ISSN XXXX XXXX © 2018 IJESC

Research Article Volume 8 Issue No.7

An Experimental Study on Deterioration of Concrete in Coastal Region Structure and on M20 Grade Concrete

K.MohanKrishna[1], M.Rani[2]
M.Tech, Structural Engineering[1], Assistant professor[2]
Department of Civil Engineering
Vikas Group of Institutions, Andhra pradesh, India

Abstract:
Concrete is a Major Construction material used for the construction ofstructures. It is homogeneous mixture of cement, aggregates and water. Due to several Factorslike environmental effects, defects in materials, and mixing,design faults leads to deteriorationof structure. It can be identified by cracking, spalling, abrasion, deflection andcorrosion.Deterioration mainly caused due to aggregate and water/cement ratio. Use of porous aggregate,saline water and soft aggregate causes deterioration. This research investigating the chlorine attack, PH value, and strength ofconcrete.Chloride ions are mainly responsible for deterioration of structures. Due to corrosion initiated bychloride attack is a significant problem especially in marine regions. The chloride ions penetratein to the concrete and results in initiation of the corrosion. The PH represents the nature of concrete.Generally concrete has a PH about 13. Concrete can be attacked by liquids of PH value less than6.5 but the major attack only at PH value below 5.5. Due to all the cement compounds are eventually broken down and leached away. This project highlights the chlorine content, PH and strength of concrete in agedbuildings which are constructed at 30years ago. The climatic conditions effects on the buildingsand suggests suitable remedies to avoid those effects.

Keywords: Compressive strength, chloride, Fly-ash, GGBS, PH-strips, Seawater

I. INTRODUCTION

1.1 General: Now-a-days the most suitable and widely used construction material is concrete. This building material, until these days, went through lots of developments. The definition of concrete is the mixture of cement, water, additives or sometimes super-plasticizers. It is artificial material. In the beginning it is soft, ductile or fluid, and gradually will be solid. We can consider this building material as an artificial stone. Deterioration is the process of degeneration or reduction in quality to an inferior state of material. There are many factors which lead to deterioration of concrete. A concrete structure undergoing deterioration shows the indicative signs in the form of cracking, spalling, abrasion, stains, deflection and corrosion.

The most important part of concrete is cement.The aggregate comprises of 70% of the total volume of the concrete mix. The aggregate influence the workability of concrete. Selecting good quality aggregates give the durability the concrete. The pH of fresh concrete is about 12 to 13.5. Concrete is sound in compression and weak in tension. Steel in introduced in the concrete due to its thermal properties. Steel is good in both tension and compression. The durability of a Reinforced concrete structure depends upon its ability to withstand the various agencies which lead to the deterioration of concrete. Most often the term durability is linked with the compressive strength of concrete. Basically the agencies which lead to deterioration of concrete can be summed up into physical, chemical and mechanical agencies. In order to achieve durability in concrete we must take care on design, detailing, reinforcement placement and use of proper material.

1.2 Scope and Objectives:

- pH value of the concrete sample.
- Chlorine content in the concrete.
- Compression strength of the concrete
- Suggest suitable remedies to avoid deterioration of concrete.

II. METHODOLOGY ANDMATERIALS:

2.1 Methodology:

- Collection or Sample Preparation
- Testing of samples
- Results
- Suitable remedies
- Conclusion

2.2Cement: Cement used in this experiment work is ordinary Portland cement of 53- grade available in the local market. The cement should be fresh and of uniform consistency. The specific gravity of the cement is 3.15. All properties of cement are tested by referring IS 12269 – 1987[11].

TABLE I
PROPERTIES OF CEMENT

Sl. No.	Property	Value
1	Fineness test	1%
2	Setting time a) initial b)final	63min 321 min
3	Specific gravity	3.11

2.3 Fine Aggregates: Locally available sand conforming to grading zone II which is passing from 4.75 mm sieve and of specific gravity of 2.58 is used.

TABLE II
PROPERTIES OF FINE AGGREGATE

Sl. No.	Property	Value
1	Sieve analysis	Zone II
2	Specific gravity	2.58
3	Finess Modulus	2.26

2.4 Coarse Aggregate: Locally available crushed stones conforming to graded aggregate of nominal size 20 mm as per IS: 383 – 1970[12]. Specific gravity of course aggregate is 2.66.

