An Experimental Study on Effect of Various Accelerators on Strength Parameters of Concrete

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Abstract- *This dissertation presents an experimental study conducted on concrete cubes and beams to find out the effect of accelerators on compressive and flexural strength of concrete at standard days of curing with water. In this experimental study Ordinary Portland Cement (OPC) was used to produce concrete mixtures specimen of grade M20 and M30. Concrete mixtures for this experimental study were designed as per the new guidelines of IS 10262:2009. Three accelerators Potassium Carbonate, Sodium nitrite and calcium nitrite were used. Both compressive strength and flexural strength of standard specimens of concrete mix with accelerators have been recorded at one, three, seven, fourteen and twenty-eight days of curing with water and compared with strengths of controlled specimens at their corresponding ages. The test results exposed that the maximum percentage gain was observed for Calcium nitrite accelerator out of three accelerators at 1, 3, 7, 14 and 28 days compressive and flexural strength parameter for both M20 and M30 grade of concrete. Also discovered there is a very little change in 28 days compressive strength and flexural strength with all three accelerators for both M20 and M30 grade of concrete.*

I. INTRODUCTION

GENERAL

At the beginning of the 20th century, sprayed concrete technology was born. Originally, it was utilizationd to imitate the rock and in no-engineer applications such as taxidermy. In all of them, the concrete had a rather esthetical function with a very low structural responsibility. The development of the wet-mix system and the utilization of the sprayed concrete as a part of the new Austrian tunnelling method (NATM) marked an increase in the utilization and in the structural responsibility of the material, with special importance in underground construction.

In these constructions, the quality and the thickness of the sprayed layer was closely related with the stability and the support provided by the ground. In most cases, to achieve a stable layer it was necessary to add accelerators to the material. These admixtures interacted with the mix, accelerating the chemical reactions and reducing the setting time of the concrete.

The definitions of the thickness or the mix composition were based on trial and error and previous experiences. However, problems still existed regarding the technical decisions during the excavations since the scientific and theoretical bases for the structural design and the quality control were not sufficiently established. To overcome such deficiency, several studies regarding the properties of sprayed concrete were conducted. As a result, different recommendations and guidelines were proposed.

These days, sprayed concrete is utilizationd in many applications with clear structural responsibility. In order to minimize the cost and the construction time, a tendency towards the reduction of sprayed layer is observed. Furthermore, an ever-growing pressure for the utilization of environmentally friendly materials that lead to less contamination and a safer workplace is observed. To cope with these trends, cements and accelerators that provide a better performance were developed.

The utilization of new materials creates a special type of sprayed concrete. Moreover, the requirement of thinner layers lead to an increase in the level of stress applied and, consequently, in the structural requirements. It is obvious that more studies are still needed to achieve an optimized design with the new materials. Table 1.1 shows some of the issues that must be addressed in order to promote the efficient utilization of sprayed concrete.

II. LITERATURE REVIEW

The relevant literature pertaining to the present research carried out in India and abroad has been reviewed and presented as under:-

M. Mazloom et al. (2000) explored the impact of metakaolin, fly powder, silica smoke And Ground granulated impact furnance slag on the underlying and last setting time of cement. The normal impact of silica smoke, metakaolin, fly

cinder and ground granulated impact heater is to impede the setting times of cement. The utilization of Ground granulated impact heater at substitution levels of 40% brought about huge hindrance in setting times of concrete. For high-quality cement containing metakaolin, there was a dynamic increment in the hindering impact up to 10% substitution levels. Be that as it may, at a higher substitution level of 15%, the hindering impact seems to diminish in the solid.

A. Sivakumar et al. (2002) Concentrate the properties of Concrete that can be delivered with extensive substitution of bond by fly slag in blend and with Calcium nitratre as quickening agent. Tests were directed on various solid examples, where fly cinder was supplanted with bond up to 30%. Bond substitution up to 30% fly fiery debris reflects early age quality pick up marginally lower than cement made with 20% fly cinder. Higher fine- to-coarse-totals proportion with 1% quickening agent indicated higher quality at early ages.

D. P. Bentz (2006) explored the impact of three antacid to be specific lithium, potassium, and sodium, on the hydration rates of concrete glues. The review demonstrated that these three salt are promptly solvent in water and are effortlessly joined into the concrete hydration items, and they adjust the morphology of the calcium silicate organize. The diverse soluble base increases displayed regular impact as speeding up of early age hydration.

