International Journal of Latest Engineering and Management Research (IJLEMR)
ISSN: 2455-4847
www.ijlemr.com || REETA-2K16 ǁ PP. 815-824

Comparison of High Strength Concrete (M_{45}) Against Acid and Alkali Attack Using Different Superplasticizers

P.VIJAYKUMAR[1], K. NAVEEN KUMAR[2], Y. KRISHNA LOHITH REDDY[3]
[1]*P.G Student, Department of Civil Engineering, Shree Rama Educational Society Group of Institutions, Andhra Pradesh, India*
[2]*Assistant Professor, Department of Civil Engineering, Sri venkatesa perumal college of engineering, puttur, Andhra Pradesh, India*
[3]*Assistant Professor, Department of Civil Engineering, Shree Rama Educational Society Group of Institutions, Andhra Pradesh, India*

Abstract: Due to rapid urbanization, industries are increasing promptly day by day, therefore as a result of the pollution generated by industries acid precipitation was occurring. In view keeping in the mind, here we have a tendency to develop a new type of concrete using completely different super plasticizers. In this project we discuss concerning high strength concrete, i.e. M45 that ends up in a replacement construct in construction era. During this project we have a tendency to used three differing types of chemicals like 1.Sulphonated melamine formaldehyde (SMF) 2.Sulphonated naphthalene formaldehyde (SNF) 3.Polycarboxylic ether (PCE) By adding the above super plasticizers in several proportions, i.e. 0.5%, 1.0%, and 1.5% was used and also the tests were conducted like compression strength, split tensile test, acid resistance and resistance towards alkalinity were tested and checked the strength parameters in different proportions.
Keywords: Compatibility, Admixtures.

I. INTRODUCTION

Modern concretes almost always possess additives, either in the mineral form or chemical form. Particularly, chemical admixtures such as water reducers and set controllers are invariably used to enhance the properties of fresh and hardened concrete. A „Chemical Admixture is any chemical additive to the concrete mixture that enhances the properties of concrete in the fresh or hardened state. This does not include paints or coatings. ACI 116R [2000] defines the term admixture as „a material other than water, aggregates, hydraulic cement, and fiber reinforcement, used as an ingredient of concrete or mortar, and added to the batch immediately before or during its mixing . A number of types of chemical admixtures are used for concrete. The general purpose chemicals include those that reduce the water demand for a given workability (called 'water reducers'), those entraining air in the concrete for providing resistance to freezing and thawing action (called 'air entrainers'), and those chemicals that control the setting time and strength gain rate of concrete (called 'accelerators' and 'retarders'). Apart from these chemicals, there are others for special purposes namely, viscosity modifying agents, shrinkage reducing chemicals, corrosion inhibiting admixtures, alkali-silica reaction mitigating admixtures.

Apart from the multitude of chemical admixtures, a number of different types and brands of cement are also available in the market today. With the increasing number of types and brands of cement, as well as variants of the water-reducing chemicals, there are issues that arise related to the compatibility between these two ingredients of concrete. Most users apply a trial-and-error approach to these chemicals, often resulting in an unfortunate negative experience and/or low cost-effectiveness, which produce a bias against admixtures in general. Common problems that arise as a result of incompatibility between cement and water reducers are: rapid loss of workability, excessive quickening / retardation of setting, and low rates of strength gain. Very often, there even exists incompatibility between a particular chemical and a certain batch of the same otherwise compatible cement, indicating that the nature of the problem is complex, and needs further understanding. Moreover, high performance concretes, which are in wide use today, almost always incorporate a mineral admixture or filler such as silica fume, fly ash and limestone powder. This further complicates the physico - chemical behaviour of the cement-based system since the mineral admixtures play an important role in the evolution of the hydration reactions and the availability of free water during the early ages of concrete.

II. SUPER PLASTICIZER BASED CONCRETE AND APPLICATIONS

- In Ready-mix concrete
- In Precast concrete

- High-Performance concrete
- Shotcrete
- Fly Ash concrete.

