

# EFFECT OF BARYTES POWDER ON MECHANICAL AND DURABILITY PROPERTIES OF M<sub>30</sub> CONCRETE

<sup>1</sup> C. Navya Kiran, <sup>2</sup> Dr.S.M.V.Narayana

<sup>1</sup> M.Tech.,(PG Scholar), <sup>2</sup>Professor & Head of the Department

<sup>1</sup> DEPARTMENT OF CIVIL ENGINEERING, <sup>2</sup> DEPARTMENT OF CIVIL ENGINEERING

<sup>1</sup> Department Of Civil Engineering,Annamacharya Institute Of Technology & Sciences, Rajampet, Kadapa,

<sup>2</sup> Department Of Civil Engineering,Annamacharya Institute Of Technology & Sciences, Rajampet, Kadapa,

**Abstract :** Cement concrete is an universal material. It is the largest consumed material next to water. Concrete is a marvelous material that can, without any hesitation accept its special characteristic of receiving so many waste materials/byproducts viz flyash, ggbs, silica fume etc. into it and producing good results for us. In the scenario rampant use of natural materials for the production of cement, the emission of greenhouse gases into the atmosphere and the contribution of cement industry in the emission of CO<sub>2</sub> and other objectionable gases, there is an obligation to use all sorts of indigenous waste products /byproducts and cheaply available minerals in the concrete check/verify and determine the suitability of them as cement concrete admixtures so as to reduce the green house gases in large scale. In kadapa district there are Barytes mines which the world class barytes is extracted. Barytes is used in as coarse/fine aggregate in high density concrete/mortars for the attenuation of radiation. Much research is not done on the usage of barytes powder as filler in concrete. In the present investigation, an attempt is made to find the effort of barytes powder on the mechanical and durability properties of concrete. Compressive and split tensile strength test, Water permeability, Chloride permeability an Electrical resistivity test were conducted to find strength and durability properties of concrete .It is observed that barytes powder can be used successfully in M30 Concrete to enhance the said properties.

**Keywords:** OPC concrete, barites powder, Water permeability, Chloride permeability, Electrical resistivity.

## I INTRODUCTION

The Use of Concrete has become so compelling now a days that the life in earth without concrete is unconceivable. Cement concrete is the largest consumed man mae material in the world. Most of the concrete that we use now-a-days consume huge quantities of natural resources which can't be deplete. On the Other hand the production of Ordinary Portland cement (OPC) not only consume natural resources but also release objectionable gases into the atmosphere. The production of one tons of cement consumes about 1.5 tonnes of limestone and release about one ton of CO<sub>2</sub> into the atmosphere. Global Cement production increased rapidly from the year 1990 and it has received nearly 3 billion tones [1]. The Cement plants not only emit CO<sub>2</sub>,NO,SO which pollute the air, the pollution associated with merely also has much impact on local air pollution (2).To reduce the atmospheric [2]. Disorders due to the emission from cement industry there is an every need to reduce the production of OPC and at the same time increase the use of all sorts of waste products available locally which can safely be use in the production of cement/concrete in Kadapa district, Andhra Pradesh, India is rich in Mineral wealth. Baryte or Barite is a Soft Crystalline mineral form of Barium sulphate Baso<sub>4</sub>.Approximatly 80% of the barytes produce worldwide is used for oil and gas drilling .Among the states in INDIA, Andhra Pradesh alone accounts for 92% of country's barytes resourses. Barytes is used as filler and extender in rubber products. It is added to rubber compounds to impart resilimey and durability [3] and it is used as filler in paper industry. In order to enhance the value of barytes there is a need to explore the possibilities of using barytes in the production of valuabe material concrete is universal material and barite powder can be use in cement concrete. Therefore in the present investigation barytes powder which is cheaper than cement is used as replacement to cement upto 10% .Increasing the barytes powder from 2.5% to 10% at 2.5% increments the mechanical and durability properties of concrete such as compressive and tensile strength, water and chloride permeability and the Electrical resistivity of M30 grade concrete were studied.

## II LITERATURE SURVEY

This chapter reveals about the past references that are helpful to proceed the project by referring the way of using the Admixtures, minerals in micro fine form by partially replacing with cement, how to reduce the water content and different types of destructive tests and Non-destructive tests and terminology. M.I.Abdou, A.M.AL-Sabagh, Hany El-Sayed Ahmed, A.M.Fadi (2018)(1) In this article they studied about the Alternative weighting materials should be demand to offer superior properties such as barite, available in sufficient reserves to meet field requirements and be competitively priced. A Weighing material to substitute barite would be a good innovation in the drilling industry. They made three mud samples with different densities i.e., water based mud with barite, second sample was water based mud with ilmenite and third sample was water based with barite and ilmenitein which were added 50:50 by ratios. The study shows that the rheological properties of barite/ilmenite mixture were found to give comparable results as barite and has the potential to be used as alternative weighting material especially in a heavier drilling mud. Samantha Mirante and Ali GHahremaninezhad (2018)(2) This study presents the results of an investigation of the effect of glucose on hydration, microstructure and properties of cement pastes. The hydration was studied using non-evaporable water content measurement of the rmogravimetric analysis