R. Duval et al. (2006) The reason for this work is to research the impact of calcium nitrate, calcium nitrite and triisopropanolamine, on the setting and solidifying time of concrete glues. The outcomes uncovered both calcium nitrite and triisopropanolamine performed well as a solidifying quickening agent at all ages free of the concrete sort utilized. The mix of calcium nitrate with either calcium nitrite or tri-isopropanol amine brought about lessening in the underlying and last setting process and a quality upgrade at all periods of the concrete glues, especially at early ages. Tri-isopropanolamine is more proficient as far as increment in quality than calcium nitrite when utilized as a part of equivalent measurements.

Mushtaq Ahmed Bhavikatti et al. (2012) explore the part of non-chloride solidifying quickening agent on the different properties of asphalt cement at ahead of schedule and later age, created with Pozzolana Cement. Compressive and flexural qualities of standard research center examples, cured with water were done at early age and at its full development. Result demonstrate that Accelerator was additional viable in expanding the flexural quality than compressive quality of the composed solid blend of review M40.Maximum rate pick up in compressive quality recorded at two day of water curing with most extreme measurements of quickening agent.

Vilas V. Karjinni et al. (2012) Directed a trial work that is clarifies the Combined impacts of a business non-chloride solidifying quickening agent and technique for curing in the quality advancement of asphalt cement. Conventional Portland bond was utilized to deliver solid blends of review M40 in this investigation. The outcome shows that Interaction of the quickening agent was better at three and five day in the solid blends cured with water and at one day in similar blends cured with curing compound. The test demonstrates Average productivity of the curing compound was observed to be higher at early-age than at later-age.

Mushtaq Ahmed Bhavikatti et al. (2012) Concentrate the communication of non- chloride solidifying quickening agent with conventional Portland bond (opc) and Portland pozzolana bond (ppc) and technique for curing in the quality advancement of solid blend business wax based film shaping curing compound, was utilized for curing in the trial think about. The outcome showss that the communication of quickening agent was better at three and five day in the opc blends cured with water and at one day in similar blends cured with curing compound. Normal proficiency of the curing compound was observed to be more for PPC blends than for OPC blends. Along these lines result indicates Curing compound was more compelling in PPC blends.

A study performed by Han et al. (2013) performed to determine the effect of Water reducing admixtures on strength of concrete investigated the effect of various HRWR dosages to cement ratios (by mass), in the range from 0 to 1.2%. These dosages were studied for a high and low w/cm ratio. The optimum HRWR dosage leading to the ideal dispersion of cement particles in the mortar and maximum compressive strength was found to be 1% for the w/cm ratios studied (0.3 and 0.6).

Pilli Narendra Babu , K. Sundara Kumar (2016) study the effect of adding sodium nitrate in concrete on its performance. It is decided to explore compressive strength, Split tensile strength, and Flexural strength of concrete on addition of different percentages of sodium nitrate. For this Mix proportions of OPC concrete for M30 by IS method (9103-1999) were determined. The mix proportion with partial addition such as 1%, 1.5%, 2%, 2.5% and 3% of sodium nitrate with OPC were calculated. At sodium nitrate content of 2.5 % by weight of cement, the concrete attained maximum compressive strengths in terms of compressive, split tensile strength and flexural strength of concrete for M30 grade of concrete. Hence the accelerating effects and other benefits of

sodium nitrate as an admixture to concrete can be tapped by limiting the admixture content up to 2.5% by weight of cement.

Zhang et al. (2017) the accelerator is a necessary admixture in shotcrete and its quality can greatly affect shotcrete performance. They propose a new liquid accelerator characterized by short initial and final setting time, small dosage, and good adaptability to cement. Laboratory tests and field tests are conducted to verify the influence of this liquid accelerator on performance of shotcrete. Numerical simulation is carried out to study the strength growth of shotcrete with time and interaction between the strength and stress release of surrounding rock. The results show that the initial and final setting time of this liquid accelerator is 2 minutes and 4 minutes respectively. Its dosage is just 1.5% to 4% of the cement quantity. Adding this liquid accelerator can effectively improve the early strength and reduce the later strength loss of shotcrete, and therefore enhance the supporting effects of shotcrete on surrounding rock. In the field application, it is an ideal liquid accelerator for shotcrete, characterized by little resilience, no slurry shedding, and low dust.