A. Aims and Objectives

The aim of the research is to evaluate the performance and compatibility of type and dosage of super plasticizer on high strength concrete (M 45). The objectives include:

- To study the setting characteristics of super plasticizer paste.
- To optimize the mix to get paste of good workability.
- To study the effect of percentage of superplasticizer on the strength of concrete.
- To study the durability of concrete by sulphate attack (by using $MgSo_4$ curining).and also to study the percentage of weight loss as well as percentage of compressive strength loss by $MgSo_4$ solution 28 days curing.
- To study the durability of concrete by acid attack (by using HCl curining).and also to study the percentage of weight loss as well as percentage of compressive strength loss by HCl solution 28 days curing.

B. Scope of Work

The study contributes to the compatibility of super plasticizer on type and dosage of high strength concrete and also observes at which percentage and which type of super plasticizer will give good results. As far as possible the technology used for manufacture of ready-mix concrete and precast concrete. The concrete property studied is the compressive strength in relation with the percentage of superplasticizer added. The tests and analytical methods those were available for the OPC was used to predict the results. This study contributes the split tensile strength of concrete and flexural strength and also compares the results at which percentage it had given more strengths. And also study the durability of concrete by chloride attack as well as sulphate attack

III. ADMIXTURES

Admixtures is defined as a material, other than cement, water and aggregates that is used as an ingredient of concrete and is added to the batch immediately before or during mixing. Additive is a material which is added at the time of grinding cement clinker at the cement factory. Admixtures are chemicals which are added to concrete at the mixing stage to modify some of the properties of the mix. Admixtures should never be regarded as a substitute for good mix design, good workmanship, or use of good materials. These days concrete is being used for wide varieties of purposes to make it suitable in different conditions. In these conditions ordinary concrete may fail to exhibit the required quality performance or durability. In such cases, admixtures are used to modify the properties of ordinary concrete so as to make it more suitable for any situation.

A. What Are Admixtures?

Admixtures are natural or manufactured chemicals which are added to the concrete before or during mixing. The most often used admixtures are Fly ash, silica Fume, Air entraining agents, water reducers, water reducing retarders and accelerators.

B. Why We Use Admixtures?

Admixtures are used to give special properties to fresh or hardened concrete. Admixtures may enhance the durability, workability or strength characteristics of a given concrete mixture. Admixtures are used to overcome difficult construction situations, such as hot or cold weather placements, pumping requirements, early strength requirements, or very low water cement ratio specifications. Uses are

- Increase in workability
- Increase in strength
- Increase in cohesiveness and homogeneity
- Increase or decrease of setting time
- Increase in property of resistance of corrosion

- Increase in water proofing property
- Increase in dirability
- Increase in soundness

C. TYPES OF ADMIXTURES

1. Chemical admixtures

2. Mineral admixtures

1. Chemical Admixture

Chemical admixtures are added to concrete in very small amounts mainly for the entertainment of air, reduction of water or cement content, plasticization of fresh concrete mixtures, or control of setting time. Seven types of chemical admixtures are specified in ASTM 494, and AASHTOM 194, depending on their purpose or purposes in PPC. General and Physical requirements for each type admixtures which were used are included in the specifications.

- Air – Entrainment
- Water – Reducing
- Set – Retarding
- Accelerating
- Super Plasticizer

2. Chemical Admixture Used

The chemical admixture which we used in this present project is polycarboxylic ether.

Advantages

- Reduction in water- cement ratio.
- Optimization of cement content-cost savings.
- Considerably high early strength.
- Increased ultimate strength.
- Improved water tightness.
- Early removal of formwork.

