Effect of local additive (BM2010) on high performance concrete under sulphate attack
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Abstract. Many of reinforced concrete structures especially underground and undersea are subjected to aggressive environmental conditions throughout their exploitation. These conditions are represented by the aggressive sodium sulphate attack from surrounding soil or underground water. When based materials of cement are exposed to sodium sulphate attack produce gypsum and ettringite by its chemical reactions. Formation of gypsum plays a very important role within the damage of materials. According to that the actual compressive strength of concrete elements decreases accompanied with large deformations of concrete. Consequently, a higher reduction of the construction durability occurs, so using of effective and economic admixture for concrete elements protection against sulphate attack or the other environmental conditions is needed.

The main purpose of this research is to study through an experiment the effect of the local admixture (BM2010) which contained in its composition wastes from petroleum industries, silica fume, Wastes of coke factory and its mechanism effect on the compressive strength of concrete specimens subjected to external sulphate attack.

The experimental results showed that Compressive strength of concrete specimens modified with the organic admixtures (BM2010) at age of 128 days hardened in salt solution with concentration (9%NaCl + 12% Na₂SO₄) increased by about 15% compared to the control specimen with (Addicrete dm2) for sulphate resistance cement (S.R.C) & 3.6% compared to the control specimen (without admixture) for ordinary Portland cement (O.P.C). The absorption of concrete specimens modified with the organic admixture (BM2010) at age of 128 days hardened in salt solution with concentration (9%NaCl + 12% Na₂SO₄) is less than concrete specimens modified with (Addicrete dm2) by about 29%percent in case of (S.R.C) but in case of (O.P.C) it is more by about 16% percent. The experimental results showed that, the optimum composition of all components of the suggested admixture (BM 2010) was successfully and experimentally achieved.

1. Introduction

Marine concrete occupies a vital half and becomes one in all the most issues. sulfate attack of concrete in marine setting has been wide investigated. The degradation behaviours and harm phenomena of concrete served in marine setting are very difficult. it's the interaction between sulfate ions, calcium hydroxide which ends up in cracks and degradation of concrete materials. historically, the employment of pozzolanic materials, made of silica and alumina, as partial replacement of cement is one in all economical ways to rising sulfate attack resistance (1).

Successful usage of supplementary cementitious materials (SCMs) to replace cement helps to solve relevant environmental issues such as CO₂ emission and waste management as well as saving energy. It is also well known that the inclusion of SCMs in concrete mixtures enhances durability and improves mechanical properties. However, when only taking environmental and economic pressure into consideration, the high replacement levels of most of the SCMs usually lead to losses in strength at early ages (1).
Lee et al., (2) used Silica fume, Nie et al., (3) used pozzolanic reaction of fly ash, Atahan et al. (4) used ground granulated blast furnace slag and Chalee et al., (5) used rice husk ash in sulphate attack resistance. Metakaolin have been proved to be beneficial in enhancing the mechanical properties and sulphate attack of conventional concrete (6).

When concrete structures are in a sulphate environment, external sulphate ions will enter the concrete, which generates a diffusion of sulphate ions in concrete, better known as an external sulphate attack. Two causes of this attack are:

- sulphate ions diffuse from a high concentration to a low concentration in concrete pores.
- sulphate ions react with the hydration products of cement.

The concrete sulphate attack is caused by the cracking and spalling of concrete due to the expansion of the sulphate attack products, resulting in a concrete strength loss. Sulphate ions from outside environment will attack the concrete through two patterns: diffusion and chemical reaction. However, it is still difficult to quantify the sulphate attack product and its interaction in concrete (7).

Concrete subjected to Sulphate attack is one of concrete durability problem in concrete which used in industrial application and concrete exposed to sea water or marshy organic soil where sulphate concentration (SO4) in water or soil is enough to initiate sulphate attack in concrete, which pose in turn of Expansive Ettringite compound within the hardened cement paste & resulting disruption of concrete start from concrete core to surface due to its continuous increase in volume within the same specified volume. Considering the durability problem of concrete exposed to sulphate exposure there are many ways of preventive measures are usually adopting in practice either internally or externally (8).

Sodium Sulphate Na2SO4 attack in concrete is more serious and hindering than Calcium sulphate attack in concrete due to high solubility of Sodium sulphate than Calcium sulphate. The sodium sulphate is reacting with hydration product of cement Calcium hydroxide present in concrete to form Calcium sulphate (gypsum), which is then react with Tri calcium aluminate (C3A) to form Calcium Sulpho-aluminates (Ettringite) which is hydrophilic in nature & absorb water resulting increase in volume within the hardened concrete & disruption of concrete will start. The step wise reaction mechanism of Sodium sulphate in concrete are hereby stated below in equation (1) and (2).

Step-I: \( \text{Na}_2\text{SO}_4 + \text{Ca(OH)}_2 = \text{CaSO}_4 .2\text{H}_2\text{O} + \text{NaOH} \) (1)

Step-II: \( 3\text{CaSO}_4 + 2\text{H}_2\text{O} + 3\text{C}_3\text{A} + 26 \text{H}_2\text{O} = 3\text{C}_3\text{A} + 3\text{CaSO}_4 + 32\text{H}_2\text{O} \) (Ettringite) (2) (8).