P.Jagadeesh and S.khaviya (2017) investigated the effect of chemical admixtures on various grades of concrete. The Chemical admixtures used for the concrete were High Range Water-Reducers hence they achieve early high strength in the period of 12 hours. Here they used various chemical admixtures in concrete and compared the strength with the conventional concrete. When using chemical admixtures in concrete the workability of the concrete is improved under lower water-cement ratio, when compared to conventional concrete where the water-cement ratio is high.

III. MATERIAL INVESTIGATION

The materials used in preparation of concrete cube and beams to obtained objectives of study are described as follows:

3.1 Cement

It is a gray colour powdery substance created with calcium oxide and clay in clinker. it's mixed with sand and water to make mortar or mixed with sand, gravel, and water to create concrete.

3.1.1 The History of Cement

The record of establishing material is as old as the historical backdrop of building development material. Some different sort of solidifying materials were used by Egyptians, Romans and Indians in their old fashioned developments. It is trusted that the old Egyptians fundamentally utilized solidifying materials, gotten by consuming gypsum. Very little light has been tossed on solidifying material, utilized as a part of the improvement of the urban communities of Harappa and Mohenjadaro. In the early ages Greeks and Romans utilized establishing materials acquired by consuming of lime stones. The noteworthy hardness of the mortar utilized as a part of early Roman brickworks, some of which still exist, is showing adequate confirmation of the flawlessness that the specialty of solidifying material had earned in old circumstances. The predominance of Roman mortar has been credited to exhaustiveness of mixing and since a long time ago kept smashing. The Greeks and Romans later ended up noticeably mindful of the very certainty that specific volcanic cinder and volcanic shake, when blended with lime and sand yielded mortar having predominant quality and higher solidness in new or salt water. Roman manufacturers utilized volcanic tuff discovered near Pozzuoli town close Mount Vesuvius in italy. This volcanic tuff or fiery debris essentially silicious in nature in this manner gained the name Pozzolana. Later on, the name Pozzolana was connected to some other material, normal or manufactured, having close creation as that of volcanic tuff or fiery debris found at Pozzuoli.

The Romans, without regular volcanic cinder, utilized fueled tiles or ceramics as Pozzolana material. In India, engaged block named surkhi has been utilized as a part of mortar. The Indian routine with regards to through blend and since quite a while ago kept slamming of lime mortar with or without the expansion of Surkhi yielded strong and impenetrable mortar that affirmed the mystery of predominance of Roman mortar. It is discovered that the Romans included blood, drain and fat to their mortar and cement to accomplish higher workability. Hemoglobin is an effective air-entraining operator and plasticizer, which perhaps is yet another explanation behind the strength of Roman structures. Most likely they didn't grasp the solidness side however utilized them as workability operators. The solidifying material made by Romans abuse lime and regular or counterfeit Pozzolana protected its position as the head building material for all development work, especially, for pressure driven development. Belidor, an essential specialist in water powered development, prescribed intensive blend of tiles, stone chips, and scales from a smithy's fashion, mindful ground, washed free from coal and soil, dried and filtered and after that blended with crisp slaked lime for making sensible cement.

When we tend to come back to more up to date times, the most critical progress inside the data of concretes, the herald to the disclosures and fabricate of every current bond is undoubtedly the examinations completed by John Smeaton.

When he was known as upon to reproduce the Eddystone Light-house in 1756, he made top to bottom enquiries into the condition of workmanship existing back then and conjointly led tries different things with a view to see out the best material to oppose the extreme activity of sea water. At long last, he presumed that lime-stones that contained extensive extent of clayey matter yielded better lime having better water driven properties. Disregarding the accomplishment of Smeaton's examinations, the utilization of water powered lime gained next to no ground, and the old see of blend of lime and pozzolana stayed basic for a repetitively extended sum. In 1976 water powered concrete was made by calcining knobs of clayey lime-stones. In around 1800 the item consequently acquired was known as Roman concrete. This sort of bond was being used until concerning 1850 when this was obsolete by Portland concrete.

