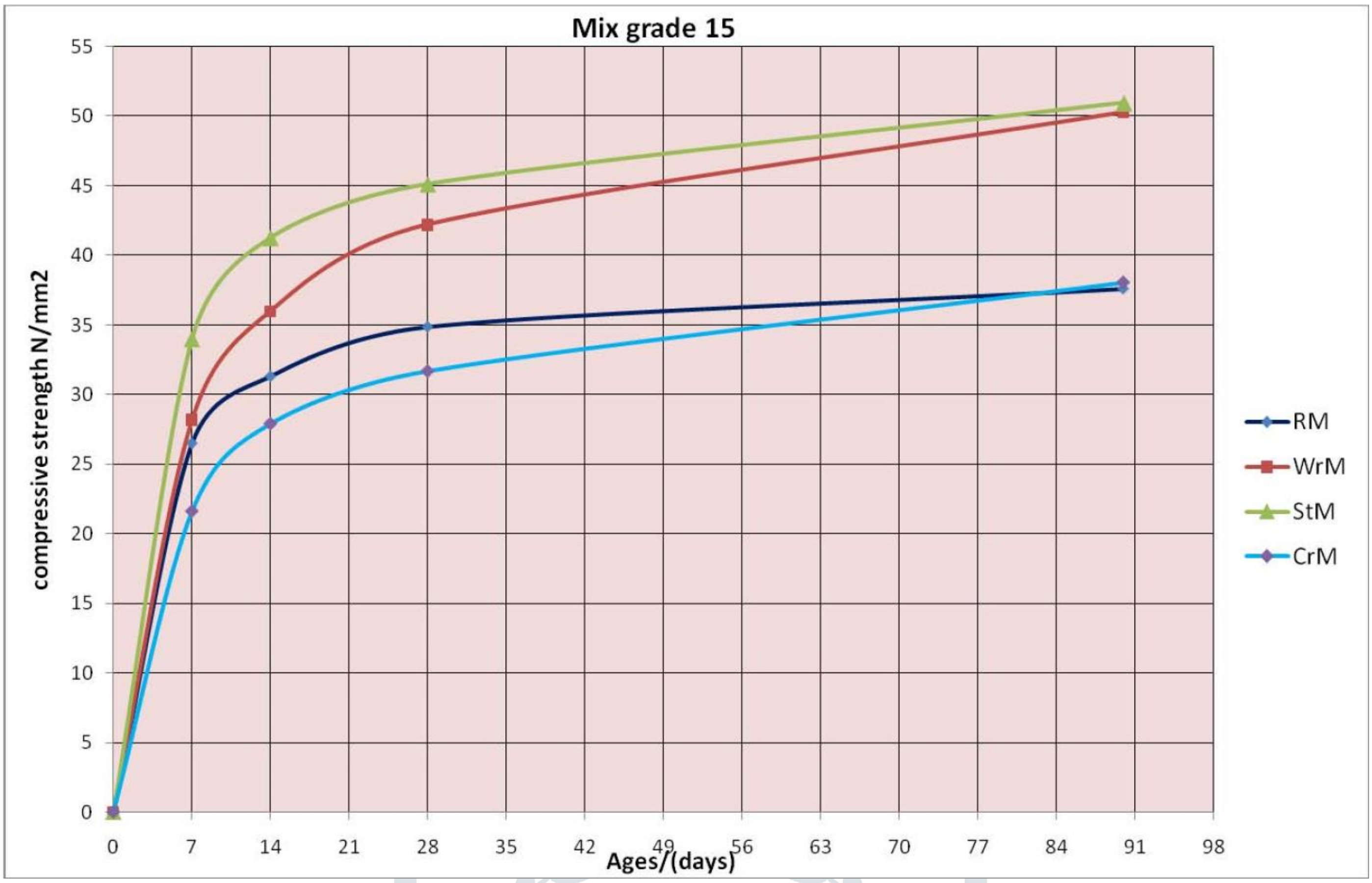

Figure (4.1) compressive strength development for different mixes grade 15

4.2. Workability

Slump test have been used as a measure of workability for the four mixes for each grade and the results are as follow:

Grade 15

Mix type	(RM)	(WrM)	(StM)	(CrM)
SLUMP/mm	55	160	60	50

For the grade the observation on slump are as follow:

a) The observed workability of mixes containing admixture (WrM) (reference mix with admixture to increase workability) was much higher than that of the ordinary reference mixes satisfying the first object of the research to increase workability.
b) As a result the concrete workability has been increased without adding water to the mix keeping same strength.
c) The amount of mixing water can be reduced when using admixture with concrete mixes designed for a given workability to improve specific properties (StM) & (CrM).