TABLE III
PROPERTIES OF COARSE AGGREGATE

Sl. No.	Property	Value
1	Specific gravity	2.66
2	Fineness modulus	7.68

2.5 Water
Fresh potable water free from acid and organic substances was used for mixing and curing concrete.

III. EXPERIMENTAL WORK

Mix design for each set having different combinations are carried out by using IS:456-2000[10]. The mix proportion obtained for normal M20 grade concrete is 1:1.5:3 with a water-cement ratio of 0.46.

TABLEIV
MIX PROPORTIONS

Material	Cement	Fine aggregate	Coarse aggregate
Weight	17kgs	25.5kgs	51kgs

This experimental program consists of the following steps:

- Case study on structure in coastal regions
- Collection of Materials
- Casting
- Curing
- Testing

3.1 Case study on structures in coastal regions:
Coastal areas are commonly defined as the interface or transition areas between land and sea. In this case study three buildings of age 30 years building samples are collected from Kanuru area which is located 15km from Machilipatnam beach . On these samples pH and chlorine tests are conducted.
Cubes are tested after completion of curing and for 28days these are tested by UTM with rate of loadingCubes are tested after completion of curing and for 28days these are tested by UTM with rate of loading 14mpa/min and for 28 days. The samples are tested again for PH and Chlorine Content.

FIGUREI
CUBES

IV.TESTS AND RESULTS

A number of tests were carried out to determine the design mix properties of concrete in the laboratory. In the present work, the strength of the hardened concrete is determined. The strength criterion includes measurement of following parameters:

- P^H Test
- Chlorine Test
- Compressive Strength on cubes

4.1. pH Test:
pH is an approximate measure of acidity or alkalinity of a solution and defined as the negative logarithm of the hydrogen ion (H+) concentration. The pH ranges from 0 to 14. Substance with pH more than 7 are basic nature, less than 7 are acidic nature and equal to 7 is considered as neutral.
pH test was conducted on samples by using pH strips available in market. These strips are indicating the pH value by color. pH strip colors

4.1.1Preparation of sample for testing:

- ollect the sample from the building (i.e., From 30years building, 28days curing cubes in normal water and sea water)
- eigh the samples to 5gms and then take the 100ml of two small beakers and fill it with the Weighed Samples and then add 50ml of distilled water in to both the beakers
- eep the sample in a dark place upto 24hrs
- fter 24hrs test the samples by using pH strips

FIGUREII: P^H TEST ON 30YEARS BUILDING SAMPLE

FIGUREIII
P^H TEST ON FRESH CONCRETE

4.2: Chlorine test:

- Collect the sample (i.e., From 30years building, 28days curing cubes in normal water and sea water)
- Weigh the samples to 5gms and then take the 100ml of two small beakers and fill it with the Weighed Samples and then add 50ml of distilled water in to both the beakers
- Keep the sample in a dark place upto 24hrs
- After 24hrs test the samples

$$\frac{(V_2\text{-}V_1)\ X\ (0.0141)\ X\ (35.5)\ X1000}{20}$$

V_1 = volume of distilled water
V_2 = volume of water sample

FIGUREIV
CHLORINE TEST

4.3 Compressive strength

Compression test on cubes of size (150 x 150 x 150) mm was performed on compression testing machine.

FIGUREV
COMPRESSION TESTING ON CUBES

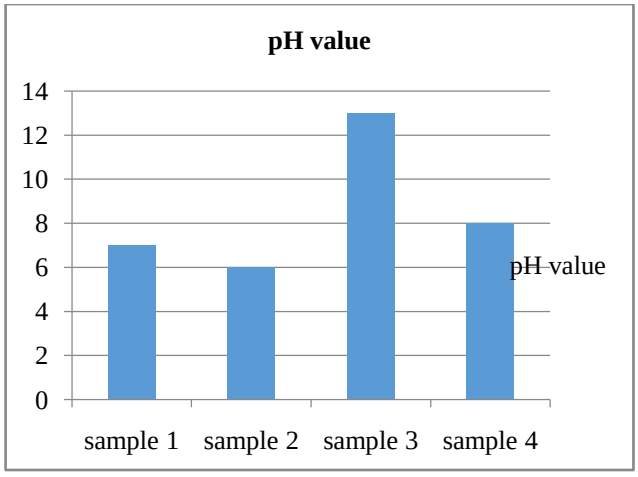
V.RESULTS & DISCUSSIONS

Durability studies of compressive strength of concrete effected with 5% of HCl and H_2SO_4 acid is studied at 15% replacement of POFA along with different percentage of steel and glass fibers.