- High quality concrete of lower permeability and improved durability

IV. WATER REDUCING CHEMICALS

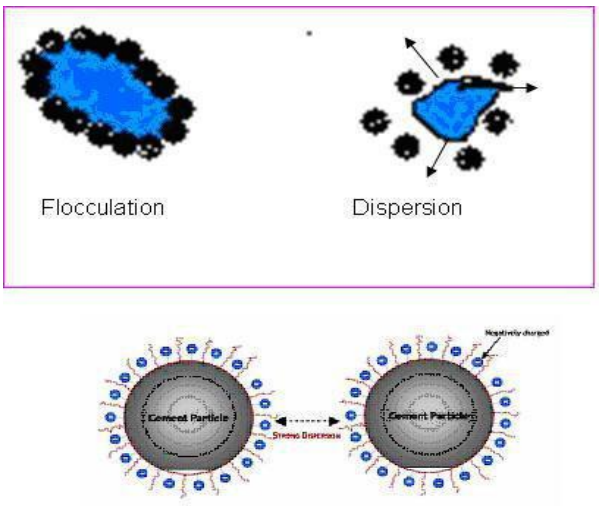


Fig.1 Mechanism of electrostatic repulsion (top) and steric hindrance (bottom)

A. Mechanism of Action of Water Reducer

Water-reducing chemicals belong to a group of chemicals known as „dispersants . The action of the

dispersant is to prevent the flocculation of fine particles of cement. These dispersants are basically surface - active chemicals consisting of long-chain organic molecules, having a polar hydrophilic group (water - attracting, such as $-COO^-$, $-SO_3^-$, $-NH_4^+$) attached to a non-polar hydrophobic organic chain (water-repelling) with some polar groups (-OH). The polar groups in the chain get adsorbed on the surface of the cement grains, and the hydrophobic end with the polar hydrophilic groups at the tip project outwards from the cement grain. The hydrophilic tip is able to reduce the surface tension of water, and the adsorbed polymer keeps the cement particles apart by electrostatic repulsion (The grinding of cement results in the ground particles having a surface charge (zeta potential). The adsorption of the admixture leads to a decrease of the zeta potential, and eventually causes like charges (negative) on the cement particles). With the progress of hydration, the electrostatic charge diminishes and flocculation of the hydrating product occurs.

B. Materials Used in Present Project

In the present investigation the following materials were used:

- Deccan-53 grade cement conforming to IS: 12269 – 1987.
- Fine aggregate and coarse aggregate conforming to IS: 383 – 1970.
- Super plasticizers(SMF, SNF, PC)

C. Cement

Cement is a binding material, which is the combination of two raw materials called calcareous and argillaceous materials. DECCAN -53 grade ordinary Portland cement conforming to IS: 12269 were used in concrete. The physical properties of the cement are listed in Table

Table1. Physical Properties of Deccan 53 Grade Cement

S.No	Properties	Results	IS : 12269-1987
1.	Specific gravity	3.09	-
2.	Standard consistency	29%	-
3.	Initial setting time	32 min	Minimum of 30min
4.	Final setting time	280 min	Maximum of 600min

D. Aggregates

A crushed granite rock with a maximum size of 20mm was used as a coarse aggregate. Natural sand from Swarnamukhi River in Srikalahasti was used as fine aggregate. The individual aggregates were blended to get the desired combined grading. The specific gravity and water absorption of the aggregate are given in table. The individual grading of aggregates is given in table2

Table2. Physical Properties of Aggregate

Specific gravity of coarse sand	2.60
Specific gravity of fine sand	2.56

E. Super Plasticizers

Super plasticizers are well known chemical admixtures for concrete used in the reduction of water to cement ratio without affecting workability, and to avoid particle aggregation in the concrete mixture. These are also known as high range water reducers (HRWR), fluidifiers, and dispersants as these are capable of reducing water to cement ratio by 40.0%. These chemical admixtures are added in the concrete just before the concrete is

placed. These admixtures help to improve strength and flow characteristics of the concrete.