(TGA). Electrical Resistivity as a measure of the transport property of cement pastes was evaluated using electrochemical impedance spectroscopy (EIS). It was found that all cement pastes showed a similar degree of hydration at late ages. The cement paste with a low concentration of glucose (0.05%) showed a slightly higher compressive strength and electrical resistivity compared to the control cement paste. This was most likely due to improved workability and dispersion of cement particles in the cement. However, the cement paste with 0.25% glucose showed a lower electrical resistivity compared to control cement paste. MD. Shahadat Hossain (2018)(3) In this current study presents electrical resistivity responses of clayey samples at different consolidation stages. The consolidation properties of our soil specimens were measured in conjunction with electrical conductivity. Scanning electron microscope (SEM) analysis were performed on soil samples before and after consolidation to identify the changes in fabric morphology due to the application of loads. It was observed that the electrical conductivity of samples decreased with the increase of pressure and the trends of variations were similar to  $e$  vs  $P$  curves. Although a linear correlation exists between electrical conductivity and void ratio, the relationship depends on the structural changes in clay particles. Therefore changes in fabric structures were analyzed using SEM images and results showed that the aspect ratio of the particles increased as much as 18.3% after consolidation. Based on the investigation, the coefficient of consolidation and one dimensional strain were determined using Electrical Resistivity method. The compressibility tests are conducted in conjunction with electrical resistivity measurements to identify the correlation between strain and electrical properties. P.Meenakshi (2017)(4) In this research represents the behavior of concrete having partial replacement of cement with barites and lime powder. M30 grade concrete was used for which the barites and lime powder is replaced and an experimental study was carried out and the effect on compressive strength characteristics (0%, 10%, 20%, 30%) was studied. The result of this investigation shows that the replacement of cement with barites and lime powder showed an increase in the compressive strength in the early stages 7th day and when tested on 14th day showed almost the same results for all the mixes, but the results for 28th day also didn't show any positive result. The usage of barites and lime powder as replacement for cement in concrete not shown increase in compressive strength in 28th day. Sadik Alper Yildizel (2017)(5) In this study Barite is used as sand substitution for the Glass fiber reinforced concrete (GFRC). It is a cementitious composite reinforced by the addition of alkali-resistant glass fibers. GFRC is widely used for various types of precast products in civil engineering industries' mixes generally include silica sand to produce precast concrete elements, however, silica sand was replaced with barite sand at the ratios of 5%, 10% and 15% of wt. in order to reveal its applicability and potential for different engineering purposes. The flexural strength and the freeze-thaw resistance of the composites were studied. The experimental results showed that the replacement of silica sand with barite sand up to 15% of wt. enhances the mechanical properties of the composites in respect to flexural strength and F&T resistance properties. Barite Mukund Vasant Rao (2017)(6) The apparent resistivity using four probe electrodes configuration of Wenner and Schlumberger method is carried out on the same selected sites to observe the similarity and compared both the applications in terms of its use and handling in the field. The VES was carried out by Wenner and Schlumberger Sema methods. For Wenner, data are plotted on respective graphs and values calculated. For Schlumberger, the IPI2 win software was used. A total of 54 VES were carried out spread over the district and spread over the different lithological units. The instrument used is resistivity meter MINITRONX MODEL AQUA II PLUS. In resistivity meter, AC voltage input is used (100/200V). Wenner method (Wenner 1969). It is based on equal distance spacing four probe methods which is carried out by inverse slope method suggested by Narayan and Ramamnujachary (1967). The objective of VES is to record the changes in resistivity with depth and to correlate it with the available geological information to interfere the depths and resistivity of layers present. The resistivity of the strata is determined by passing an electric current between two electrodes on the survey. Wissem Gallala, Yousra Hayouni, Mohamed Essghaier Gaied, Micheal Fusco, Jasmin Alsaied, Kathryn Bailey, Mohamed Bourham (2016)(7) In this investigation they used Barite incorporated with fluorspar mine waste (BFMW) as a fine aggregate additive has been investigated for its effect on the mechanical and shielding properties of cement mortar. Several mortar mixtures were prepared with different proportions of BFMW ranging from 0% to 30% as fine aggregate replacement. Cement mortar mixtures were evaluated for density, compressive and tensile strengths and gamma ray radiation shielding. The results revealed that the mortar mixes containing 25% BFMW reaches the highest compressive strength values which exceed 50 MPa. Evaluation of gamma-ray attenuation was both measured by experimental tests and computationally calculated using micro shield software package, and results have shown that using BFMW aggregates increases attenuation coefficient by about 20%. These findings have demonstrated that the mine waste can be suitably used as partial replacement aggregate to improve radiation shielding as well as to reduce the mortar and concrete costs. Harnath Balmedie, Ramesh Sara Kadam (2016)(9) In this investigation Barite is used as partial replacement of coarse aggregate. In contrast with conventional concrete weighing around 150 pounds per cubic foot, high-density concrete normally weighs up to 200 to 250 pounds per cubic foot. Among the natural aggregates most commonly used are barite, magnetite, limonite, hematite, the density will depend on the type of aggregate used. The density concrete protects from harmful radiations X-rays, gamma rays, neutrons. Integral part of this project is to replacement of coarse aggregate with barite and natural sand is used as fine aggregate and 4% of silica fume are used by weight of cement. Water-cement ratio is to be kept same as that of normal concrete. The properties of HDC concrete are lower thermal expansion, creep deformation and high modulus of elasticity. Sanjay kumar, Rsuganya Devi. K (2016)(10) In this study they used barite as fine aggregate. For self-curing concrete, it involves the use of shrinkage reducing admixture polyethylene glycol (PEG 400) which helps in self curing and for better hydration and strength. Barite powder is used as a partial replacement of fine aggregate of about 30% is used in the self-curing concrete beam and also an hot rolled steel I section is enhanced in the beam. The flexural behavior of these concrete beams are studied and compared with each other. T.Ch.Madhavi and Annamalai (2016)(11) Here the Electrical Conductivity of Concrete is of current interest since it can be used as parameter relating to certain characteristics of concrete. Electrical resistivity is the inverse of electrical conductivity. This literary indicate that moist concrete behave as a semiconductor with resistivity of the order of 10<sup>5</sup> ohm-mm while oven dried concrete behaves as an insulator with resistivity of the order 10<sup>12</sup> ohm-mm. The methods of measuring resistivity are studied which draws to the fact that Wenner probe method being more reliable method. The principle behind the measuring techniques is to quantify the conductive properties of the microstructure or pore network of concrete. This study also presents the factors affecting the resistivity measurements and applications of the measured conductance in determining certain parameters of concrete. The variation in the measured electrical resistivity in wet and dry concrete can be interpreted to find that the electrical conductivity of concrete is a

