RHEOLOGY STUDY OF NA_2SIO_3/NAOH RATIO FOR FLY ASH BASED SELF-COMPACTING GEOPOLYMER CONCRETE

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ABSTRACT

The SCGC is a distinctive concrete, which does not require any extra compaction, it will flow and compact by way of it's self-weight, mainly at congested reinforcement. The SCGC is manufactured through utilizing industrial by means of-products like Fly ash, GGBS, waste glass powder, silica fume and rice husk ash, materials containing extra alumina and silica can be used. These materials can be activated by adding an alkaline solution (Sodium Hydroxide and sodium silicate). By utilizing of superplasticizers like Viscosity modifying Agent (VMA). The requirement of SCC is designed under i) Filling ability, ii) Passing ability and, iii) Segregation resistance. The size of coarse aggregate shall not exceed 20mm. Experimental tests like (Slump-Flow by Abrams cone, T50cm Slump Flow, J-ring, V-funnel, U-box, L-box). Self-compacting concrete offers a rapid rate of concrete placement, with faster construction times and ease of flow around congested reinforcement. The fluidity and segregation resistance of SCC ensures a high level of homogeneity, minimal concrete voids and uniform concrete strength, providing the potential for a superior level of finish and durability to the structure. SCC is often produced with low water-cement ratio providing the potential for high early strength, earlier demoulding and faster use of elements and structures. The elimination of vibrating equipment improves the environment on and near construction and precast sites where concrete is being placed, reducing the exposure of workers to noise and vibration. The improved construction practice and performance, combined with the health and safety benefits, make SCC a very attractive solution for both precast concrete and civil engineering construction.

Keywords: SCGC, fly ash, GGBS, Viscosity modifying Agent (VMA), Slump-Flow by Abrams cone, T50cm Slump Flow, J-ring, V-funnel, U-box, L-box

I. INTRODUCTION

The SCGC is a distinctive concrete, which does not require any extra compaction, it will flow and compact by way of its self-weight, mainly at congested reinforcement. The SCGC is manufactured through utilizing industrial by means of-products like Fly ash, GGBS, waste glass powder, silica fume and rice husk ash, materials containing extra alumina and silica can be used. These materials can be activated by adding an alkaline solution (Sodium Hydroxide and sodium silicate). By utilizing of superplasticizers like Viscosity modifying Agent (VMA), concrete can flow.The Self Compacting Concrete is a special concrete, which does not require compaction. It will flow and compacted by its self-weight. Self-compacting concrete offers a rapid rate of concrete placement, with faster construction times and ease of flow around congested reinforcement. The fluidity and segregation resistance of SCC ensures a high level of homogeneity, minimal concrete voids and uniform concrete strength, providing the potential for a superior level of finish and durability to the structure. SCC is often produced with low water-cement

ratio providing the potential for high early strength, earlier demoulding and faster use of elements and structures. The elimination of vibrating equipment improves the environment on and near construction and precast sites where concrete is being placed, reducing the exposure of workers to noise and vibration. The improved construction practice and performance, combined with the health andsafety benefits, make SCC a very attractive solution for both precast concrete and civil engineering construction.

1.1.Scope :-

It is compacted by its own weight so that it don't need any extra compaction because of that it is use at big works and it minimize the cost of construction.Now a days the all are facing the labours problem so that it is helpful some manner .Some experiment are done on SCC but we are doing different manner .. The VMA & chemicals like NAOH combination are used.

1.2. OBJECTIVES:-

1 Rheology study of Na_2Sio_3/NaoH ratio for fly ash based self-compactingGeopolymerconcrete
2. To differentiate Na_2Sio_3 / NaoH ratio for scc based GPC concrete
3 To analyse microstructure for different sodium hydroxide molarities.
4. To study temperature variation of Fly ash based self comp.geopoymer concrete for elevated temperature.
5. To investigate Lime addition into self compacting concrete with microscopic study

II. LITERATURE REVIEW

Brief information of the research work done by researchers about topic which will help us to decide about the subject is as given below.

MadheswaranC.K et.al[2013 studied the variation of strength for different grades of geo polymer concrete by varying the molarities of sodium hydroxide. Different molarities of NaOH (3M, 5M, and 7M) are taken to prepare different mixes and cured in the ambient temperature. GPC mix formulations with compressive strength ranging from 15 to 52 M pa have been developed. The specimens are tested for their compressive strength at the age of 7 and 28 days. The compressive strength of GPC increased with increasing concentration of NaOH

Subhash V. Patankar et.al(2013) investigated that, the desired compressive strength was achieved by fixing the solution-to-fly ash ratio of 0.35for the Mix Design of Fly Ash Based Geopolymer Concrete on the basis of various parameters such as quantity and fineness of fly ash, quantity of water and grading of fine aggregate. It also investigated that, the rate of gain of strength is slow when heat cured at 40°C as compared to strength at 120°C. But there is no appreciable change in compressive strength beyond curing temperature of 90°C. Similarly, duration of heating in the range of 6 to 24 hours produces higher compressive strength. However, the increase in strength beyond 12 hours is not very significant. It is also observed that the compressive strength of geopolymer concrete increases with increase in test period upto three days .It is recommended that effect of concentration of sodium hydroxide, temperature, duration of heating, and test period on the development of geopolymermortar. It is observed that the workability as well as compressive strength of geopolymer mortar increases with increase in concentration of sodiumhydroxide solution in terms of molarity. The rate of gain of strength is slow when heat cured at 40°C as compared to strength at 120°C. But there is no appreciable change incompressive strength beyond curing temperature of 90°C. The duration of heating inthe range of 6 to 24 hours produces higher compressive strength. However, the increase in strength beyond 12 hours is not very significant. It is also observed that the compressive strength of geopolymer concrete increases with increase in test period up to three days. The suitable

preparation of geopolymer mortar, 13-molar solution of sodium hydroxide is recommended on the basis of workability and compressive strength.