Fig2.Superplasticizers used in concrete mix

V. EXPERIMENTAL DETAILS

A. Purpose

In the present proposal it is planned to conduct lab investigation using super plasticizers in various proportions such as 0.5%,1%and 1.5% respectively, for M45 grade of concrete. The main purpose of this investigation is to develop confidence among user agencies in India to use super plasticizers in a desirable proportion in all civil engineering constructions. The following tests were conducted on the concrete:

- Testing of materials (cement , sand ,aggregate)
- Compatibility of superplasticizer on compressive strength
- Compatibility of super plasticizer on split tensile strength
- Compatibility of super plasticizer on durability test by acid (HCl) attack
- Compatibility of super plasticizer on durability test by sulphate($MgSO_4$) attack Analyzing the which super plasticizer will give good results respective tests above mentioned

A. Tests for Fresh Properties of Cement:

1. Specific Gravity Test

The specific gravity of cement is determined by using density bottle of capacity 50ml. The procedure for determination of specific gravity of cement is as follows

Fig3. Specific Gravity Bottle

B. Compressive Strength Equipment:

Compressive Strength = (LOAD IN N/ AREA IN mm^2)

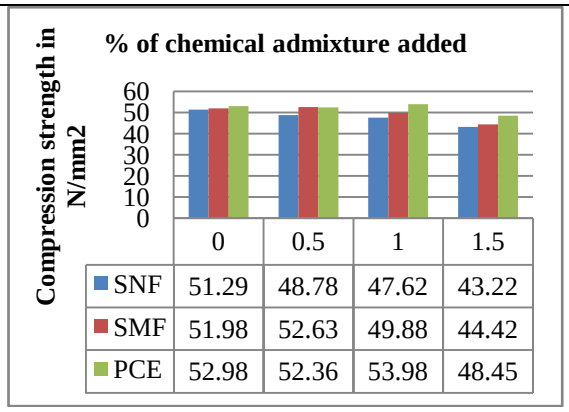
Fig4. Compression strength of concrete cube.

Fig5. Fracture in the concrete cube.

VI.RESULR AND DISCUTIONS

COMPRESSIVE BEHAVIOUR: The 28-days compressive strength of High Strength Concrete is discovered to be beyond that of conventional concrete. The strength increase is observed in HSC when the chemical admixture mixed may be attributed, the rationale for that's, the water content decreases than the conventional concrete. The compression strength of concrete cubes for varied share of chemical admixtures intercalary is shown within the table. From tables, it will be discovered that because the share of chemical admixture like S.M.F and S.N.F will increase, compressive strength of concrete combine decreases.

It will be discovered that because the share of chemical admixture at one hundred and twenty fifth like P.C.E will increase, compressive strength of concrete combine increase and compressive admixture will increase on top of one hundred and twenty fifth once P.C.E is used. This a very important purpose to stay in mind chemical admixture once intercalary to concrete ends up in increase of compressive strength solely within the case of P.C.E. however the compressive strength of concrete with alternative chemical admixtures is small than the concrete with S.N.F and S.M.F. therefore whenever we have a tendency to are addressing HSC choosing appropriate chemical admixture is added for higher bond formation in concrete matrix. The percentage decrease in compressive strength is a lot of in 1% volume replacement of cement with S.N.F and S.M.F. The average percentage decrease in compressive strength of concrete with S.N.F and S.M.F is 8.65% and average percentage increase in compressive strength of concrete by adding P.C.E is 1.69%.



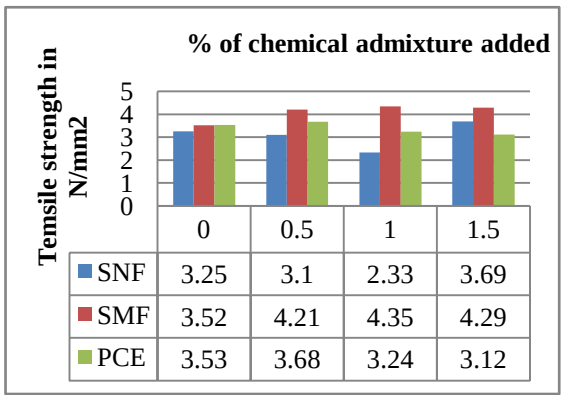
	0	0.5	1	1.5
SNF	51.29	48.78	47.62	43.22
SMF	51.98	52.63	49.88	44.42
PCE	52.98	52.36	53.98	48.45

Fig.6. Compressive strength of a cube after 28 days of curing showing variation of concrete M45 grade with different admixtures added.

