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"EFFECT OF TREATED SEA WATER ON STRENGTH AND DURABILITY PROPERTIES OF CONCRETE"

M.VEENA PRATYUSHA[1], K.V MADHAV[2]

[1]*M.Tech in Structural Engineering, DMS SVH MACHILIPATNAM*
[2] *Assistant Professor, Civil Engineering, DMS SVH College, Machilipatnam, Andhra Pradesh, India*

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Abstract - *Water is by far the communist substance on earth, the 97% of the total sea water is Unfit for human consumption. Of the 3% that is fresh, two-thirds is locked up in glaciers of ice and frozen around the poles. Only 1%of the world's water is available for human consumption. Substantially pure water is produced via desalination using a directional solvent that directionally dissolves water but does not dissolve salt. The directional solvent is heated to dissolve water from the salt solution into the directional solvent. The remaining highly concentrated salt water is removed, and the solution of directional solvent and water is cooled to precipitate substantially pure water out of the solution. Additionally, if use of sea water as concrete material is permitted. It will be very Convenient and economical in the construction, especially in the coastal works. By considering all the above factors my experimental study carries on converting. Seawater into domestic water by using various plant extracts(Clearing Nuts, M.Olifera seeds) and chemicals(Ethyl Acetate, Butyl Acetate, Decanoic Acid) (Some how we call it as desalination using directional solvent extraction) and that water will be used for casting cement concrete of M25 grade. The effects of mixing and Curing concrete with treated seawater on the compressive, tensile and flexural Strength of concrete will be investigated. Then investigations were carried out for Percentage loss in compressive strength, Percentage loss of weights by considering the Durability tests such as acid attack test, alkaline attack test and sulphate attack test at the age of 28, 56 and 90days.*

Key Words: : **Cement, Aggregate, Clearing Nuts, M.Olifera seeds, Ethyl Acetate, Butyl Acetate, Decanoic Acid.**

1. INTRODUCTION

Groundwater is the preferred source for drinking water in rural areas of developing countries and it generally requires no or minimal treatment. In the event that no suitable aquifers are available, relatively clean waters from lakes or streams are preferred. However, only simple, practical technologies such as gravity chemical feed with solutions, hydraulic rapid mixing and flocculation, horizontal-flow sedimentation, and manually operated filters should be used for treatment of such waters. The present study used a coagulation-filtration test to examine quality improvement of surface water by direct filtration with S. potatorum seed or M. oleifera seed as the coagulant. The goal was to assess suitability of the method for home water treatment in rural areas of developing countries

2. OBJECTIVES OF STUDY

1. By Considering all the above factors my experimental study carries on converting Seawater into domestic water by using various plant extracts and chemicals. And that water will be used for casting of cement concrete.

2. The effects of mixing and curing concrete with treated seawater on the compressive, tensile & flexural strength of concrete will be investigated.

3. A method for separating water from a saline solution using a directional solvent Extraction Method,

4. Observe the behavior of Chemicals in treated seawater.

5. To study the effect of Treated Seawater on Structural concrete.

6. To determine the maximum strength of the concrete by using treated sea water of Natural Herbs & Chemicals.

7. To study the durability properties of concrete with acid attack test, alkaline attack test and sulphate attack test and comparison of the test results for casting concrete specimens of TSW with DA.

3. LITERATURE REVIEW

Ray et al., 1981 studied psychology and Heavy Metal pollution. And Heavy Metal tolerance in algae isolated from contaminated lakes near Sudbury (Stokes et al., 1973) reviewed. In Toxicity of Heavy Metals to fresh water algae (Whit ton, 1970) also reviewed.

Raveendra Babu and Malay Chaudhuri et al., 1992 Seeds of S. potatorum and M. oleifera contain materials that are effective as coagulant, and direct filtration of water with S. potatorum seed or M. oleifera seed as coagulant brings about a substantial improvement in its aesthetic and microbiological quality.