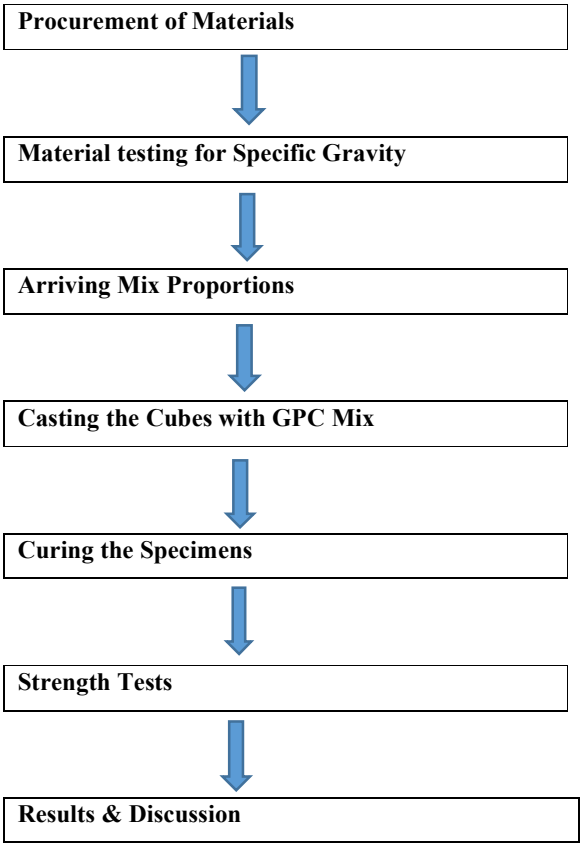
Sourav K r. Das et.al(2014) investigated that, with a higher Na2SiO3 gives a higher strength, and generally with a ratio of 2.5.Heat cures geopolymer concrete gives higher strength. The rate of increase of strength is rapid in the initial 24 hours of curing beyond that the gain of strength was moderate so the specimens should be cured for 24 hours only which will be sufficient enough. Geopolymer concrete has excellent properties as discussed earlier so it can be very useful for rehabilitation and retrofitting works

Hake et al(2015) reported that the cement production generated carbon dioxide,which pollutes the atmosphere. The thermal industry produces a waste called fly ash which is simply dumped on the earth, which occupies larger areas.the waste water from the chemical industries is discharged into the ground which contaminates ground water. By producing geopolymer concrete, all the above-mentioned issues shall be solved by rearranging them. Waste fly ash from thermal industry + waste water from chemical refineries geopolymer concrete. Further, the use of fly ash as a value-added material as in the case of geopolymer concrete reduces the consumption of cement.Reduction of cement usage will reduce the production of cement which in turn cut the CO 2 emissions. Many researchers have worked on the development of geopolymer cement and concrete for the past ten years. The present work deals with the result of the experimental investigation carried out on geopolymer concrete using processed and unprocessed fly ash with sodium silicate and sodium hydroxide. The study analyses the effect of processed and unprocessed fly ash on compressive strength and split tensile strength for different temperatures. To study the effect of different types of processed and unprocessed fly ash, we use processed fly ash such as P60, P80, and P100 fromDirk India Pvt. Ltd. And unprocessed fly ash from different cities such as Bhusawal, Nashik, and Beed. In this paper, the effect of the alkaline solution on different fly ash is investigated.

Nisha Jain et.al[2016] she is studied that Compressive strength can be achieved for both the grade of GPC by replacing Fly ash with Cement for various percentages i.e.5% & 10% by opting wet curing. The compressive strength goes on increasing with the increase in replacement percentage with cement in M30 grade of GPC by opting wet curing where maximum can be achieved by replacing 10% with cement. It also investigated that, the compressive strength goes on increasing with the increase in the rest period of geopolymer concrete with addition of 10% of Lime and it's cured at normal room temperature. The maximum compressive strength was achieved at the completion of 28 days of rest period thereby giving it a wide scope. The compressive strength achieved by grade M30 of geopolymer concrete cured at normal room temperature at a rest period of 7 days is higher than the compressive strength achieved by ordinary concrete for similar rest period. Grade M30 having alkaline solution ratio as 2.5 and were cured at 90°C in an oven for 24 hrs with the addition of optimized lime percentages (10%). The lime percentages were calculated in accordance with the weight of fly ash. After the completion of the defined curing time, these specimens were kept at normal room temperature with a rest period or testing age of 07, 14, 21, 28, and 56 days. The specimens were tested after testing age to know the effect of the rest period on the strength of GPC with lime addition into geopolymer concrete.

III. METHODOLOGY

Figure.1. shows the methodology adopted in this study.



3.1 Material used

3.1.1 Cement –

The Ordinary Portland Cement of 53 grades conforming to IS: 8112 is used. The cement used is fresh and without any lumps. Physical property of cement is as per Table 1.

Specific gravity	3.12
Consistency	33 %
Initial Setting Time	34 minutes
Final Setting time	455 minutes

Table 1. Physical Properties Of (OPC) Cement Characteristic Value.

3.1.2 **Alkaline solution:**

Alkanline liquid was used combination of sodium hydroxide and sodium silicate solution. Sodium hydroxide solution(NaOH) in flaked form with 98% purity purchase from local chemical supplier was

used and sodium silicate solution(NaO=16.89%,SiO 2 =35.01%and water 46.37% by mass) was used as alkaline solution. Sodium hydroxide solution is prepared by dissolving flaks in water. Tap water available in laboratory was to used prepare NaOH solution. Activation solution was prepare at least one day prior to its used. Molarity of solution was 16 M.

Compressive strength Test:

Compressive strength is one of the important properties of concrete. Concrete cubes of size 150mmx150mmx150mm were cast with and without of fly ash. After 24 hours, the specimens were demoulded and subjected to water curing. After 28 days of curing specimens were taken and allowed to dry and tested in compressive strength testing machine.

3.1.3 **Fly Ash:-**

The specific gravity of the Fly Ash used is 2.26. The residue of fly ash retained on 45µm IS sieve was reported as 16.84%. The fineness of the Fly Ash by Blen's method is 360m2/kg. Fly Ash of grade P-63 and P-100 is used as a partial replacement to cement.

Physical Properties of Fly Ash:

specific gravity	2.12
Unit weight(KN/M 2)	14.39
Liquid limit (%)	24
Loss on ignition (% by mass)	0.40

Table 3.2 : Physical Properties of Fly Ash

3.1.6 Lime :-

Lime is a generic term, but by strict definition it embraces only the manufactured forms of lime — quicklime, Slaked and hydrated lime. It does not include limestone, which is the feedstock for lime manufacturing. Quicklime, the product of calcinations of limestone, consists of the oxides of calcium and magnesium.