significant effect of the evadable water present in it. Therefore it can be expected that conductivity increases with increase in ion transfer, which is with increase in water cement ratio of concrete.

### III. OBJECTIVES AND SCOPE OF INVESTIGATION

The main objective of this experimental study is to find the effect of barytes powder on strength properties of M<sub>30</sub> Concrete and also to know the durability properties of the concrete when cement was partially replaced with admixture. And also the results was noted in the chapter 5 showing the strength of concrete exhibited with and without adding super plasticizer (POLYCARBOXYLIC ETHER). By this investigation, it has been well established that barytes powder and super plasticizer can be used for structural elements in civil engineering technology. Accordingly, the theme of the experiment to study the mechanical and Durability properties of concrete with and without presence of Super plasticizer.

#### 3.1 OBJECTIVES OF THE TEST PROGRAM

1. To find out the effect of barytes powder on the mechanical properties of the concrete.
2. To find the effect of barytes powder on durability properties of the concrete.
3. To find out how the super plasticizer effect the strength and durability properties of concrete.
4. To know the behavior of various concrete mixtures with barytes power under compression, tension, RCPT and Water permeability at 7days,14days, 28 days and 60 days.To attain the above objectives, the experimental work, and the test programmes were planned.

Total 240 number of specimens were prepared with barytes powder (2.5%, 5%, 7.5% and 10%) and super plasticizer is added in water in order to reduce the water content.

The details of each category are described below.

#### 3.2 DETAILS OF SPECIMENS

Size of cube specimen: 150mm x 150mm x150mm

Size of Cylinder specimen: 150mm diameter x300mm height.

Size of RCPT specimen: 100mm diameter x 50 mm height.

Size of Water permeability: 200mm diameter x120mm height.

Mix proportions:1:1.92:3.00 (for details refer Annexure-1)

Water cement ratio:0.45

Number of specimens: 240 specimens with (2.5%,5%,7.5% and 10% replacement of cement with barytes powder with and without adding super plasticizer).

#### 3.3 MATERIALS USED

In the present investigation the materials and methods of the tests conducted in the present study are presented Materials used for experimental study are

- Cement
- Fine aggregate
- Coarse aggregate
- Water
- Barytes powder
- Super plasticizer (POLYCARBOXYLIC ETHER)

##### 3.3.1 Cement

In this study, 43 grade Ordinary Portland Cement manufactured by Zuari cement, confirmly to IS 12269 was used. The physical properties of Cement is presented in tabular No 3.1 and the specific gravity of cement is 3.15.

**Table 3.1: Physical Properties of Cement**

SL.No.	Properties	Numerical value
1	Fineness	250 m <sup>2</sup> /kg
2	Specific gravity	3.15
3	Initial setting time	32 min
4	Final setting time	600 min



Fig.3.1: Cement Used in the Experimental Study

### 3.3.2 Fine Aggregate

For this experimental study, natural sand obtained from local river namely CHEYYERU is used as fine aggregate. The Specific gravity of sand is 2.64. The sieve analysis of sand is shown in table 3. The properties of fine aggregate as shown in table 3



Fig.3.2: Fine Aggregate Used for Experimental Study

Table 3.2: Physical Properties of Fine Aggregate

Sl.No.	Particulars	Results
1	Type	Normal sand
2	Specific Gravity	2.65
3	Fineness modulus	2.59
4	Bulk density Loose state Compacted state	1278.67 kg/m <sup>3</sup> 1525.82 kg/m <sup>3</sup>