Anurag Bajpayee, Daniel Kraemer, Andrew Jerome Muto , Gang Chen John H. Leonhard , Borivoje B. Mikic et al., 2001 Substantially pure water is produced via desalination using a directional solvent that directionally dissolves water but does not dissolve salt. The directional solvent is heated to dissolve water from the salt solution into the directional solvent. The remaining highly concentrated salt water is removed, and the solution of directional solvent and water is cooled to precipitate substantially pure water out of the solution.

4.1 Experimental Program

Thesis flow chart:-

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Y First we have to collect Sea water after that we have to remove Turbidity from water by using various plant extracts then casting the concrete with sea water after removing turbidity, Next process desalination process desalination of seawater after removing turbidity by directional solvent extraction then casting the concrete with water obtained after desalination then durability of concrete tests will be conducted with chemically treated seawater.

4.2 Directional Solvent Extraction process:

In order to accomplish effective salt removal from saline water using directional solvents

the process cycle must consist of (1) forming a saline water-in-solvent emulsion (2) heating the emulsion to a temperature greater than ambient so that pure water is dissolved into the solvent (3) brine-phase settling and removal (4) cooling down the solvent to ambient temperature to precipitate out pure water.

(a). A directional solvent is heated in a beaker and maintained at 40 - 95 'C and the saline solution is added while stirring. Care is taken to ensure that the temperature is higher than ambient to facilitate recovery of water but less than 100 *C to prevent vaporization of water. Phase change could lead to undesired evaporation and loss of water as well as cause excessively high energy consumption.

(b) Upon mixing the beaker turns cloudy indicating emulsion formation. The water droplets formed within the solvent scatter light and give the contents a cloudy appearance.

(c) Upon mixing for some time, the cloudiness in the beaker reduces indicating dissolution of some water. This is due to the water droplet sizes and numbers reducing resulting in the reduced light scattering.

(d) After stirring is stopped, the remaining brine settles gravitationally, leaving clear solvent and the dissolved water above. At this stage the solvent has dissolved the pure water phase and separated it from the salts.

(e) The clear contents are decanted into conical tubes maintained at room temperature. Care is taken to ensure that the brine or crystallized salts do not get transferred to the conical tubes and get mixed with the pure water.

(f) Cloudiness reappears in the conical tubes as the contents cool and pure water precipitates out resulting in the re-appearance of water-in-solvent emulsion droplets.

(g) Pure water separates gravitationally leaving clear the clear solvent above a forming a Clear water layer at the bottom.

(h) This purified water is separated from the bottom of the tube and the solvent is reused.

Again, care is taken to ensure that solvent is not lost or gets collected together with the Recovered water sample.

4.3 OBSERVATIONS:

The water obtained after desalination process is more when Ethyl acetate is used as a solvent. And the order of extraction is shown below.

Ethyl acetate > Butyl acetate > Decanoic acid

Similarly the quality of pure water extraction is more in case of Decanoic acid is used and the order is shown below.

Decanoic acid > Butyl acetate > Ethyl acetate

Desalination process cycle.