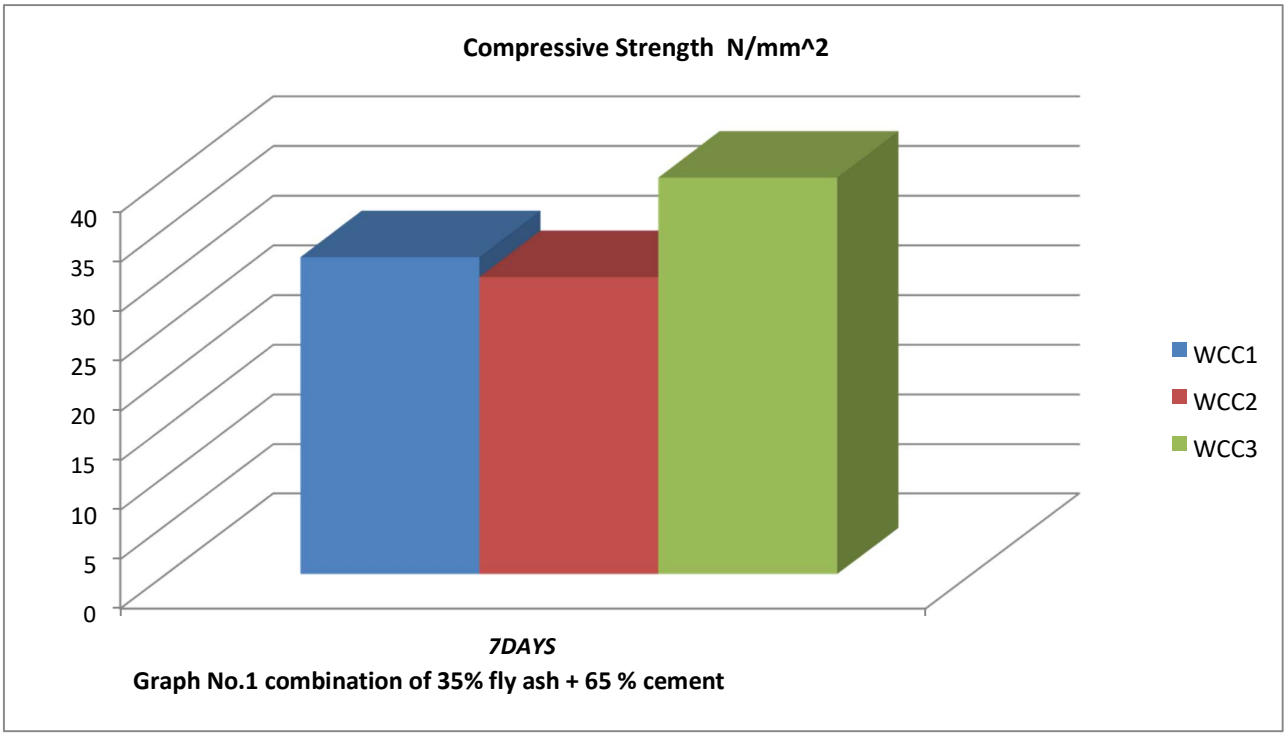
a) Quick lime.

b) Hydrated lime.

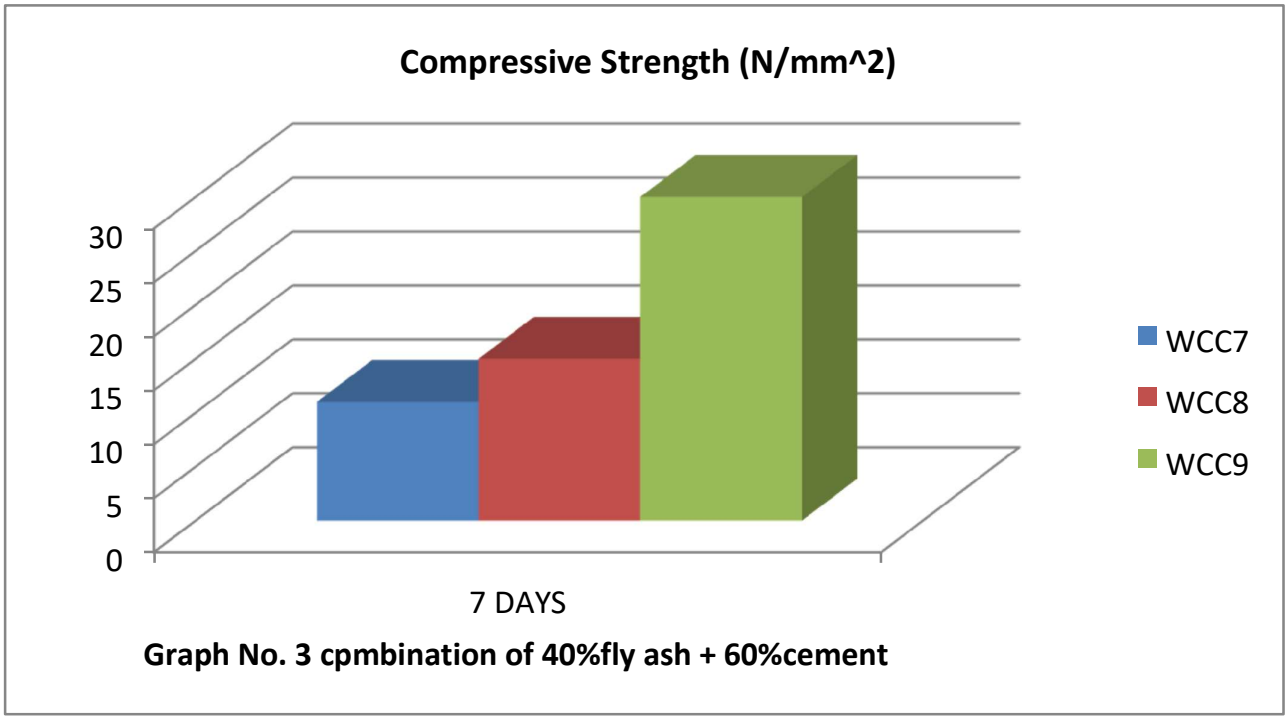
c) Slaked Lime

2.1.9 Water: Water should be free from acids, oils, alkalis, vegetables or other organicimpurities. Soft waters also produce weaker concrete. Water has two functions in aconcrete mix. Firstly, it reacts chemically with the cement to form the cement paste in which the inert aggregatesare held in suspension until the cement paste has hardened. Secondly, it serves as a lubricant in the mixture of fine aggregates and cement.