3.1.2 Early History of Modern Cement

The examinations of L.J. Vicat drove him to set up a man-made water driven lime by calcining a personal blend of limestone and mud. This strategy could be viewed as the most imperative information to the fabricate of Portland bond. James Frost likewise protected a bond of this kind in 1811 and built up a plant in United Kingdom. The credit of the creation of Portland concrete is, in any case, ascribed to Joseph Aspdin, an effective manufacturer and understudy, despite the fact that comparative trial had been embraced by different designers. Joseph Aspdin took the patent of Portland bond on 21st October 1824. The favour name of Portland was offered attributable to the comparability of this solidified result of concrete to the common stone happening at Portland in European nation. In his procedure Aspdin blended and ground hard lime stones into fine powder and finely separated dirt into the sort of slurry and calcined it in a to a great degree heater simply like a lime furnace until the carbon dioxide was removed. The blend so calcinated was then grounded to a fine powder. In this procedure conceivably a temperature lower than the clinkering temperature was used by Aspdin. Later in 1845 Isaac Charles Johnson consumed a blend of dirt and chalk until the clinkering stage to make enhanced bond and built up plant in 1851. In the early period, concrete was utilized for making sand mortar as it were. Later on the utilization of bond was broad for making concrete expediently. As the utilization of Portland bond was expanded for making solid structure in the development business, engineers called for deductively higher standard material to be utilized as a part of real works. Relationship of Engineers, Consumers and Cement producers have been built up to detail principles for bond. Right off the bat The German standard particular for Portland concrete was stirred up in 1877. The British standard determination was first attracted up 1904. The main ASTM particular was issued in 1904. Portland concrete was first produced in 1904 close Madras in India, by the South India Industrial Ltd. Be that as it may, this venture unsuccessful. the Indian Cement Co. Ltd., was built up at Porbander (Gujarat) Between 1912 and 1913 and by 1914 this Company was able to convey around a thousand tons of Portland bond. By 1918 three production lines were built up. Together they were prepared to convey around 85000 tons of concrete for every year. Amid the initial Five-Year arrange (1951-1956) bond creation in Republic of India rose from 2.69 million tons to 4.63 million tons. By 1969 the aggregate creation of bond in India was 13.8 million tons and Republic of India was then involving the ninth position on the planet, with the USSR delivering 89.6 million tons and the generation of USA was around 70.5 million tons. Preceding the produce of Portland bond in Republic of India, it was transported in from Great Britain and just a couple strengthened solid structures were worked with imported concrete. A three storied building worked at Byculla, Mumbai is one of the most established RCC structures utilizing imported Portland concrete in Republic of India. A solid stone work expanding on Mount Road at Madras (1903), the har-ki-pahuri connect at Haridwar (1908) and the Cotton Depot Bombay (1922), at that point a standout amongst the most imperative of its kind inside the world are a portion of the most seasoned solid structures in Republic of India. The early logical investigation of concretes neglected to uncover much with respect to the synthetic responses that occur at the season of consuming. A logical investigation of the way that the clayey constituents of limestone are in charge of the water driven properties in lime (as set up by John Smeaton) wasn't taken for any exploration. It might be specified that among the before bond technologists of the world, Vicat, Le Chatelier were the pioneers inside the hypothetical and commonsense field. Precise work on the piece and compound response of Portland bond was initially started in the United Kingdom. The logical review on setting of concrete was attempted by the Bureau of Standards in more profound way and since 1926 much work on the investigation of Portland bond was likewise directed by the Portland concrete Association,

U.K. At this point, the produce and utilization of Portland concrete had spread to a few nations. Methodical work on bonds and major logical commitments to the science of Portland concretes were completed in Federal Republic of Germany, Italy, France, Sweden, Canada and USSR, notwithstanding Britain and USA. In Great United Kingdom with the foundation of Building logical research Station in 1921 a precise research program was embraced and bunches of most vital commitments are made. Early literary works on the improvement and utilization of Portland bonds is additionally composed inside the Building Science Abstracts

distributed by Building research Station United Kingdom. Since 1928, "Documentation Bibliographique" issued quarterly in France and since 1948 "Handbuch der Zement Literature" in Germany.