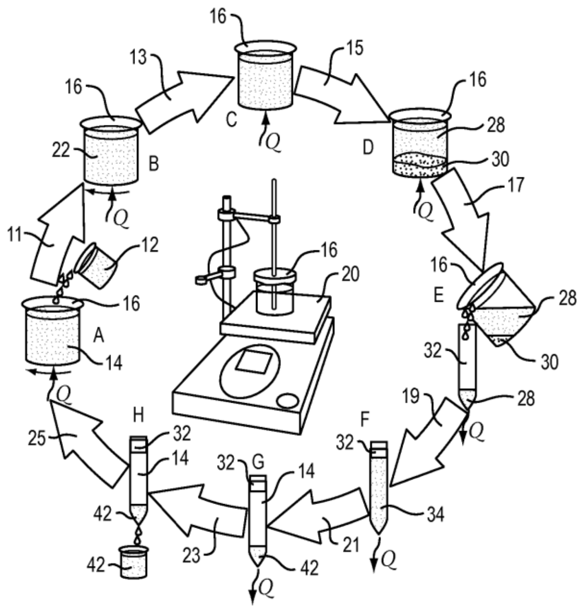


Fig 1 :- Chemical layer separated from water

5. DURABILITY TESTS

5.1 Alkaline Attack Test:

To determine the resistance of various concrete mixtures to alkaline attack, concrete specimens casted with treated Seawater were immersed in alkaline water having 5% of sodium hydroxide (NaoH) by weight of water was found. Then the cubes were immersed in alkaline water continuously for 28, 56 and 90days. The alkalinity of water was maintained same throughout the test period. After 28, 56 and 90 days of immersion, the concrete cubes, cylinders and prisms were taken out of alkaline water. Then, the specimens were tested for compressive strength, Split tensile strength, Flexural strength (N/mm^2). The resistance of concrete to alkaline attack was found by the % loss of weight of specimen and the % loss of Compressive strength, Split tensile strength, Flexural strength (N/mm^2) on immersion of concrete specimens in alkaline water.

5.2 Acid Attack Test:

For experimentation program, cube specimens have been cast as per given schedule in the above and kept curing for 28 days. After curing days, 3 specimens were taken out from water tank and recorded their respective weight and compressive strength. After 28 days, again these specimens have been exposed to 1% concentrated HCl and water. After completion of the exposure period of 28, 56 and 90 days, percentage loss of weight of specimens and loss of compressive strength with respect to reference concrete have been calculated.

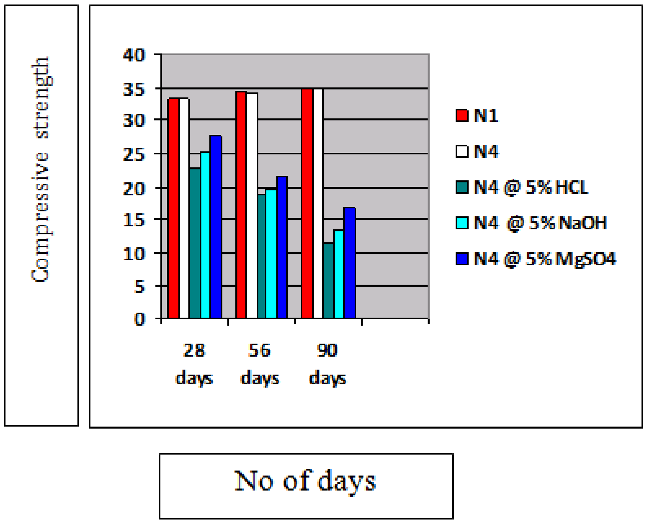
5.3 Sulphate Attack Test:

The resistance concrete specimens casted with treated Seawater with chemicals to sulphate attacks was studied by determining the loss of Compressive strength, Split tensile strength, Flexural strength (N/mm^2) or variation in Compressive strength, Split tensile strength, Flexural strength (N/mm^2) of concrete cubes, cylinders and prisms immersed in sulphate water having 5% of magnesium sulphate ($MgSO_4$) by weight of water and those which are not immersed in sulphate water. The concrete cubes, cylinders and prisms were immersed in 5% of $MgSO_4$ added water for 28, 56 and 90days. The Concentration of sulphate water was maintained throughout the period. After 28, 56 and 90days immersion period, the concrete cubes, cylinders and prisms were removed from the sulphate waters and after wiping out the water and girt from the surface of cubes tested for Compressive strength, Split tensile strength, Flexural strength(N/mm2) following. This type of accelerated test is finding out the loss of compressive strength for assessing sulphate resistance of concrete.