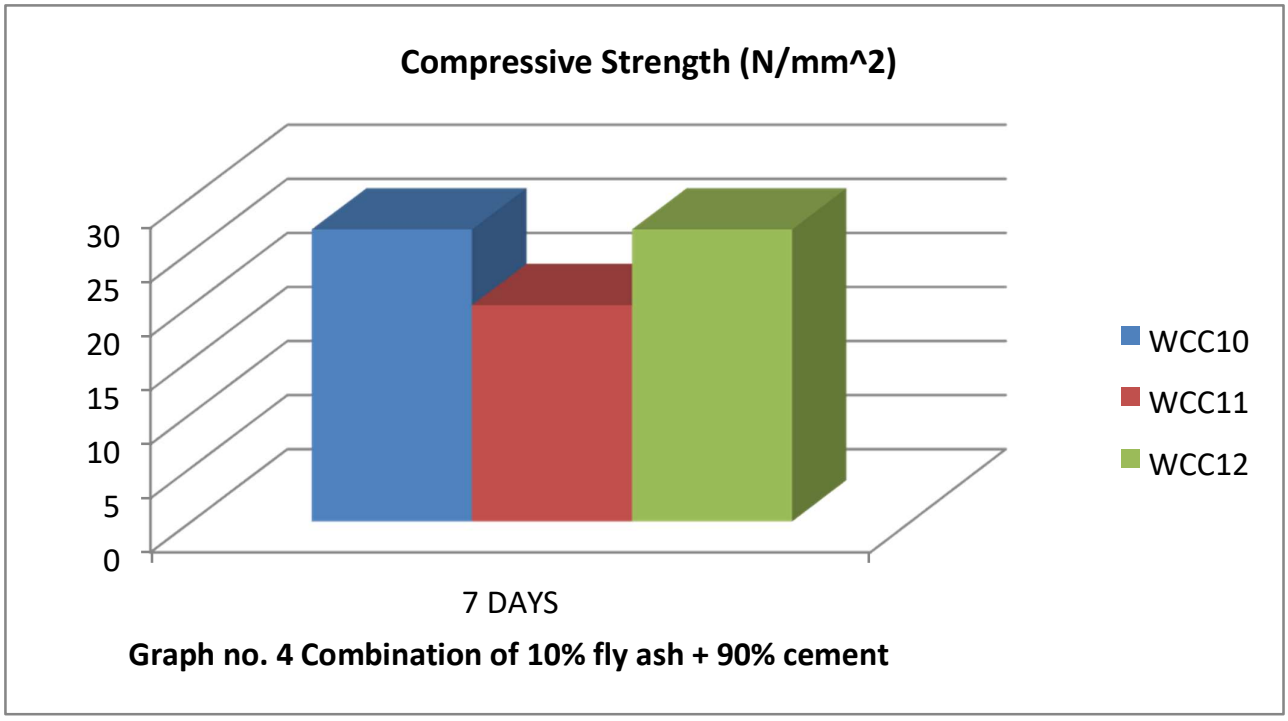
5. Results;- The following are different combination of ingredients, % of ingredients varying and compressive strength with varying in days



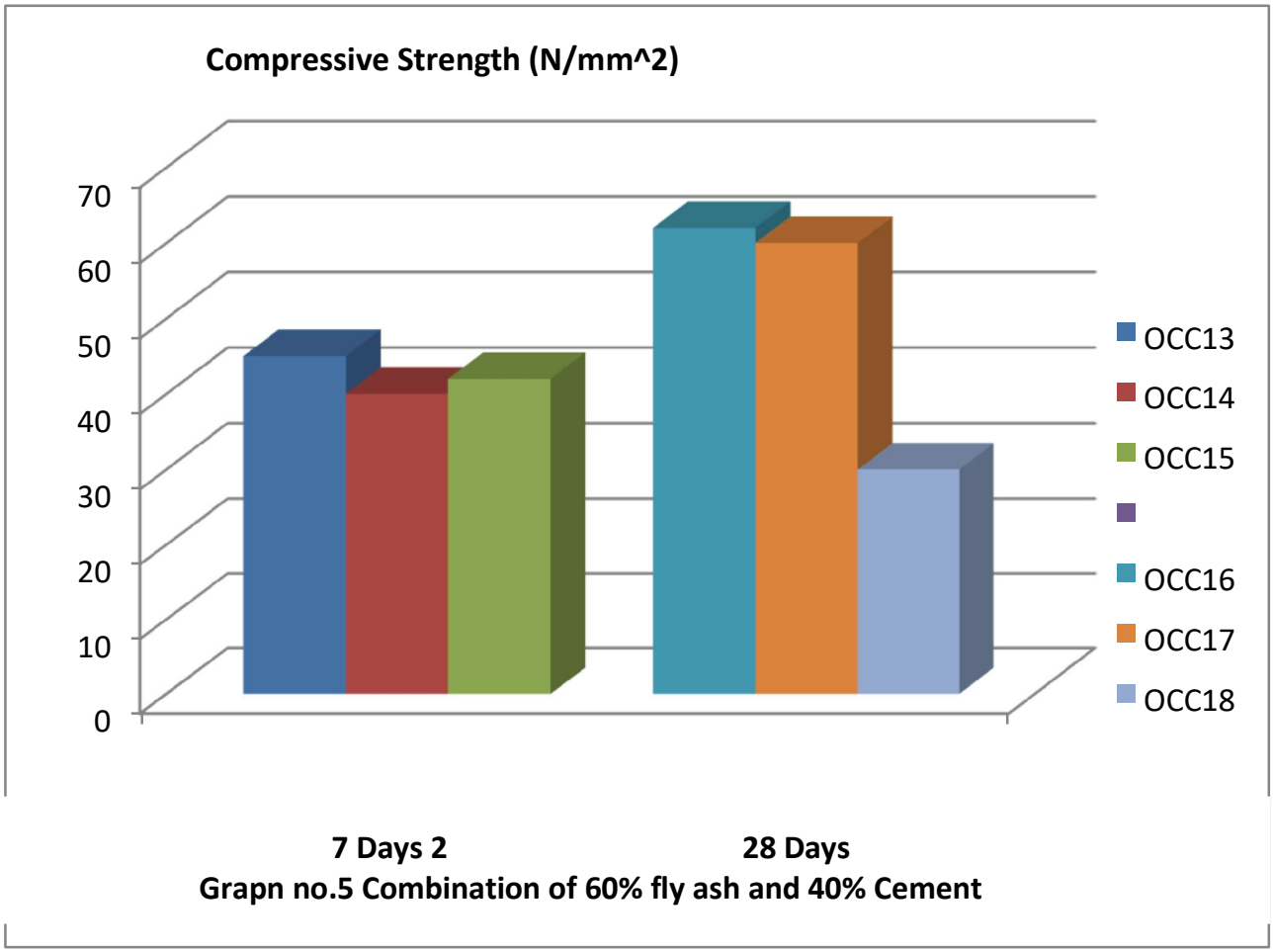
Graph No.1 combination of 35% fly ash + 65 % cement