Table 3.3: Sieve Analysis for Fine Aggregate

Sieve size (mm)	Weight Retained(kg)	Cumulative weight retained	Cumulative (%) Weight retained(F)	Cumulative % weight passing
4.75	0.04	2.0	2.0	98.0
2.36	0.172	8.6	10.6	89.4
1.18	0.954	47.7	58.3	41.7
600	0.334	16.7	75	25.0
300	0.396	19.8	94.8	5.2
150	0.094	4.7	99.5	0.5
pan	0.01	0.5	100	0

$$\text{Fineness modulus} = \frac{\text{cumulative \% wt of material retained}}{100} = \frac{259.8}{100} = 2.59$$

### 3.3.3 Coarse Aggregate

In this Experimental study crushed aggregate of 20 mm size was used. Coarse aggregate was found in locally available stone crusher Rajampeta, Kadapa District. Finess Modulus is obtained by sieve analysis

Table 3.4: Physical Properties for Coarse Aggregate

Sl.No.	Properties	Value
1	Size of Aggregate	20 mm

2	Specific gravity	2.7
3	Bulk density(compact)	1635 kg/cum
4	Bulk density(Looser)	1486 kg/cum
5	Fineness modulus	4.48



Fig.3.3: Coarse Aggregate Used for Experimental Study

Table 3.5: Seive Analysis for Coarse Aggregate

Weight of the Sample Coarse Aggregate for 5 kg

Sieve size (mm)	Weight of the sample retained (kg)	% of weight retained	Cumulative % of weight retained	Cumulative % of weight passing(kg)
63	0	0	-	100
50	0	0	-	100
31.5	0	0	-	100
25	0	0	-	100
13.2	3.256	65.12	65.12	34.88
9.5	1.133	22.66	87.78	12.22
6.7	0.564	11.28	99.06	0.94
4.75	0.042	0.84	99.9	0.1
Pan	0.005	0.1	100	0

$$\text{Fineness modulus} = \frac{\text{cumulative \% of wt of material retained}}{100} = \frac{448.14}{100} = 4.48$$

### 3.3.4. Water

For this investigation, clean potable water available in the campus is used for casting and curing operations.

### 3.3.5. Barytes Powder

Low quality of barytes (waste product from barytes pulverized) in kadapa is used for this investigation.

What is Baryte?

It is a mineral consisting of barium sulphate, typically occurring as colorless prismatic crystals and thin white flakes. It is originated from Greek Word "Barus" and "ites" which means heavy (Barites). From 18<sup>th</sup> century is also named as Baryte.

Americans defined Baryte as a Soft, Heavy, Orthorhombic mineral, Barium sulphate ( $\text{BaSO}_4$ ) i.e. The chief ore of the Barium used in making paint, drilling mud etc.



Fig.3.4: Crystal Form of Barytes



**Fig.3.5: Barytes Powder**

The properties of the Baryte powder of Tabulated below

**Table 3.6: Physical Properties of Barytes**

Chemical classification	Sulphate
Color	Colorless, whight, light blue, light yellow, lightred, light green
Streak	White
Luster	Vitreous to pearly
Diaphaneity	Transparent to Translucent
Cleavage	Very good, basal, prismatic
Specific Gravity	4.5
Diagnostic properties	High specific gravity, three cleavage directions at right angles
Chemical composition	Barium Sulphate, Baso <sub>4</sub>
Crystal system	Orthorhombic
Uses	Drilling mud, high-density filler for paper, rubber, plastics

### 3.3.6. Super Plasticizer

The Super plasticizer conforming to IS 9103-1999 was used in present study. The super Plasticizer used was a high range water reducing agent with Chemical base as POLY CARBOXYLIC ETHER. The Specific gravity given by the manufacturer was 1.21. The dosage recommended varies from 50 ml to 1000 ml per kg of cement.



**Fig.3.6: Super Plasticizer**

## IV EXPERIMENTAL INVESTIGATION

### 4.1 GENERAL

The Concrete mix proportions were determined for the grade of M<sub>30</sub> by following the guide lines in the code book of IS 10262-2009. The present investigation discuss about the percentage of cement has been replaced with Micro fine barites powder i.e. 5% and 10%. To study the various properties of the concrete, Concrete Specimens were casted and tested. Water cement ratio of 0.45 has been adopted. The Experimental investigation started with selection of materials and followed by their testing, casting and Curing of Specimens and finally the specimens will be tested according to their requirement.

### 4.2 MIX DESIGN OF CONCRETE

Mix design can be defined as the process of selecting suitable ingredients of Concrete and determining their relative proportions with the objectives of producing concrete of certain minimum strength and durability as economically as possible.

The mix design was done in order to attain the required data for the design procedure, in accordance to the parent material types and location, and the specific density of the designed concrete, that will be suitable, adoptable, durable,

economical, workable and generally safe for the structural design objective of the weather conditions in any specified locations. And also to reduce the Structural Failures.

#### 4.3 MIXING OF CONCRETE

All the materials of the concrete such as cement and barytes powder is mixed well firstly then the mixture was poured in coarse aggregate which is already made an mixture with fine aggregate. After that water is added. later super plasticizer is added in water the mortar was properly mixed and then ready for casting.

#### 4.4 CASTING OF SPECIMENS

For casting specimens, the concrete has been placed in the standard metallic moulds in three layers and compacted with tamping the rod by giving 25 blows. Before the moulds are filled with mortar it is coated with grease for easy removal of specimens. Then moulds are placed for vibrator for 30 seconds and the specimens has been finished smoothly.