6.2 Test results for durability:

Table 6.2.1 Comparison of compressive strength between N4 & N4 with attack of chemicals

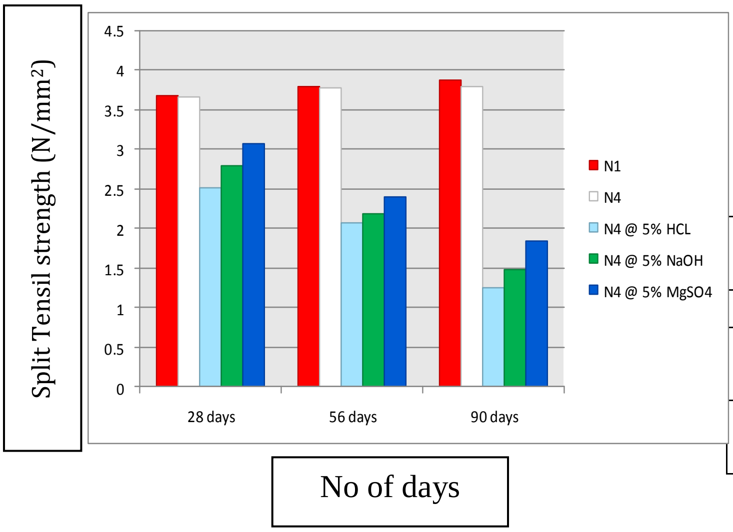
Type of specimen	28 days (N/mm^2)	56 days (N/mm^2)	90 days (N/mm^2)
N1	33.12	34.23	35
N4	33.1	34.05	34.92
N4 @ 5% HCL	22.68	18.62	11.26
N4 @ 5% NaOH	25.23	19.64	13.28
N4 @ 5% $MgSO_4$	27.64	21.63	16.64



Graph 6.2.1 Comparison of compressive strength between N4 & N4 with attack of chemicals

Table 6.2.2 Comparison of Split Tensile strength between N4 & N4 with attack of chemicals

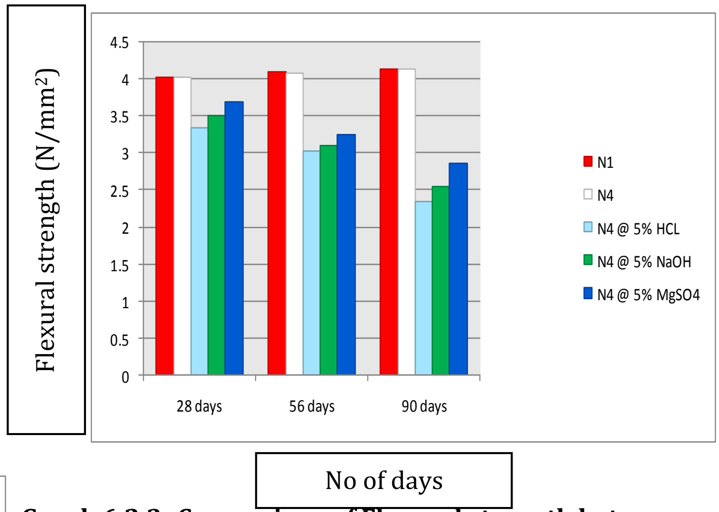
Type of specimen	28 days (N/mm^2)	56 days (N/mm^2)	90 days (N/mm^2)
N1	3.68	3.80	3.88
N4	3.67	3.78	3.8
N4 @ 5% HCL	2.52	2.68	1.25
N4 @ 5% NaOH	2.80	2.18	1.47
N4 @ 5% $MgSO_4$	3.07	2.40	1.84



Graph 6.2.2-Comparison of Split Tensile strength between N4 & N4 with attack of chemicals

Table 6.2.3 Comparison of Flexural strength between N4 & N4 with attack of chemicals

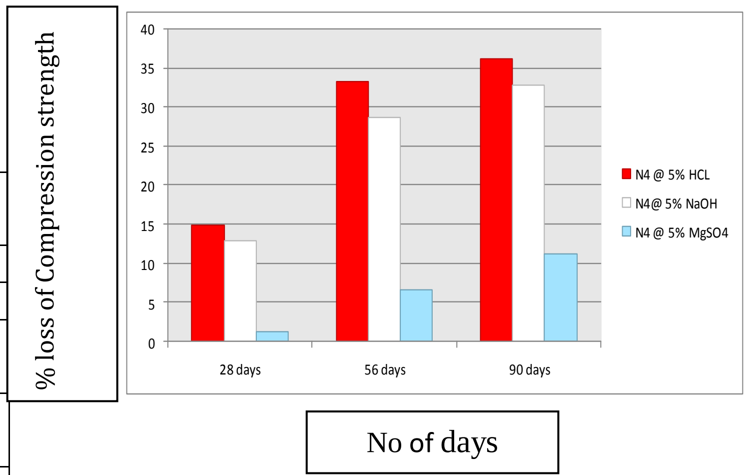
Type of Specimen	28 days (N/mm^2)	56 days (N/mm^2)	90 days (N/mm^2)
N1	4.028	4.095	4.14
N4	4.027	4.084	4.13
N4 @ 5% HCL	3.33	3.02	2.34
N4 @ 5% NaOH	3.51	3.10	2.55
N4 @ 5% $MgSO_4$	3.68	3.25	2.85