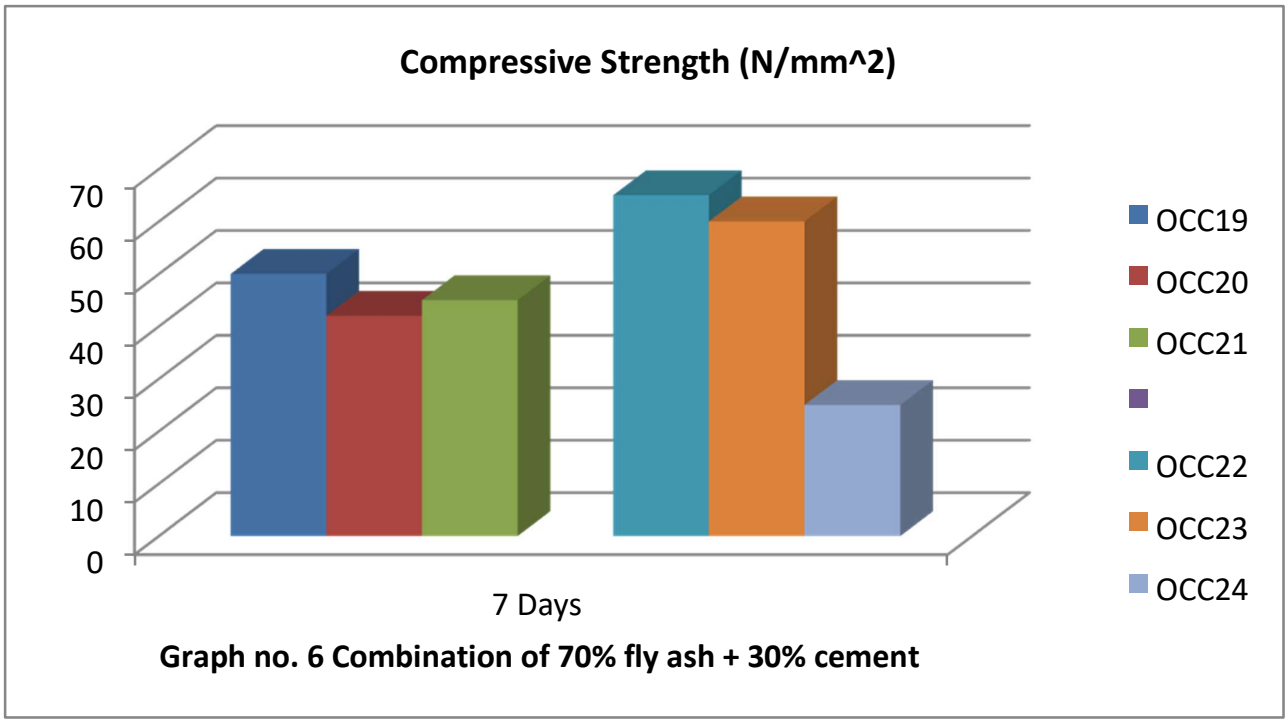
Graph No. 3 cpmbination of 40%fly ash + 60%cement



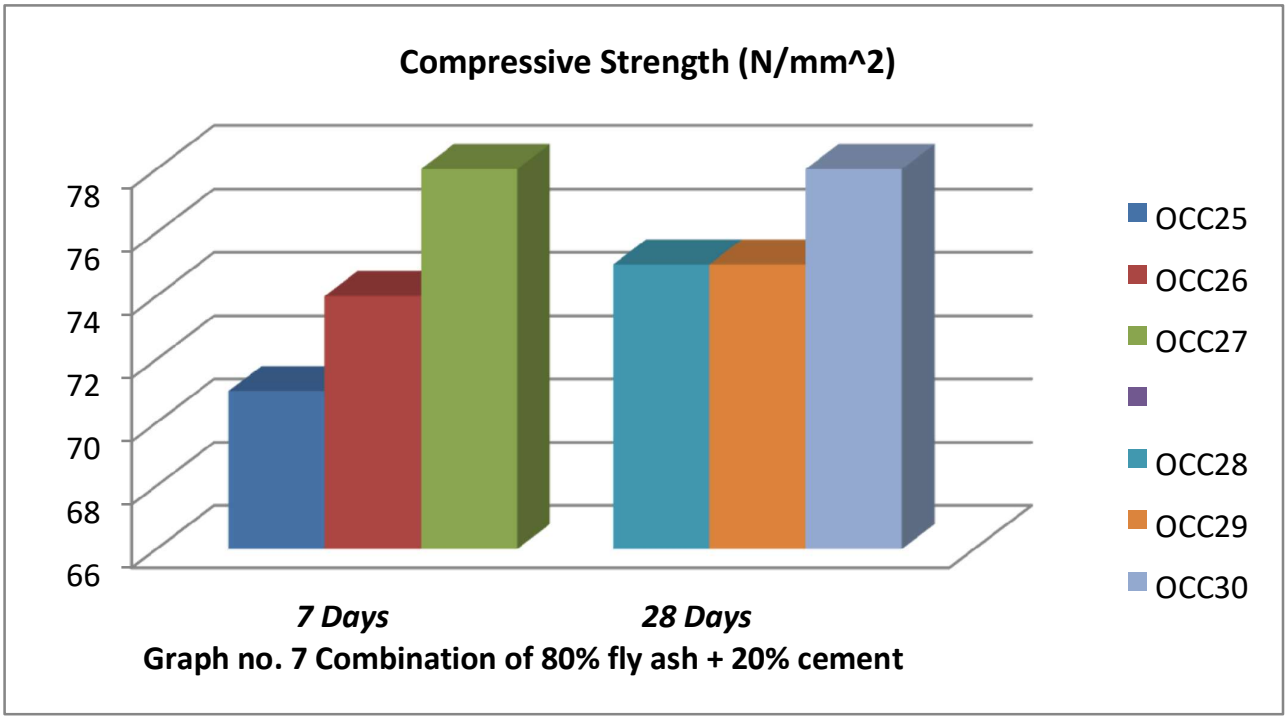
Graph no. 4 Combination of 10% fly ash + 90% cement