SPLIT TENSILE BEHAVIOUR: The 28-day split tensile strength of each conventional concrete while not and with super plasticizer of High Strength Concrete were evaluated. The split tensile strength of concrete is observed to be higher once P.C.E is added. The explanations for increment in split tensile strength are same as that of compressive strength as explained higher than .From the table, it can be observed that the percentage of chemical admixture accessorial increase increase tensile strength up to a 1% for S.N.F and S.M.F. As proportion admixture increase on the far side that resulted in reduction of tensile strength of concrete.

Hence when load applied on the specimen crack starts on the specimen slowly and extends. The tensile strength of concrete with P.C.E decreases chemical admixture at 0.5% and beyond 0.5% the tensile strength decreases. However these results when compared while not chemical admixture and its strength enhanced. However when placed with reduction in compressive strength, tensile strength reduction is moderate.

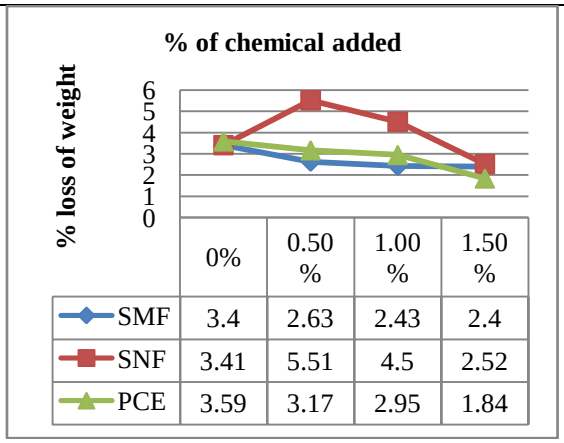
The percentage decrease in tensile strength is additional in 0.5% volume replacement of cement with and without chemical admixture of SMF and SNF will increase. The average percentage decrease in tensile strength of concrete with SMF and SNF is18.65% and average proportion decrease in tensile strength of concrete with increase in P.C.E is 7.5%.



	0	0.5	1	1.5
SNF	3.25	3.1	2.33	3.69
SMF	3.52	4.21	4.35	4.29
PCE	3.53	3.68	3.24	3.12

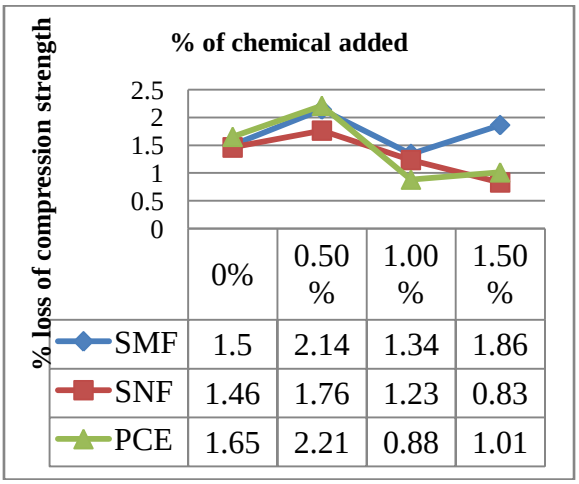
Fig.6. Tensile strength of a cube after 28 days of curing showing variation of concrete M45 grade with different admixtures added.