3.1.3 Types of Cement

The various types of cement used in construction industry are as follows

- OPC
- OPC confirming 33 Grade– IS 269: 1989
- OPC confirming 43 Grade– IS 8112: 1989
- OPC confirming 53 Grade– IS 12269: 1987
- Rapid Hardening Cement confirming IS 8041: 1990
- Sulphate Resisting Cement confirming IS 12330: 1988
- High Alumina Cement confirming IS 6452: 1989
- Portland Slag Cement confirming IS 455: 1989
- Concrete Sleeper grade Cement confirming IRS-T 40: 1985
- Super Sulphated Cement confirming IS 6909: 1990
- Low Heat Cement confirming IS 12600: 1989
- Portland Pozzolana Cement confirming IS 1489 (Part I) 1991 (fly ash based), IS 1489 (Part II) 1991 (calcined clay based)
- Oil Well Cement confirming IS 8229: 1986
- Coloured Cement: White Cement confirming IS 8042: 1989
- Hydrophobic Cement confirming IS 8043: 1991
- Masonry Cement confirming IS 3466: 1988

3.2 Aggregates

Totals are the imperative constituents in solid mass. They offer quality to the solid, decrease shrinkage and impact economy of structure. Prior, totals were considered as artificially idle materials however presently it has been archived that some of the totals are synthetically dynamic and conjointly that guarantee totals display exceptionally solid concoction bond at the interface of total and solid glue. The notable reality that the totals possess 70–80 for every penny of the volume of cement, their effect on different compound attributes and properties of cement is without doubt impressive. To perceive a considerable measure of properties with respect to the solid it's extremely basic that one ought to know a great deal of in regards to the totals that constitute real volume in bond concrete. Without the through investigation of the total qualities and range and properties, the investigation of the solid is inadequate. Bond is the main manufacturing plant made standard restricting component in cement. Different elements of cement, in particular, water and totals are common happening materials and will change to any degree in a few of their properties.

3.2.1 Classification of Aggregate

Aggregates can be classified as

- Normal weight aggregates,
- Light weight aggregates and
- Heavy weight aggregates.

Normal weight aggregates also further classified on the basis of occurrence as natural aggregates and artificial aggregates. Aggregates can also be classify on the basis of the size of the aggregates as coarse aggregate and fine aggregate.

3.2.2 Source of Aggregate

All regular total materials get from parent bed shakes in the peak. The stones can be arranged three sorts in particular, molten shake, sedimentary and changeable. These characterizations depend on the method of arrangement of rocks at the season of peak. The volcanic rocks are chiefly shaped by the cooling of liquid magma or magma at the plane of the earth (trap and basalt) or far below the peak of the earth (stone). The sedimentary rocks are framed initially beneath the sea bed by the sedimentation of little split rocks particles and in this way lifted up by the different structural exercises. Changeable rocks are initially either molten or sedimentary rocks which are a short time later transformed because of climatic outrageous warmth and weight. The properties that makes total for solid making are influenced to some rank on the premise of land properties of the parent shakes together with the progressive procedures of weathering, extraordinary environmental change.

3.2.3 Size of Aggregate

The largest maximum size of aggregate feasible to handle easily under a given set of conditions at the site should be used. Perhaps, 80 mm size is the maximum size that could be suitably used at site for concrete making. Using the largest possible maximum size will result in

- reduction of the cement quantity in the concrete mix
- reduction in water requirement for hydration of cement
- reduction of drying shrinkage in the matrix

However, the maximum size of aggregate that can be used in any given set of condition may be limited by the following conditions:

(i) Thickness of section;
(ii) Spacing of reinforcement;
(iii) Clear cover;
(iv) Mixing, handling and placing techniques.

Aggregates are separated into two categories depending on size
(i) Coarse aggregate and
(ii) Fine aggregate. The size of aggregate bigger than 4.75 mm is considered as coarse aggregate and aggregate having size is 4.75 mm and less is considered as fine aggregate.

3.2.4 Shape of Aggregate

The state of totals is a noteworthy trademark since it influences the workability of crisp cement. It is exceptionally hard to truly gauge and characterized the state of sporadic body like total utilized as a part of solid which are gotten from different rocks. the state of totals depends Not just the normal for the parent shake additionally the kind of crusher utilized e.g., the stones accessible indirect Pune(Maharashtra) locale are found to yield impressively flaky totals, while, great stone shake will yield cubical total as found in Bangalore. The state of the total is especially influenced by the sort of crusher utilized for making total at plant and the lessening proportion i.e., the proportion of size of material sustained into crusher to make total to the span of the completed item. Many rocks contain planes of separating or joints and overlap which is normal for its arrangement. It likewise mirrors the inner petro realistic structure of the stone. Accordingly of these got trademark, schists, slates and shales ordinarily turn out flaky structures, while, rock, basalt and quartzite typically shaped pretty much equi-dimensional total. Essentially, quartizite, a sedimentary shake which does not have cleavage planes produces cubical shape totals.