4.3 Compressive strength

Compressive strength results for the grade(M15) were obtained from the average of three cubes under the normal laboratory temperature and same curing conditions for 7, 14, 28 days. The ratio between the mixes containing admixtures and the reference mix are shown below:

Table No.: Grade 15:

Crushing strength of concrete containing Admixtures as compared to ordinary concrete

	Strength as percentage of reference mix			
Ages/days **Mix type**	**7**	**14**	**28**	**90**
(WrM)	106	116	121	133
(StM)	128	131	129	133
(CrM)	82	90	93	100

For the grade increased ratio of strength in mix (WrM) was in the range of :
(6 – 23)% for grade 15.
For the grade increased ratio of strength in mix (StM) was in the range of :
(28 – 33)% for grade 15.
For the grade ratio of strength in mix (CrM) was in the range of : (.8 – .92)% for grade 15.

V. CONCLUSION

5.1. Conclusion

The results from the teste for the grade (15) conducted on the fresh and hardened state of concrete mix lead to the following observations:

- Super plasticizers admixtures improve the workability without increasing water demand, for the three grades of concrete no decreasing in compressive strength was observed.
- Super plasticizers admixtures provide an increasing in ultimate strength gain by significantly reducing water demand in a concrete mix for the grade, without affecting workability.
- Super plasticizers admixtures reduce cement content up to 23%for the three grades without reducing the compressive strength and no effect on workability.
- Super plasticizers admixtures provide improved durability by increasing ultimate strength and reducing w/c ratio.
- Super plasticizers admixtures save cost of the reduced cement of about (4.5 – 8.9)% per cubic meter for the grade of concrete.

5.2. Future scope

- Further researches using admixtures should be conducted on concrete mixes with low and high workability.
- Further researches should be conducted on grades above 40N/mm^2.
- More studies have to be carried on the effect of using super plasticizers admixtures on the percentage reduced of cement content on the concrete mixes.
- More studies has to be carried on the effect of using admixtures in concrete mixes in the aggressive environment of Sudden to improve concrete properties such as strength, workability, durability, shrinkage, creep,…..etc.
- As per future perspective, we can use the admixtures without any hesitation to improve the quality of concrete properties like strength, workability, increase or decrease the setting time, reduce the water -cement ratio.

REFERENCES

[1] A.M. Neville "Properties of concrete" fourth and final edition. London , Longman 2000.
[2] A.M Neville. and J.J Brooks, "concrete technology" London ,Longman 1990.
[3] N.JACKSON "Civil Engineering Materials" second edition 1980.

[4] Abdul Nabi Ali Ahmed." A study of the properties of concrete containing admixture in the hot and dry environment of the sudan",proceeding of the first international conference on concrete technology for developing countries, Amman 1983.

[5] V.S.Ramachandran, Ed, "Concrete admixture handbook "properties science and technology",(Noyas publication. New Jersey,1984) .

[6] Gambhir M.L. "Concrete technology" second edition Tata McGraw- Hill 2001.

[7] E& FN Sponse "Chemical Admixtures for Concrete" third edition , London EC4P 4EE ,1999.

[8] C.S.Gulti, A.roy, J.B.Metcalf and R.K.Seals, Revised 21 April 1996. “The influence of admixtures on the strength and linear expansion of cement- stabilize phosphogypsum”.

[9] Prashant V. Ram and Jan Olek. “Influence of cement composition and admixture dosage on properties of rapid-setting SCC for repair application- lessons learned”, Purdue university, school of civil engineering west Lafayette IN-47907

[10] Takahiro Nishita and Hiroshi Takiyama.“Influence of admixture impurities on the crystal quality of inorganic phosphorous compound”.

[11] P.J. Sereda, R.F. Feldman and V.S Ramachandran., “Influence of admixtures on the structure and strength development”. Reprinted from 7th International congress on the chemistry of cement. Vol. I, Paris 1980 p. VI-1/32-VI-1/44.

[12] April 2010, The Indian concrete journal.“Compatibility Issues between Cement and Chemical admixtures in concrete”.

[13] Ariel Darvasi and Sagiv Shifman. “The beauty of admixture” Volume 37 No.2 Feb 2005.