ACID ATTACK TEST: The concrete cube specimens of different concrete mixtures of size 150 mm were forged and after 28 days of water curing, the specimens were take away from the curing tank and allowed to dry for 24 hours. The weights of concrete cube specimen were taken. The acid attack test on concrete cube was conducted by immersing the cubes in the acid water for 90 days after 28 days of curing. Acid (HCL) with pH of regarding two at 5% by weight of water was added to water during which the concrete cubes were placed in. The pH was maintained throughout the time period of 90 days. When 90 days of immersion, the concrete cubes were taken out of acid water. Then, the specimens were tested for compressive strength. The resistance of concrete to acid attack was found by the % loss of weight of specimen and also the % loss of compressive strength on immersing concrete cubes in acid water



	0%	0.50 %	1.00 %	1.50 %
SMF	3.4	2.63	2.43	2.4
SNF	3.41	5.51	4.5	2.52
PCE	3.59	3.17	2.95	1.84

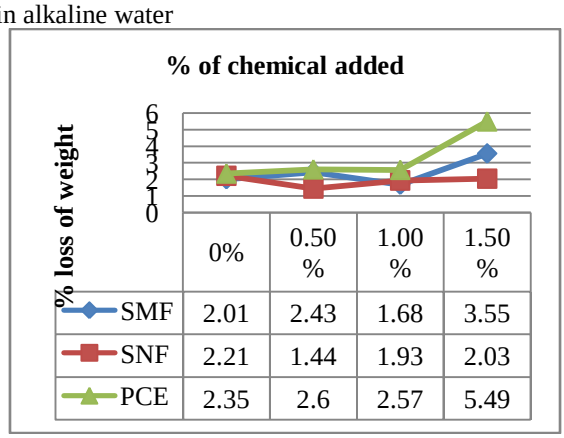
Fig.8 % loss of weight reduction of cubes in acid curing after 28 days



	0%	0.50 %	1.00 %	1.50 %
SMF	1.5	2.14	1.34	1.86
SNF	1.46	1.76	1.23	0.83
PCE	1.65	2.21	0.88	1.01

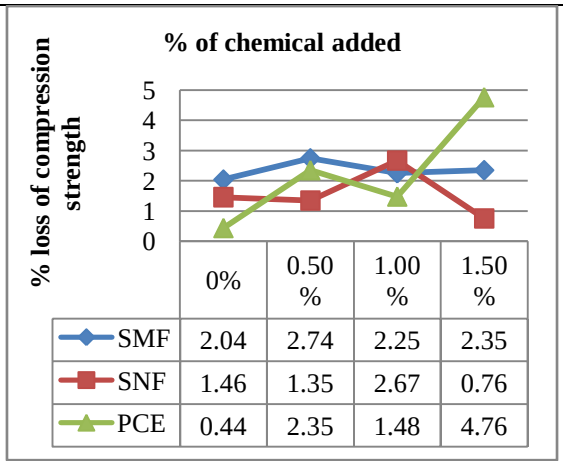
Fig.9 % loss of compressive strength reduction of cubes in acid curing after 28 days

ALKALI ATTACK TEST: To determine the resistance of different concrete mixtures to chemical bases attack, the residual compressive strength of concrete mixtures of cubes immersed in basic water having 5% of sodium hydroxide (NaOH) by weight of water was found. The concrete cubes that were cured in water for 28 days were taken from the curing tank and allowed to dry for few hours. The weights of concrete cube specimen were taken. Then the cubes were immersed in base water unceasingly for 90 days. The pH scale of water was maintained same throughout the period. Once 90 days of immersion, the concrete cubes were taken out of base water. Then, the specimens were tested for compressive strength. The resistance of concrete to base attack was found by the percentage loss of weight of specimen and also the weight loss of compressive strength on immersion of concrete cubes in alkaline water



	0%	0.50 %	1.00 %	1.50 %
SMF	2.01	2.43	1.68	3.55
SNF	2.21	1.44	1.93	2.03
PCE	2.35	2.6	2.57	5.49

Fig.10 % loss of weight reduction of cubes in alkali curing after 28 days



	0%	0.50 %	1.00 %	1.50 %
SMF	2.04	2.74	2.25	2.35
SNF	1.46	1.35	2.67	0.76
PCE	0.44	2.35	1.48	4.76

Fig.11 % loss of compressive strength reduction of cubes in alkali curing after 28 days

CONCLUSION:

- The average decrease in compressive strength of concrete with S.N.F and S.M.F is decreases and average gain of strength increase when compressive strength is tested of concrete by adding P.C.E is 53.98N/mm^2 when the chemical added of 1.0%
- The share decrease in durability could be a heap of in 0.5% volume of super plasticizer is added to cement when SMF and SNF can increase.
- The principal objective of the study is to High strength concrete by adding super-plasticizers in many volume proportions (0.5%,1%,1.5%) is to increase the strength of concrete.
- Compared the behaviour of M45 grade concrete (1:0.47:0.49:0.37)) by adding super plasticizers with nominal concrete the strength parameter changes.
- The mechanical properties like compressive strength and durability found. When the acid attack test is performed, tremendorous results were achieved when compared to conventional concrete to super plasticizer added concrete.
- The percentage loss of weight reduction in acid curing decreases with the increase of chemical content with PCE. Whereas these % loss in weight reduction in acid curing is increased in case while SNF is added.
- The % loss in weight reduction in acid curing is high with 0.5% of SNF chemical. But this reduction was low with 1.5 % of chemical content.
- The % loss in compressive strength reduction in acid curing is decreased when the chemical is at optimum percentage.
- The % loss in compressive strength reduction in acid curing is high with 1.5% of chemical content. Whereas the % loss in compressive strength reduction in acid curing is low at 1.0% of chemical content.
- It is observed that the percentage loss of weight reduction in alkali curing decreases with the increase of chemical content and there after it shows a different criteria. Whereas these % loss in weight reduction in alkali curing is decreased in case of SNF at 0.5%.
- The % loss in weight reduction in alkali curing is high with 1.5% of chemical content. Whereas the % loss in weight reduction in alkali curing is low with 1.0% of chemical content.
- The % loss in compressive strength reduction in alkali curing is high with 1.5% of PCE chemical content. Whereas the % loss in compressive strength reduction in alkali curing is low with 1.5% of SNF chemical.

REFERENCES:

[1]. Effects of hydrochloric acid in mixing and curing with water on strength of high-performance metakaolin Concrete by E. Arunakanthi1, H. Sudarsana rao and I.V.Ramana reddy
[2]. International Journal of Science and Technology Volume 1 No. 9, September, 2012
[3]. Effect of Hydrochloric Acid (hcl) on Blended Cement (Fly Ash based) and Silica Fume Blended Cement and their Concretes by B. Madhusudhana Reddy, H Sudarsana Rao, M.P George Civil Engg. Dept., JNTUA, Anantapur, Andhra Pradesh, India ICS, JNTUA, Anantapur/
[4]. Evaluation of Superplasticizer Performance in Concrete by Manu Santhanam Associate Professor, Department of Civil Engineering, IIT Madras

[5]. Effect of superplasticizer dosages on compressive strength of self compacting concrete Rahul Dubey, Pardeep Kumar Research Scholar, Department of Civil Engineering,NIT Hamirpur (HP), India. Associate Professor, Department of Civil Engineering, NIT Hamirpur (HP) India
[6]. Superplasticizer Polymeric Additives Used in Concrete daniela fiat1, mirela lazar1, victoria baciu1, gheorghe hubcap
[7]. ARPN Journal of Engineering and Applied Sciences
[8]. Effect of concentration of alkaline liquid and curing time on strength and water absorption of geopolymer concrete by Anurag Mishra, Deepika Choudhary, Namrata Jain, Manish Kumar, Nidhi Sharda and Durga Dutt
[9]. Polycarboxylate superplasticiser admixtures: Effect on hydration, microstructure and Rheological behaviour in cement pastes F. Puertas*, H. Santos*, M. Palacios* and S. Martı´nez-Ramı´rez
[10]. American Journal of Engineering Research (AJER)
[11]. Effect of Superplasticizer on Fresh and Hardened Properties of Self-Compacting Concrete Containing Fly Ash S. M. Dumne
[12]. International Journal of Applied Engineering and Technology
[13]. International journal of civil and structural engineering