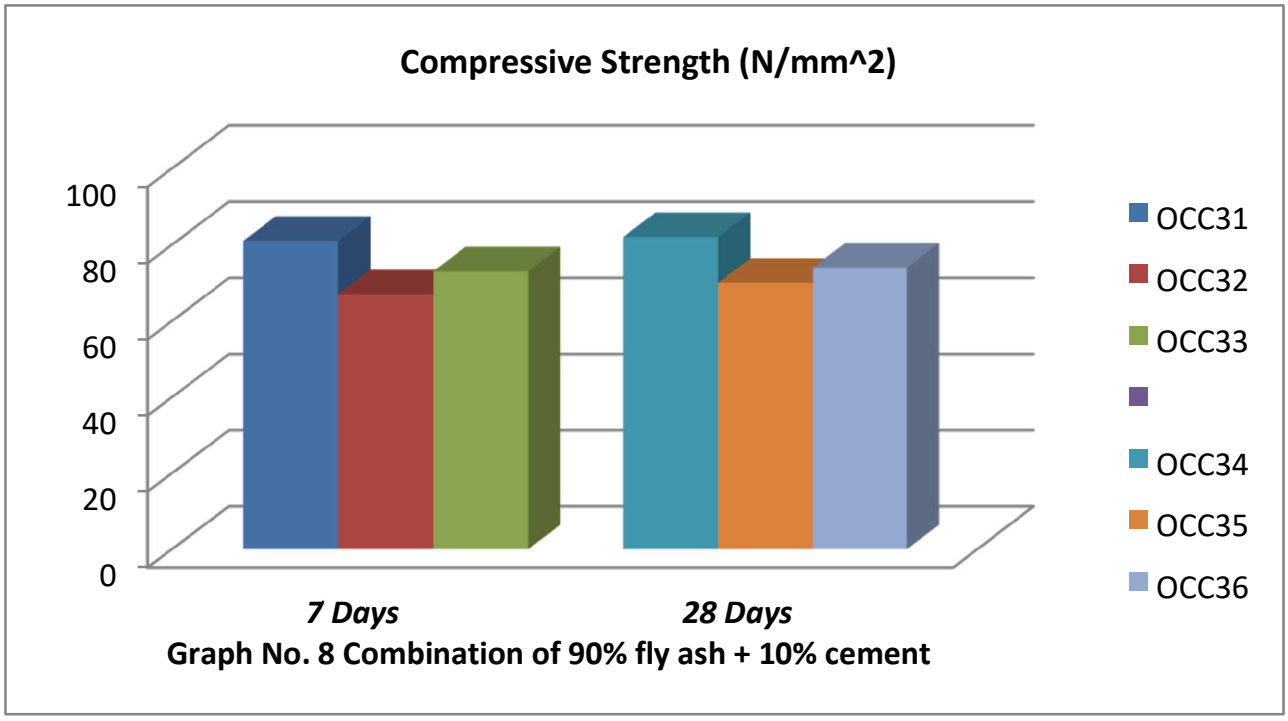
Grapn no.5 Combination of 60% fly ash and 40% Cement



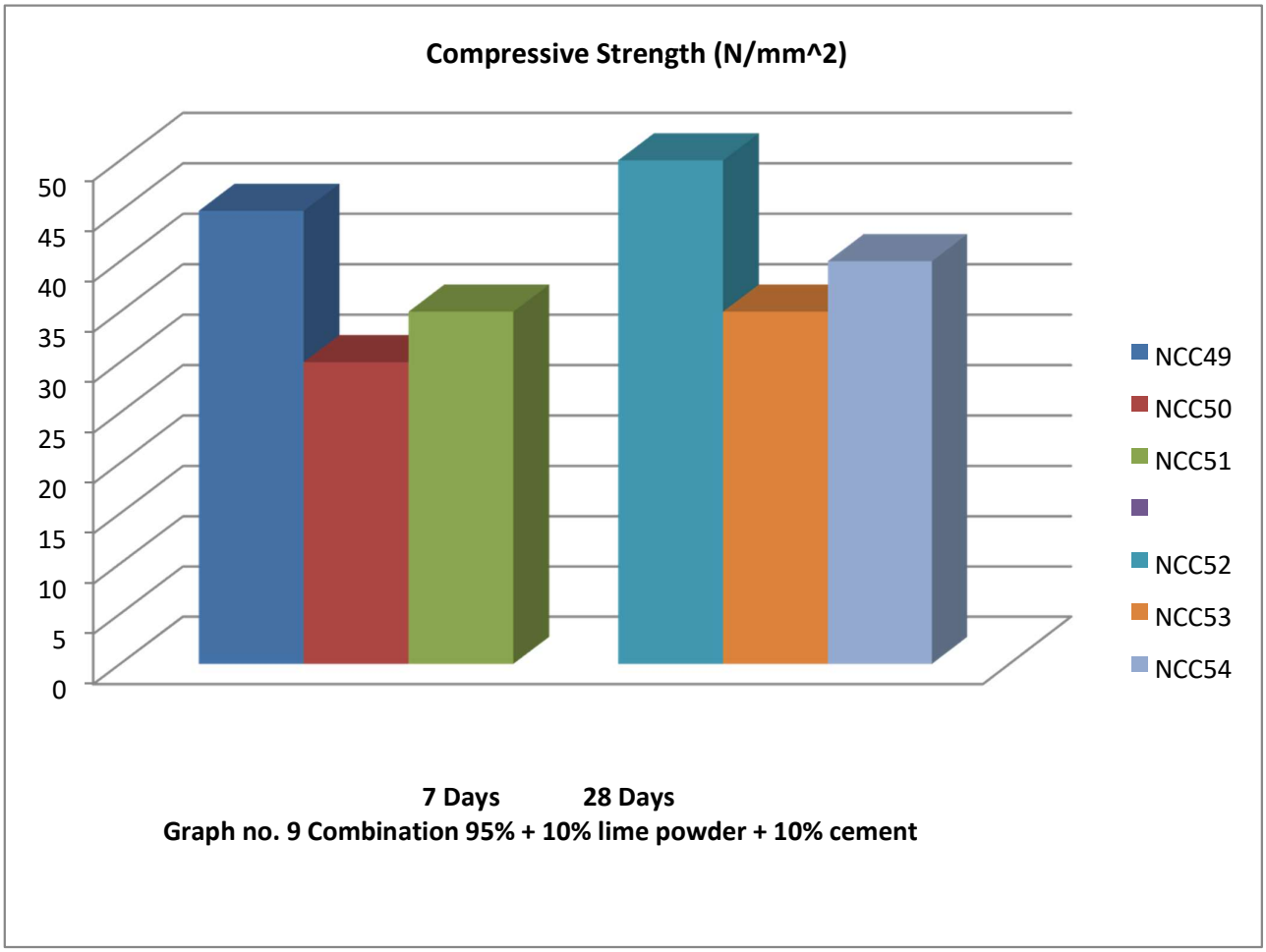
Graph no. 6 Combination of 70% fly ash + 30% cement