3.3 Water

Water is basic element of concrete as it effectively partakes in the concoction response (hydration) with bond. Since it offers quality to the bond gel, the amount and nature of water is required to be investigated painstakingly. By and by, all the time awesome control on properties of bond and total is practiced for making concrete, yet the control on the nature of water is frequently disregarded. Since nature of water influences the quality of solid, it is vital for us to go into the virtue and nature of water.

IV. EXPERIMENTAL ANALYSIS

In this thesis OPC of Grade-43 strictly conforming to IS 8112 was used. It was tested before use as per Indian standard specification, whose physical properties are given in Table 2. In this experiment locally available dry natural fine aggregate conforms to grading zone III as per IS: 383-1970 was used. The Physical Properties of Fine and Coarse Aggregates are given in Table 3. Crushed stone with maximum nominal size 20 mm graded aggregates conforming to Table 3 of IS: 383- 1970 was used for the experiment. Three accelerators namely Potassium Carbonate, Sodium Nitrite and Calcium nitrite were used to achieve the goal of the study. All three accelerators are used 1.5 % by the weight of cement.

4.1 EXPERIMENTAL SET UP

In this exploratory review the impact of different quickening agents on the compressive and flexural quality of solid blend has been researched. It will be hard to foresee the impact and the aftereffects of utilizing admixtures in light of the fact that, numerous a period, the adjustment in the brand of bond, total reviewing, blend proportioning and lavishness of blend change the properties of blend cement and furthermore the impact of more than one admixture is hard to anticipate. Once in a while numerous admixtures influence more than one property of solid framework. On occasion, they influence the alluring properties antagonistically.

V. RESULTS AND DISCUSSIONS

5.1 GENERAL

In this section, the discoveries of this exploratory examination are given and specified. The compressive strength of cube example of different evaluations at ordinary days of activity is offered. The durability of a beam specimen totally unique of various reviews especially M-20 and M-30 at various days of activity are offered. at long last the outcomes on quality parameter by exploitation carbonate, nitrite, metal radical quickening agent and each compressive quality and flexural quality of examples with quickening agents has been recorded at typical days of activity (one, three, seven, fourteen and twenty-eight days of activity with water) and contrasted and qualities of administration examples inside the research center at their relating ages are specified.

Accelerator I: Potassium Carbonate

Potassium Carbonate as a accelerator used and compressive strength of cubes of grade M20 and M30 concrete are given and durability of beams of grade M20 and M30 concrete are conferred at one, three, seven, fourteen and twenty-eight days of hardening with water.

Accelerator II: Sodium Nitrite

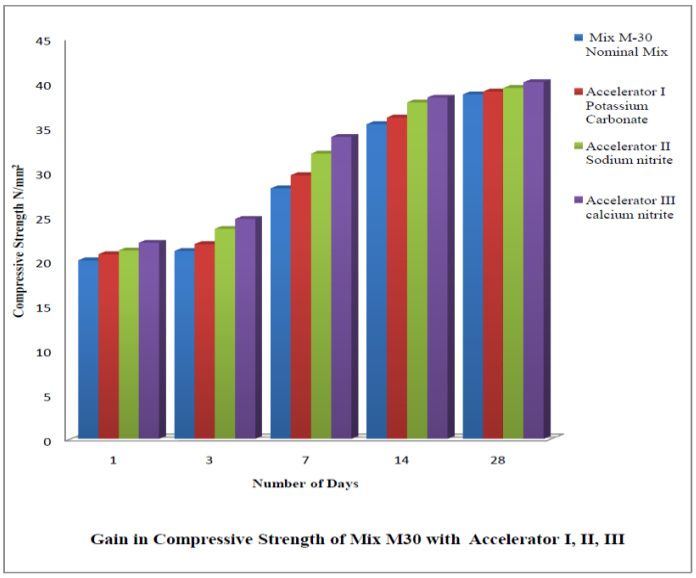
Sodium Nitrite as a accelerator used and compressive strength of cubes of grade M20 and M30 concrete are given and durability of beams of grade M20 and M30 concrete are given at one, three, seven, fourteen and twenty-eight days of hardening with water.