**Table 4.1: Specimen Details**

Mould Type	Dimensions	No of specimens			
		7 days	14 days	28 days	60 days
Cube	150mm x150mmx150mm	6	6	6	6
Cylinders	300mm dia x150mm height	-	-	6	6
Rcpt	100mm dia x50 mm height	-	-	8	8
Water Permeabiliy	200mm x120mm height	-	-	8	8

#### 4.5 CURING OF SPECIMENS

After casting the moulds were air dried for 24 hours and then the specimens are safely removed from the moulds. Marking are made on the specimens in order to avoid the confusion during testing of the samples.

#### 4.6 TESTING OF THE SPECIMENS

After certain period of curing the specimens were ready for testing like Compression, split tensile, Rcpt, Water Permeability and Electrical resistivity of concrete.

##### 4.6.1 Cube Compression testing

The test set up for the concrete cube for the compression test has done as shown in the figure 4.1. Compression test on cubes is conducted with 2000kN capacity compression testing machine. the machine has atleast count of 1KN.The machine has at least count of 1KN.the cube was placed in the compression testing machine and the load on the cube was applie gradually at a constant rate till the failure of the specimen and corresponding load was noted as ultimate load. Then the cube compressive strength of the concrete mix is computed by using standard formula

$$F_c = \frac{P}{A}$$

Where p=The ultimate load in N(newton)

$F_c$ =the compressive strength N/mm<sup>2</sup>

A=cross sectional area of the cube in mm<sup>2</sup>



## COMPRESSIVE TEST

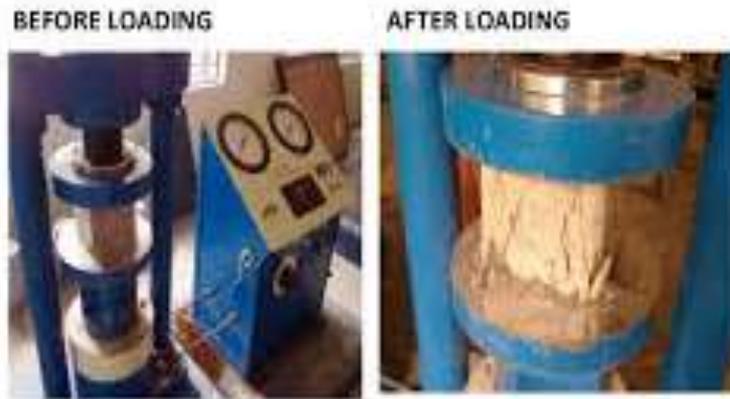


Fig.4.1: Mould for Casting the Cube

### 4.6.2 Split Tensile Strength

The test was conducted with the compression testing machine and it can be viewed in figure 4.2. The cylinder is placed on the bottom compression plate of the testing machine and was aligned such that the center lines marked on the ends of the specimen were vertical. Then the top compression plate was brought into the contact at the top of the cylinder. The load was applied at uniform rate, until the cylinder failed and same load was taken into account as a ultimate load. From this load, the Splitting tensile strength is calculated for each specimen b using the formula is

$$F_t = \frac{2p}{\pi D l}$$

- Where  $f_t$  = tensile strength in  $N/mm^2$
- P=Compressive load on the cylinder
- L=length of the cylinder in mm
- D=Diameter of the cylinder in mm



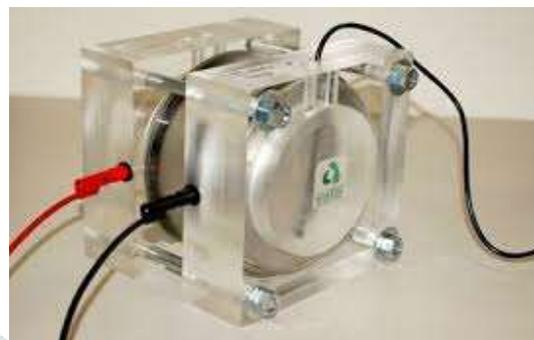
Fig.4.2: Split Tensile strength of Concrete

**4.6.3 rapid Chloride permeability test**

According to ASTM C1202 test, a water saturated, 50 mm thick, 100mm thick diameter concrete specimen is subjected to 60v applied DC voltage for 6 hours using the apparatus and the cell arrangement is shown in figure 5.4. In one reservoir is 3.0% Nacl solution and in other reservoir is 0.3 M NaOH solution. The total charge passed is determined and that's is used to rate the concrete according to the criteria included.



**Fig.4.3: Moulds casted to test RCPT**



**Fig.4.4: Equipment arrangement**

**Table 4.2: Range of Chloride Ion Penetration**

Charge passed	Chloride Ion permeability
>4000	High
2000-4000	Moderate
1000-2000	Low
100-1000	Very Low
<100	negligable

The specimens were fit in the chamber with the required brass as well as rubber O-ring. Then note the readings at an interval of 30 min in an 6 hour duration and the current of 60V is passed continuously. The data logger records the readings of the corresponding cells at the every record time with its initial readings. At the end of log time, the system halts after taking the final reading.