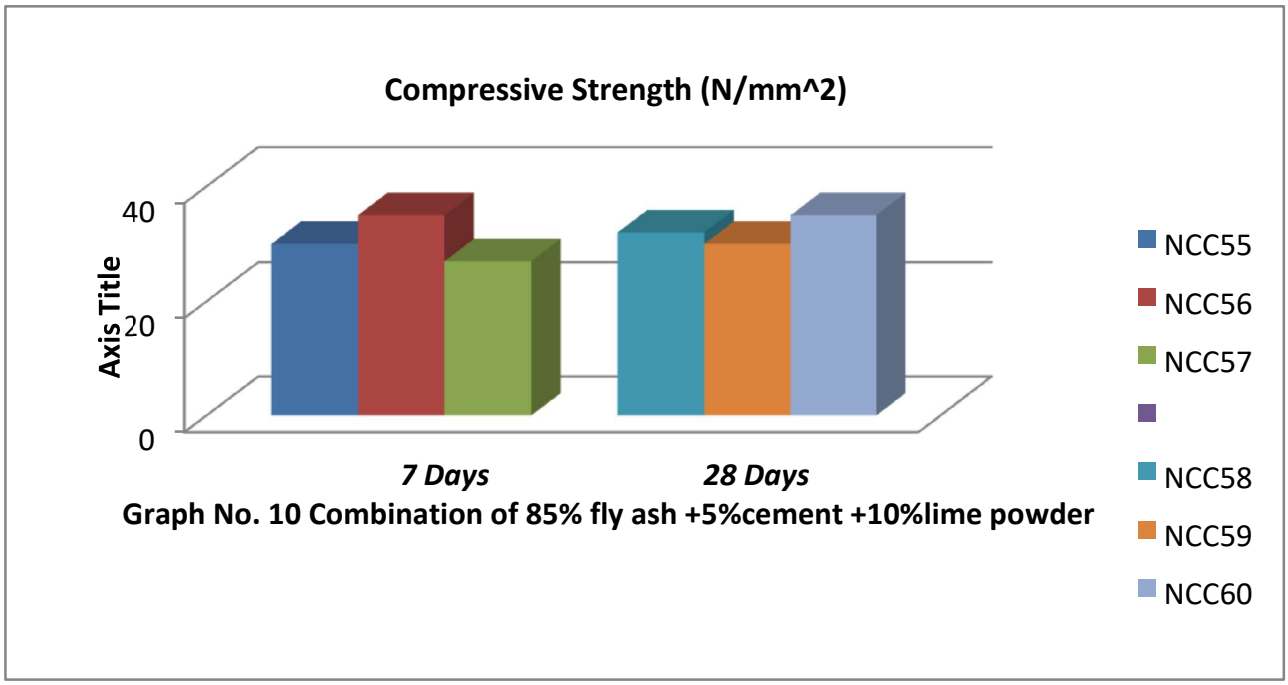
Graph no. 7 Combination of 80% fly ash + 20% cement



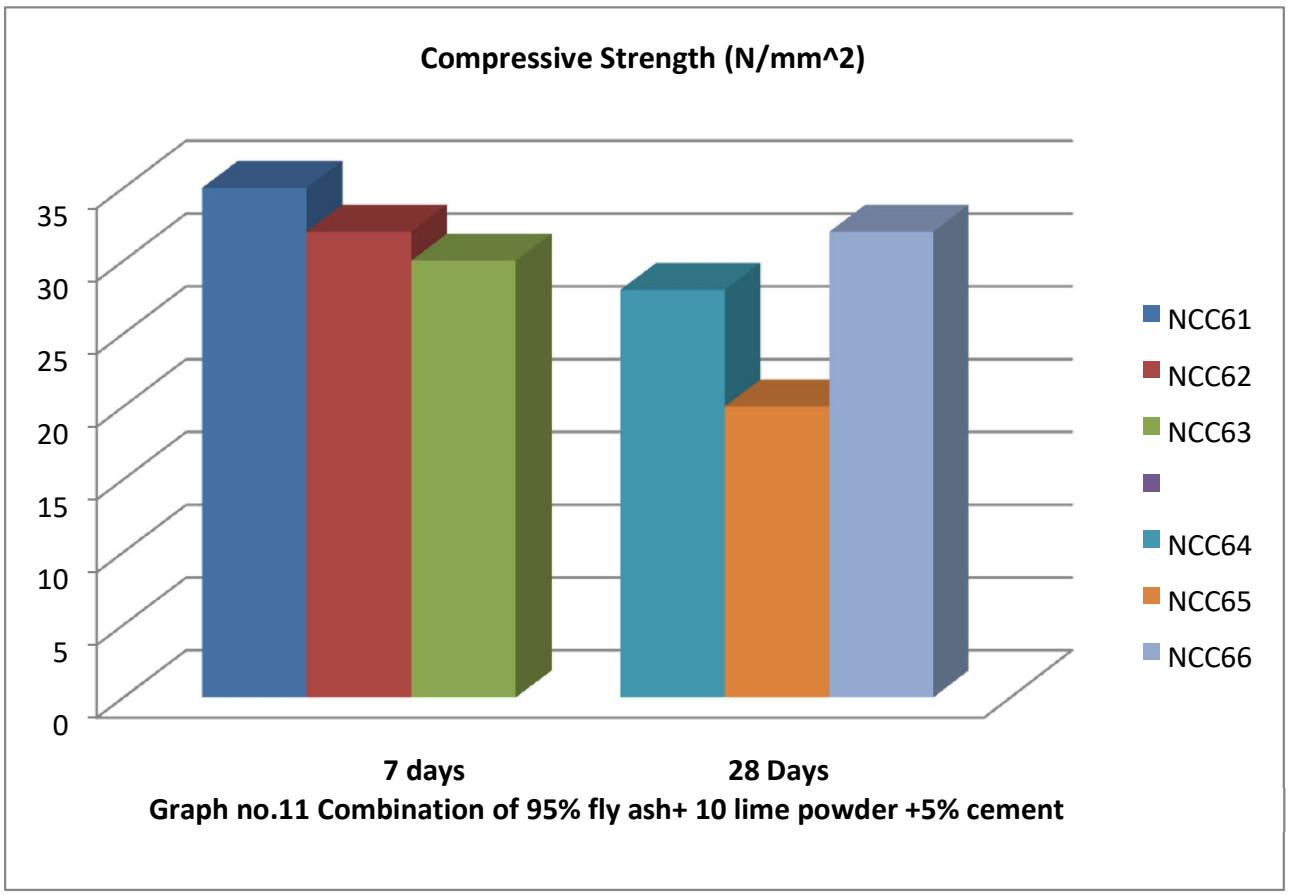
Graph No. 8 Combination of 90% fly ash + 10% cement