Graph 6.2.3 -Comparison of Flexural strength between N4 & N4 with attack of chemicals

Table 6.2.4 Comparison of % loss of weight of cube between N4 & N4 with attack of chemicals

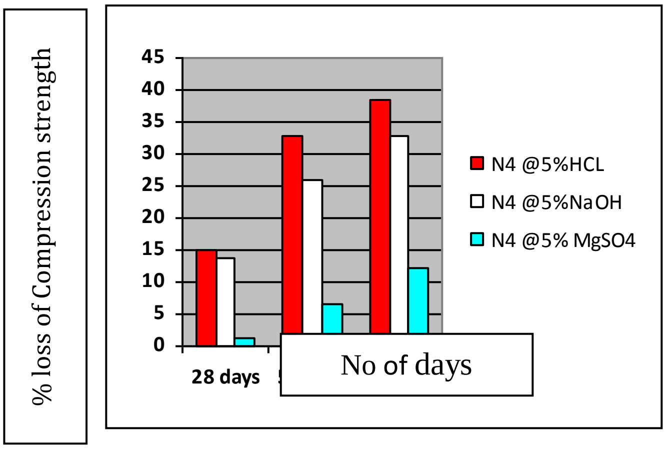
Type of Specimens	28 days (%)	56 days (%)	90 days (%)
N4 @ 5% HCL	14.8	33.3	36.21
N4 @ 5% NaOH	12.9	28.64	32.789
N4 @ 5% $MgSO_4$	1.2	6.55	11.2



Graph 6.2.4 -Comparison of % loss of weight of cube between N4 & N4 with attack of chemicals

Table 6.2.5 Comparison of % loss of weight of Cylinder between N4 & N4 with attack of chemicals

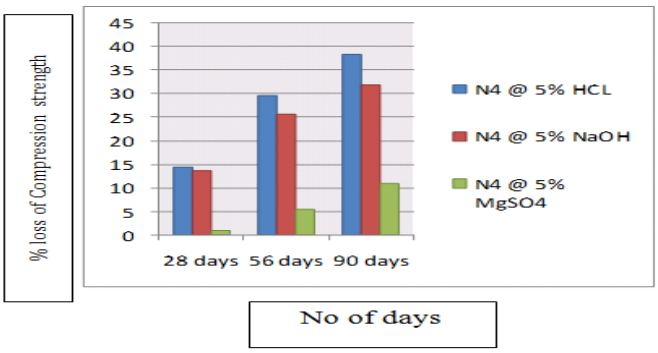
Type of Specimen	28 days (%)	56 days (%)	90 days (%)
N4 @ 5% HCL	14.98	32.9	38.47
N4 @ 5% NaOH	13.9	25.8	32.675
N4 @ 5% $MgSO_4$	1.12	6.53	12.12



Graph 6.2.5 Comparison of % loss of weight of Cylinder between N4 & N4 with attack of chemicals

Table 6.2.6 Comparison of % loss of weight of Prism between N4 & N4 with attack of chemicals