Average current flowing through one cell is calculated by

$$I = 900 * 2 * I_{\text{cumulative coulombs}}$$

$$I_{\text{cumulative}} = I_0 + I_{30} + I_{60} + I_{90} + I_{120} + I_{150} + I_{210} + I_{240} + I_{270} + I_{300} + I_{330} + I_{360}$$

Where.

- $I_0$  = Initial current reading in mA
- $I_{30}$  = Current reading at 30 minutes in mA
- $I_{60}$  = Current reading at 60 minutes in mA
- $I_{90}$  = Current reading at 90 minutes in mA
- $I_{120}$  = Current reading at 120 minutes in mA
- $I_{150}$  = Current reading at 150 minutes in mA
- $I_{210}$  = Current reading at 210 minutes in mA
- $I_{240}$  = Current reading at 240 minutes in mA
- $I_{270}$  = Current reading at 270 minutes in mA
- $I_{300}$  = Current reading at 300 minutes in mA
- $I_{330}$  = Current reading at 330 minutes in mA
- $I_{360}$  = Current reading at 360 minutes in mA



**Fig.4.5: Rapid Chloride Permeability Test Set Up**

#### 4.6.4 Water Permeability Test

Water permeability test was conducted on 150mm dia and 200mm height concrete specimen .The experimental set up was as shown in figure/water is applied at 5kg/cm<sup>2</sup> pressure for 72 hours.The pressure was maintained constantly for 72 hours. The specimen has weighed and the volume of water penetrated and the depth of penetration was measured using the formula

$$K = \frac{d^2 v}{2ht}$$

Where d=depth of penetration of water

V=volume of water penetrated

T=time in seconds under pressure

H=hydraulic head in m

$$V = \frac{1000m}{Ad}$$

M= gain in mass (mean of water penetrated)

A=cross sectional area of concrete member

D=depth of penetration in mm



**Fig.4.6: Experimental set up of water permeability**

#### 4.6.5 Electrical Resistivity Method

To find out the electrical resistivity of concrete specimen four probe wenner method was used. The experimental set up is shown in figure.50hz of Alternate current (AC) was applied through the end probes and the voltage drop or potential difference between the middle inner probes was observe .The distance between the probes was maintained as 5cms using the formula

$$\text{Resistivity } \rho = 2\pi a \frac{V}{A}$$

Where a=distance between the probes

V=voltage

A=current in amperes

ρ=resistivity in Ωcms



Fig.4.7: Arrangement of copper rods to wooden plank to connect probes

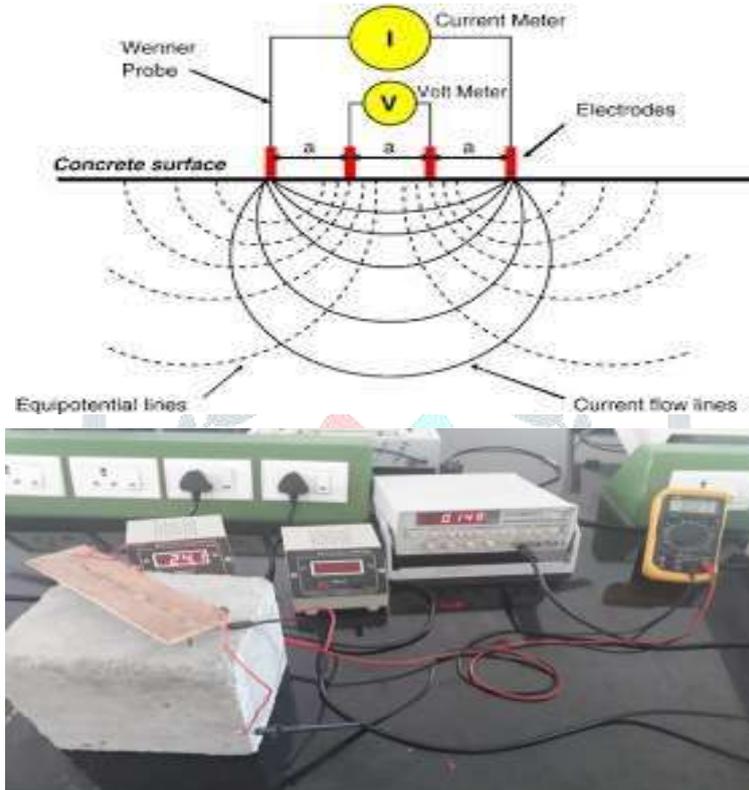
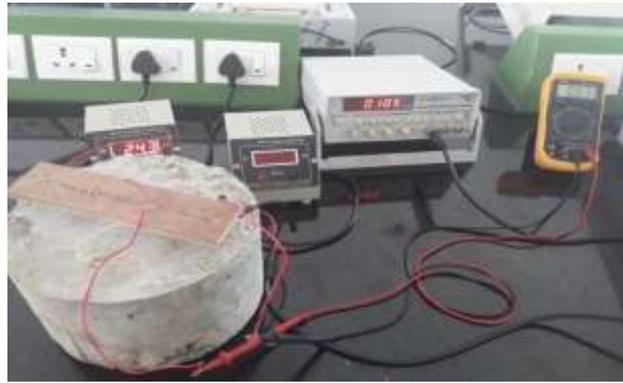


Fig.4.8: Electrical Resistivity Test Done on Cubes



Fig.4.9: Electrical Resistivity Test One on Cylinders



**Fig.4.10: Electrical Resistivity Test Done on Permeability Specimen**

In the present investigation the effect of barytes powder on the strength, water permeability, Chloride permeability and the Electrical resistivity of M<sub>30</sub> grade concrete is studied. The Cement is replaced by 2.5%, 5%, 7.5% and 10% of barytes powder and 1.5% percent of super plasticizer is used in all the mixes to study the effect of barytes with super plasticizer on concrete. The strength and durability test results are furnished in tables to the Graphs showing the effect of barytes with and without super plasticizer are given in figures.