Accelerator III: Calcium nitrite

Calcium nitrite as a accelerator used and compressive strength of cubes of grade M20 and M30 concrete are conferred and strength of beams of grade M20 and M30 concrete are conferred at one, three, seven, fourteen and twenty-eight days of hardening with water.

After performing number of laboratory tests on different cubes at different curing ages or days i.e. 1, 3, 7, 14, 28. We got the results and prepared a comparative graph showing below.

The figure is displayed between Percentage increment in compressive quality of Mix M30 utilized with quickening agent Calcium nitrite with the examination of Nominal Mix M30 and plotted at one, three, seven, fourteen and twenty-eight days of curing with water. it watched that 9.81 % expansion in compressive quality of example at one day of curing and general 3.82 % increment in compressive quality of example at twenty-eight days of curing utilizing quickening agent Calcium nitrite.



Graph- 5.1 Combined graph of compressive strength test results

The figure is exhibited between pick up in compressive quality of Mix M30 utilized with quickening agent Potassium carbonate, sodium nitrite and Calcium nitrite, with the correlation of Nominal Mix M30 and plotted at one, three, seven, fourteen and twenty- eight days of curing with water.

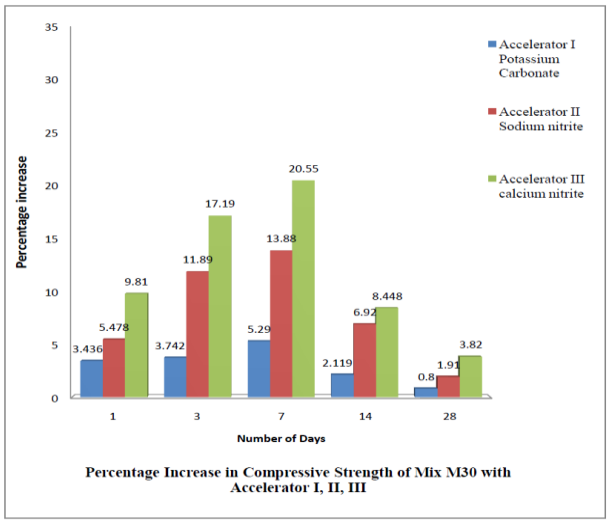


Figure 5.2: Percentage increase in compressive strength of Mix M 30 with accelerator I,II,III

VI. CONCLUSIONS OF THE WORK

The main objective of present study was to investigate the effect of accelerators on compressive and flexural strength of concrete at standard days of curing with water. On the basis of experimental study, following conclusions are drawn:

1. For all three accelerators, Maximum percentage gain was observed for Calcium nitrite accelerator at 1, 3, 7, 14 and 28 days Compressive Strength parameter for both M20 and M30 Grade of Concrete.
2. In compressive strength, there is a very little change in 28 day with all accelerators for both M20 and M30 Grade of Concrete.
3. Percentage increase in one and three days compressive strength of Concrete specimens is more for M20 Grade as compared to M30 Grade for all three accelerators.
4. Maximum percentage increase in compressive strength was more than thirty percent, recorded at Three days of water curing with accelerator calcium nitrite in M20.
5. In M30 Maximum percentage gain in compressive strength was more than twenty percent, recorded at Seven days of curing with accelerator calcium nitrite.
6. Maximum percentage gain in Flexural Strength was observed for Calcium nitrite accelerator out of all three accelerators at 1, 3, 7, 14 and 28 days for both M20 and M30 Grade of Concrete.

7. With accelerator Potassium Carbonate, there is a very little change in Flexural strength at one, three, seven, fourteen and twenty-eight days of curing for both M20 and M30 Grade of Concrete.
8. For Sodium Nitrite and Calcium nitrite accelerators Percentage increase in 1, 3 and 7 days was more for M20 Grade as well as M30 Grade of Concrete.
9. In flexural strength maximum percentage gain was recorded more than Fourteen percent, recorded at one day of curing with accelerator Calcium nitrite in M20 Grade of Concrete.
10. In flexural strength maximum percentage gain was more than Fourteen percent, recorded at Three days of curing with accelerator Calcium nitrite in M30 Grade of Concrete.

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