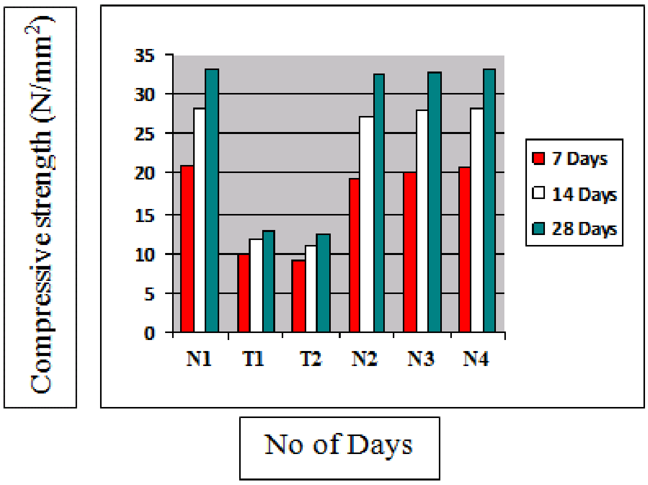
Type of Specimen	28 days (%)	56 days (%)	90 days (%)
N4 @ 5% HCL	14.5	29.5	38.2
N4 @ 5% NaOH	13.75	25.67	31.76
N4 @ 5% $MgSO_4$	1.08	5.53	11.05



Graph 6.2.6 Comparison of % loss of weight of Prism between N4 & N4 with attack of chemicals

Table 6.1.1: Compressive Strength of Concrete in Mpa

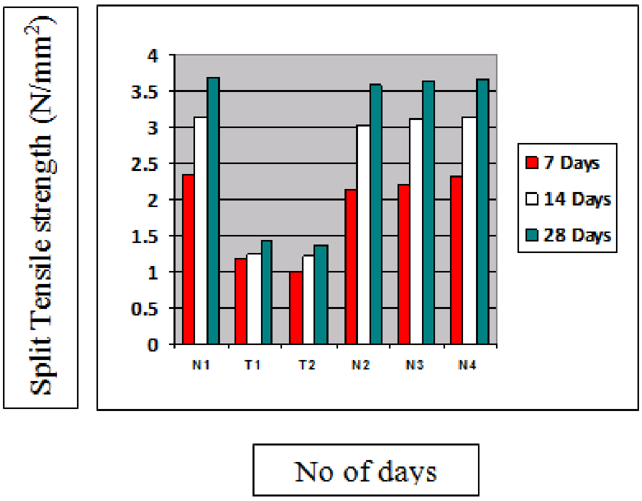
Type of Mix	Compressive strength of Concrete in Mpa		
	7 days	14 days	28 days
N1	21	28.23	33.12
T1	10	11.19	12.76
T2	9	10.95	12.32
N2	19.32	27.23	32.33
N3	20	27.96	32.59
N4	20.9	28.2	33.1



Graph 6.1.1 Compressive strength of concrete in Mpa

Type of Mix	Split tensile strength of Concrete in Mpa		
	7 days	14 days	28 days
N1	2.33	3.13	3.68
T1	1.19	1.24	1.41
T2	1.0	1.21	1.36
N2	2.14	3.02	3.59
N3	2.22	3.10	3.62
N4	2.32	3.13	3.67

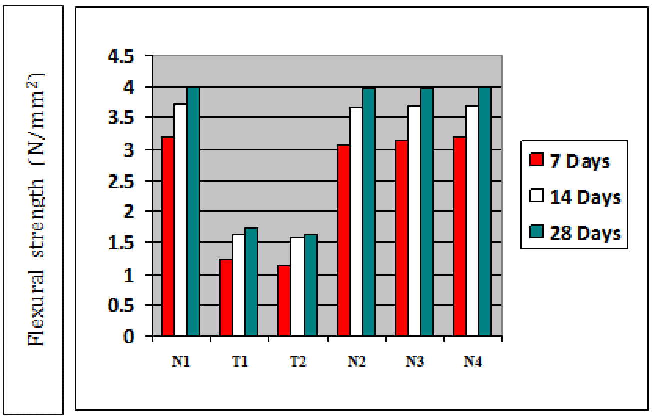
Table 6.1.2: Split tensile Strength of Concrete in Mpa