**Table 5.1: Mix Designations**

Sl.No.	Mix Designations	% of Baryte powder + super plasticizer
1	A1	0
2	A2	2.5
3	A3	5
4	A4	7.5
5	A5	10
6	B1	0 + 1.5% of SP
7	B2	2.5% + 1.5% of SP
8	B3	5% + 1.5% of SP
9	B4	7.5% + 1.5% of SP
10	B5	10% + 1.5% of SP

## 5.2 COMPRESSIVE STRENGTH

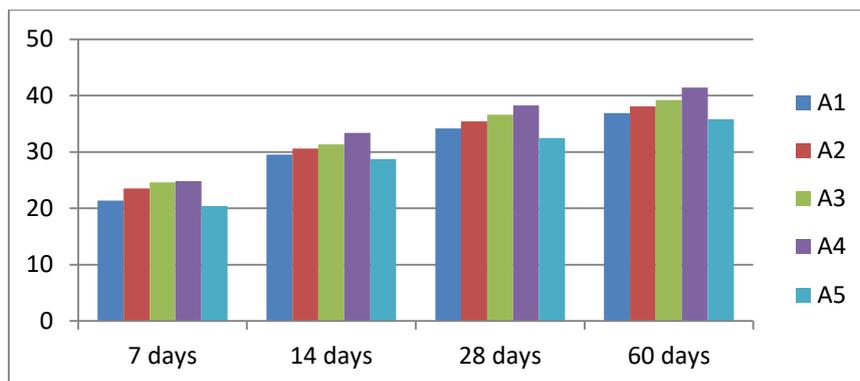
The Compressive strength of concrete is the most common performance measure used by the engineer in designing buildings and other structures.

### 5.2.1 Effect of Barytes Powder on Compressive Strength of M<sub>30</sub> Concrete

M<sub>30</sub> grade concrete with partial replacement of OPC by 2.5%, 5%, 7.5% and 10% of barytes powder with 1.5% of super plasticizer and without super plasticizer was tested for the Compressive strength at the age of 7, 14, 28 and 60 days of concrete.

**Table 5 2: Compressive Strength results for Barytes Powder Effect of barytes Power on Compressive Strength of Concrete**

S.No.	Mix designation	Barytes Powder replacement (%)	Compressive Strength			
			7 Days	14 Days	28 Days	60 Days
1	A1	0	21.40	29.52	34.16	36.90
2	A2	2.5	23.54	30.60	35.40	38.10
3	A3	5.0	24.60	31.32	36.61	39.24
4	A4	7.5	24.84	33.40	38.25	41.40
5	A5	10.0	20.42	28.72	32.45	35.80



**Graph 5.1: Plotting Compressive Strength Results without Super Plasticizer**

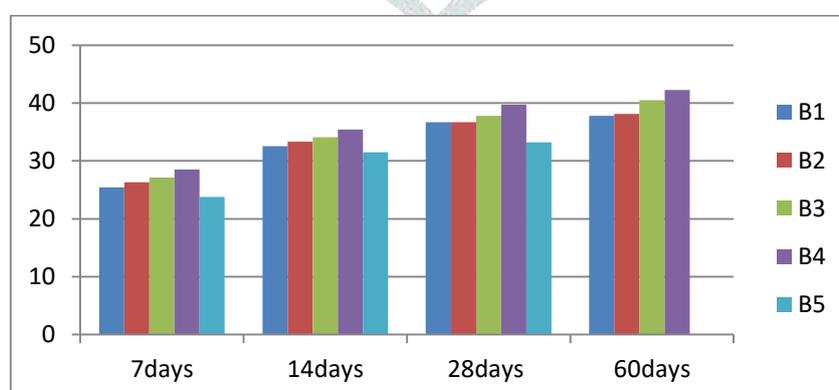
The above graph represents X- Axis = The age of the concrete cured in days

Y-Axis =The Compressive Strength of concrete in N/mm<sup>2</sup>

- By doing compression test on M<sub>30</sub> grade Concrete it is Observed that strength varies by replacing the cement with barytes powder in 2.5,5,7.5 and 10 percentages .
- The Compressive strength test was done in all ages from 7days,14ays,28days and 60 days and the results are discussed as follows
- In M<sub>30</sub> concrete, when compare with the Conventinal concrete the strength started increased when the cement was partially replaced with barytes powder i.e. for 0% replacement strength was 21.40 N/mm<sup>2</sup> but when cement replaced with barytes powder strength was 23.54 N/mm<sup>2</sup>.
- Similarly when it observed in the graph strength got increased for 14 ays,28 days and 60 days
- Likewise, cement got replaced in 5%,7.5% and 10% at certain point strength started decreasing when the barytes amount was gradually increased its quantity.