5.1 PH TEST RESULTS:

TABLEV

S. NO	SAMPLE	PH VALUE
1	Distilled water	7
2	30 years building sample	6
3	Concrete cube curing in normal water (28 days)	13
4	Concrete cube curing in saline water (28 days)	8



5.2 CHLORINE TEST RESULTS:

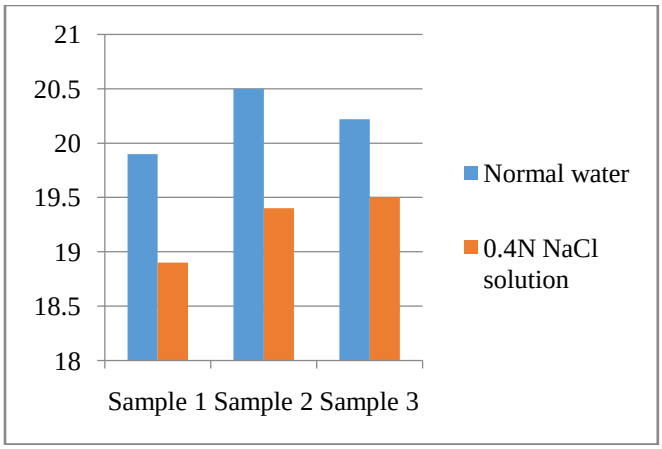
TABLE VI

SAMPLE	**Soluble Chlorine Value (Kg/m3)**
Concrete cube curing in normal water (28days)	0.257
Concrete cube curing in sea water (28days)	0.290
30years Building Sample	0.005

5.3 Compressive strength studies:

TABLE VII

STRENGTH N/mm2	CUBE-I	CUBE-II	CUBE-III
28Days (normal water)	19.9	20.5	20.22
28Days (0.4 Saline water)	18.9	19.5	19.5



VI: CONCLUSIONS

From the experimental work carried out and the analysis of the results following conclusions:

- The limiting value of chlorine percentage is 0.15 of the concrete weight.
- The chlorine content in the 30 years sample is 0.1%.
- The chlorine content in fresh concrete is 3kg/m^3 as per IS 456:2000.
- The chlorine content in the prepared sample is 0.2kg/$m^{3.}$
- P^Hvalue below 5.5 it eventually broken down and leached away.
- For 30yrs building P^H value is 6. Then the structure is safe.
- P^Hvalue is 13 for concrete cured in normal water and 8.3 for concrete cured in saline water.

VII: FUTURE SCOPE OF WORK:

GGBS is the material used for replacing of cement in concrete. GGBS is recommended to reduce the chlorine content in the concrete.

Fly ash is also a very good replaceable material for cement. It is also a waste product from power plants. It is recommended to reduce the chlorine penetration in concrete.

REFERENCES

[1] M. S. Shetty. *Concrete Technology*. S.Chand& Company Ltd., 2005, New Delhi.

[2] C.Marthong, T.P.Agrawal / International Journal of Engineering Research and ApplicationsVol. 2, Issue4, July-August 2012, pp.1986-1991 _1986|Page Effect of Fly Ash Additive on Concrete Properties.

[3] VMarciaR.SilvaandTarunR,Naik studied that "Bio-Deterioation of concrete structures in coastal zones"

[4] MS.HarshadaP.Kadim, professor D&B desai and Dr.A.K.Gupta studied that "A Review on paper on Deteerioration of concrete in marine structures".

[5] M.Sosa, T.Perez, Lopez , J.Reyes, F.Corvo, R.camacho-chab, P.Quinto, D Aguilar, studied that in "Influence of the marine environment on that reinforced concrete degradation depending on the exposure conditions".

[6] Sanjeevkumar Varma, Sudheersingh, Bhadauria Saleem Akhta, studied that in the evoluting effect of chloride attack and concrete cover of the probability of the corrosion.

[7] By Jennifer A. GRUBBHemanth.SLimaye and Ashok M Kakade studied that in testing ofPh of concrete.

[8] Rebound hammer as per IS 13311 Part 2 1992 is to find out the compressive strength of concrete.

[9]ASTM C 150-95 Standard specifications for portland cement.

[10] IS 456:2000 (Reaffilarmed 2005), Indian Standard Plain Concrete- Code of Practice (Fourth Revision).

[11]IS:12269-1987 (Reaffirmed 2004), Indian standard specifications for 53 Grade Ordinary Portland cement, Bureau of Indian Standard, New Delhi, India.

[12]IS: 383 – 1970(Reaffirmed 2007), Specifications for coarse and fine aggregate from Natural sources for concrete. Bureau of Indian Standard, New Delhi, India.