Graph 6.1.2: Split tensile Strength of Concrete in Mpa

Table 6.1.3: Flexural Strength of Concrete in Mpa

Type of Mix	Flexural strength of Concrete in Mpa		
	7days	14 days	28 days
N1	3.20	3.71	4.02
T1	1.21	1.63	1.75
T2	1.12	1.56	1.64
N2	3.07	3.65	3.98
N3	3.13	3.70	3.99
N4	3.20	3.70	4.01



Graph 6.1.3: Flexural Strength of Concrete in Mpa

Fig 2 Curing of specimens for chemical attack test

Fig: 3 Split tensile strength of concrete

Fig 4 Compressive strength of concrete Cube

Fig 5 Curing of concrete moulds

7. CONCLUSIONS

The following main conclusions were drawn from the experimental results obtained from this study:

1. In this experiment we have observed that we used Natural herbs (M.Olifera seeds& Clearing nuts) and these herbs help to remove only turbidity but not salts from seawater.
2. When the concrete specimens are casted we observed that the compressive strength, split tensile strength and flexural strength of concrete by using T1 concrete specimens are slightly greater than T2 concrete specimens.
3. After removing the turbidity from seawater with M.Olifera seeds and this water is used for chemical way of treating seawater in desalination process.
4. We have used Chemicals(Ethyl Acetate, Butyl Acetate and Decanoic Acid) with these Chemicals We have observed that they are removing salts from Seawater.
5. And by adding these chemical Treated seawater to the casting and Curing of Concrete we observed that compressive strength, split tensile strength and flexural strength have reached the maximum strength value.
6. In these Chemicals N4 concrete specimens has reached the maximum Strength value nearly equal to the Normal mix.
7. The order of strength gaining mechanical properties Obtained was **Decanoic acid > Butyl acetate > Ethyl acetate**
8. Compressive strength of N4 concrete specimens after immersed in 5% HCL solution, the strength is reduced by 31.4% at 28 days, by 45.3% at 56 days, by 67.7% at 90 days when compared to N4 concrete specimens without immersing in HCL solution.
9. Compressive strength of N4 concrete specimens after immersed in 5% NaOH Solution, the strength is reduced by 23.8% at 28 days, by 42.3% at 56 days, by 61.9% at 90 days when compared to N4 concrete specimens without immersing in NaOH solution.
10. Compressive strength of N4 concrete specimens after immersed in 5% $MgSO_4$ solution, the strength is reduced by 16.49% at 28 days, by 36.47% at 56 days, by 52.3% at 90 days when compared to N4 concrete specimens without immersing in $MgSO_4$ solution.
11. Split tensile strength of N4 concrete specimens after immersed in 5% HCL solution, the strength is reduced by 31.3% at 28 days, by 45.1% at 56 days, by 67.1% at 90 days when compared to N4 concrete specimens without immersing in HCL solution.
12. Split tensile strength of N4 concrete specimens after immersed in 5% NaOH solution, the strength is reduced by 23.7% at 28 days, by 42.05% at 56 days, by 61.3% at 90 days when compared to N4 concrete specimens without immersing in NaOH solution.
13. Split tensile strength of N4 concrete specimens after immersed in 5% MgSO4 solution, the strength is reduced by 16.3% at 28 days, by 36.5% at 56 days, by 51.5% at 90 days when compared to N4 concrete specimens without immersing in MgSO4 solution.
14. Flexural strength of N4 concrete specimens after immersed in 5% HCL solution, the strength is reduced by 17.3% at 28 days, by 26.05% at 56 days,

by 43.34% at 90 days when compared to N4 concrete specimens without immersing in HCL solution.

15. Flexural strength of N4 concrete specimens after immersed in 5% NaOH solution, the strength is reduced by 12.8% at 28 days, by 24.09% at 56 days, by 38.25% at 90 days when compared to N4 concrete specimens without immersing in NaOH solution.
16. Flexural strength of N4 concrete specimens after immersed in 5% $MgSO_4$ solution, the strength is reduced by 8.61% at 28 days, by 20.42% at 56 days, by 30.99% at 90 days when compared to N4 concrete specimens without immersing in MgSO4 solution.

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