**Table 5.3: Effect of Barytes with Super Plasticizer on Compressive Strength of Concrete**

Sl.No.	Mix Designation	% of Barytes powder replacement	Compressive Strength			
			7 Days	14 Days	28 Days	60 Days
1	B1	0	25.47	32.54	36.68	37.80
2	B2	2.5	26.33	33.35	36.72	38.14
3	B3	5.0	27.14	34.11	37.80	40.51
4	B4	7.5	28.53	35.44	39.74	42.30
5	B5	10.0	23.81	31.50	33.21	36.45



**Graph 5.2: Plotting the Compressive Strength Results with Super Plasticizer**

The above graph represents X- Axis = The age of the concrete cured in days

Y-Axis =The Compressive Strength of concrete in N/mm<sup>2</sup>

- The above Results and graph that has been shows the positive results regarding the point of strength gaining.
- As we can observe that strength got increasing more in the same age of concrete when compared without super plasticizer.

- Including the partial replacement of cement with Baryte powder 1.5% of super plasticizer also added.
- This will give the drastic difference in strength and will produce good concrete.
- Here the barite powder added in 2.5, 5, 7.5 and 10 percentages including super plasticizer gives better results.
- But the strength started decreasing when amount barite power was increased.

### 5.3 SPLIT TENSILE STRENGTH

The tensile strength of concrete is one of the basic and important properties which greatly affect the extent and size of cracking in structures.

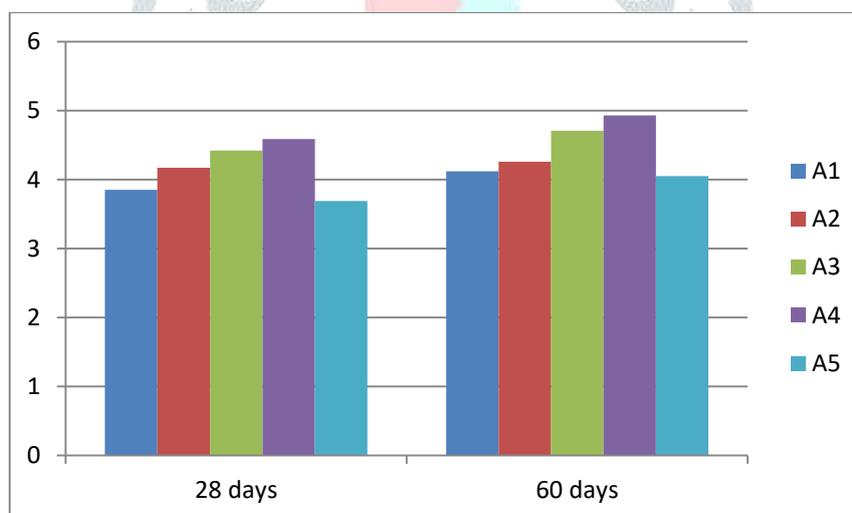
#### 5.3.1 Effect of concrete on split tensile strength:

The test was conducted to know how the barytes powder exhibits its properties on replacing with cement with and adding super plasticizer at the age of 28 days and 60 days.

#### 5.3.2 Effect of Barytes Powder on Split Tensile Strength of Concrete

Table 5.4: Strength results for Split Tensile Strength

Sl.No.	Mix Designation	Baryte powder in %	Split tensile Strength	
			28 Days	60 Days
1	A1	0	3.85	4.12
2	A2	2.5	4.17	4.26
3	A3	5.0	4.42	4.71
4	A4	7.5	4.59	4.93
5	A5	10.0	3.69	4.05



Graph 5.3: Plotting the results Obtained for Split Tensile Strength of Concrete

## V. CONCLUSION

The following conclusions are made basically on the results obtained by conducting strength and durability properties of  $M_{30}$  Concrete with 2.5%, 5%, 7.5% and 10% of barytes powder.

1. The Compressive Strength of  $M_{30}$  concrete increases at all ages with increase in barytes powder up to 7.5%.
2. The Effect of Super Plasticizer in improving the compressive strength of Concrete with Barytes is not high. Little increase in Compressive strength is observed at early age.
3. The Split Tensile strength of Concrete improves with increase in replacement of Opc with Barytes Powder. Up to 7.5%.
4. Concrete with baryte powder up to 7.5% shows good resistance to chloride permeability.
5.  $M_{30}$  concrete with OPC replace by barites up to 7.5% shows resistance to Water Permeability.
6. The Electrical resistivity of concrete improves by addition of barytes Power as replacement to OPC up to 10%.

7. The Strength and durability Properties of  $M_{30}$  OPC concrete are improved by the replacement of opc with barytes powder upto 7.5%.
8. The usage of Super Plasticizer not only increase the strength but also durability properties and reduces the usage of Water.

#### SCOPE FOR FUTURE INVESTIGATION

The Research work for pozzolanic materials is limited .But it gives a path for further studies.

Following aspects are considered for future study and investigation

1. Investigation can be done on the barytes powder with different grades of the concrete. By replacing with cement.
2. With the Usage of water reducing agents more water can be preserved by experimentation whether it can be carried out or not.

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