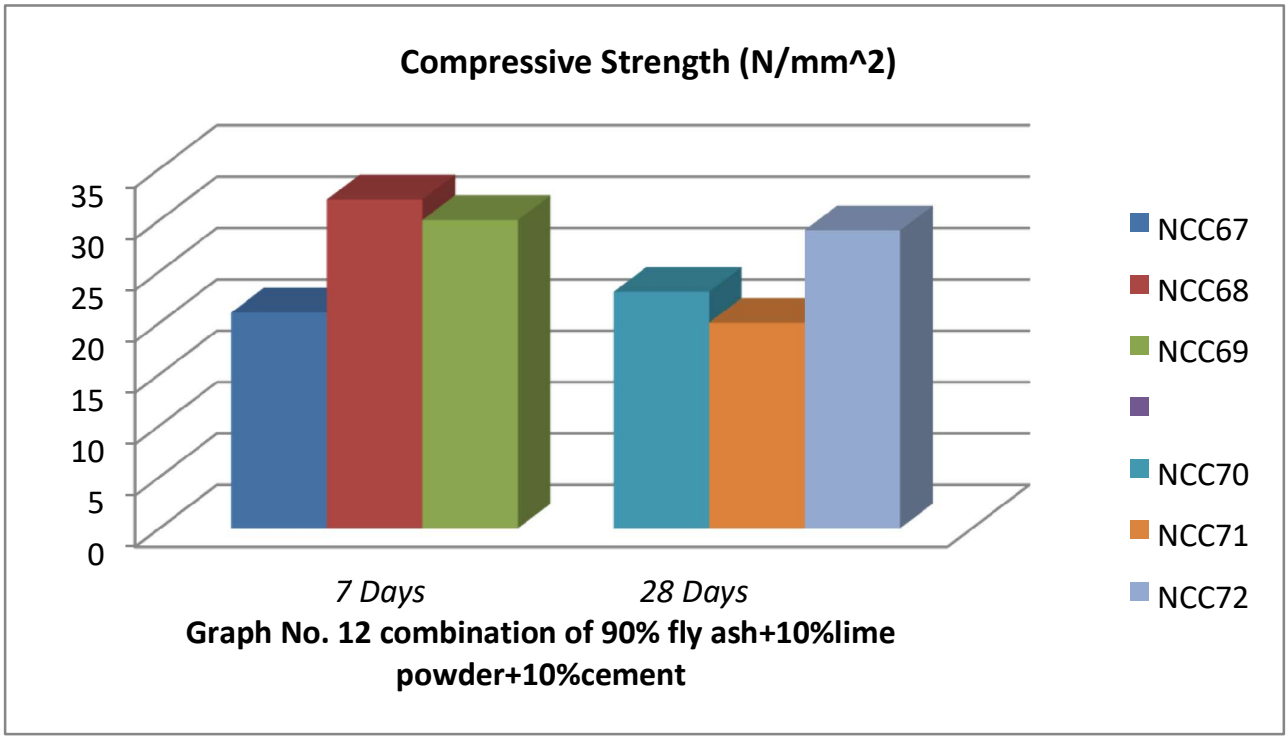
Graph no. 9 Combination 95% + 10% lime powder + 10% cement



Graph No. 10 Combination of 85% fly ash +5%cement +10%lime powder

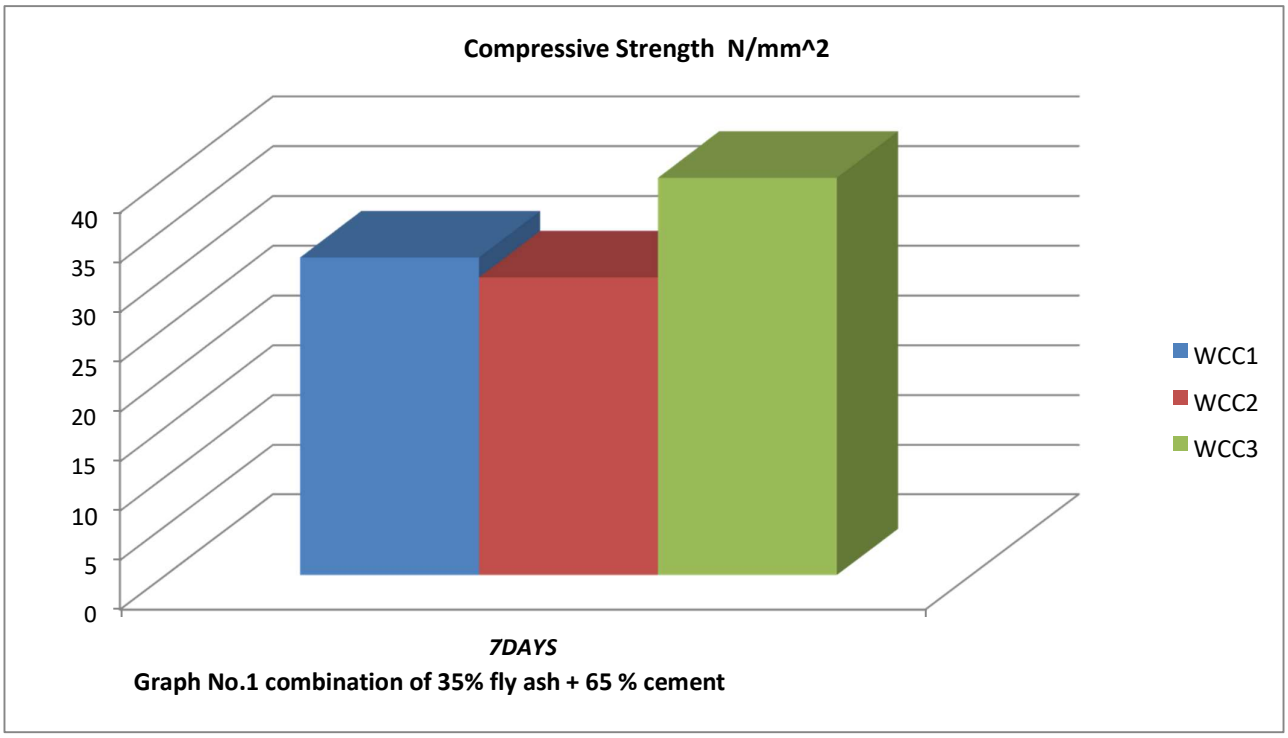


Graph no.11 Combination of 95% fly ash+ 10 lime powder +5% cement



Graph No. 12 combination of 90% fly ash+10%lime powder+10%cement

The following are different combination of ingredients, % of ingredients varying and compressive strength with varying in days :-



Graph No.1 combination of 35% fly ash + 65 % cement

5. CONCLUSION :-

1. The effect of sodium hydroxide to sodium silicate on SCC is very good which is more beneficial as compare to the conventional concrete as well as GPC

2. As the molarity of sodium hydroxide increases gives the better results upto the 16 M solution beyond that it is reduces the strunt of scope

3. The ratio of alkaline solution play important role in the production of SCGPC

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