Industrial solid wastes are inducing severe environmental problems, but the problem can be overcome by reusing them as construction materials. Concrete incorporating solid waste materials can not only promote the recycling of solid waste, but also provide high sulphate attack resistance (9).

Admixtures have long been recognized as an important component of concrete used to improve its performance. The original use of admixtures in cementitious mixtures is not well documented. It is known that cement mixed with organic matter was applied as a surface coat for water resistance or tinting purposes. It would be a logical step to use such materials, which imparted desired qualities to the surface, as integral parts of the mixture. The use of natural admixtures in concrete was a logical progression. Chemical admixtures confer certain beneficial effects on concrete, including reduced water requirement, increased workability, controlled setting and hardening, improved strength, and better durability.

Many approaches have been adopted to investigate the role of chemical admixtures. One approach is to determine the state of the admixture in concrete at different times of curing. The admixture may
remain in a free state as a solid or in solution or interact at the surface or chemically combine with the constituents of cement (10).

A. Razek (11) found that the suggested organic admixture (BM 2010) has a good effect on the properties of the concrete mixes which prepared and produced from petroleum industries wastes, silica fume and naphthalene sulfonate having main Chemical component as follows. (Tested by Analytical Chemistry Unit – ACAL Assiut University)

| Parameter         | Description            |
|-------------------|------------------------|
| Chloride          | 0.0132 % (wt/vol)      |
| Sulphate          | 0.1416 % (wt/vol)      |
| Calcium oxide     | 0.1624 % (wt/vol)      |
| Aluminum oxide    | 0.0560 % (wt/vol)      |

Concrete incorporates a low resistance to chemical attack. There are many chemical agents that react with concrete; however, 2 types of attacks are most common, namely, natural action and sulphate attack. Sulphate attack on concrete end up in the conversion of hydrous merchandise of cement to ettringite, gypsum and alternative phases, and to the destabilization of the primary strength provided calcium silicate hydrate (C-S-H) gel. The formation of ettringite and gypsum is common in cementitious materials exposed to most types of sulphate solutions. The enlargement ensuing from sulphate attack is generally attributed to the formation of these two compounds, although there is some controversy surrounding the exact mechanisms causing expansion. Chemical agents essentially react with certain compounds of the hardened cement paste and the resistance of concrete to chemical attack therefore depends largely on the type of cement used. The resistance of concrete to chemical attack has improved with increase of its permeability (12).

When cement-based materials square measure exposed to sulfate attack, gypsum and ettringite square measure made by chemical reactions of sulfate and Ca(OH)$_2$, C$_3$A. Formation of mineral plays a very important role within the injury of materials. there's a detailed relationship between Ca(OH)$_2$ content and gypsum formation. Ettringite formation ends up in cracking and growth of the material. growth is said to the water absorption of crystalline ettringite. So, it's necessary to extend the resistance of concrete against salt attack (12).

Increasing the concrete alkali content by adding alkali addition to the mixture water has harmful effects on most mechanical properties (compressive, splitting, direct tensile, and flexure strengths) of concrete. Admixtures, that contain in their compositions organic materials with restricted doses have several benefits such as: concrete compressive strength and concrete tensile strength, concrete durability subjected to aggressive environmental conditions, appropriate resistance to corrosion and really low value (12).

Many papers studied the effect of organic admixtures in concrete duo to their positive influence on the physical and mechanical properties of R.C. elements not only on their early time of hardening, but also for the period of their exploitation in the building site. Investigations of victimization chemical admixtures for the development of concrete properties in Egypt show that, they are not sufficient, and the component of those admixtures area unit foreign by the origin and not made in Egypt. Therefore, the system of our constructions utterly depends on the foreign corporations. So, these components become deficient and costly. These area unit the particular issues for business and system of Egyptian industries. it's renowned that the organic materials haven't the solubility with water. So, during this analysis the solubility of those parts with water was achieved by victimization of calcium oxide and superplasticizers. Investigations regarding victimization complicated organic
admixtures, that contain in their composition alkali wastes from oil industries for the development of cement materials properties were dole out. (12).

From the accessible literature few studies on the mechanism effect of organic admixtures, containing wastes from petroleum industries, on the resistance of concrete elements against sulphate and chloride attack. The aim of this study is to analyse the effect of the local additive (BM2010) on the strength, sulphate and chloride resistance of high-performance concrete.

2. Experimental

The materials used for the research work are 2 forms of cement (ordinary Portland cement (O.P.C), sulphate resistance cement (S.R.C)). The coarse aggregate used for the experiment is of crushed Basalt rock, Fine aggregate of coarse sand and the drinking water is used. The admixture used are local admixtures (BM 2010), (Addicrete dm2).

Tested specimen

Experimental tests have been carried out on (54) standard concrete cubes specimens (15x15x15 cm). All specimens tested under static loading up to failure. This study mentioned the effect of suggested admixture (BM 2010) by the following parameters.

- Additive type
- Cement type

These specimens were as follow:
This group divided into 2 groups:
- Group (1): O.P.C (concrete with ordinary Portland cement (Almohandes cement N.42.5))
- Group (2): S.R.C (concrete with sulphate resistance cement (Altameer cement N.42.5))

Each of these 2 groups is divided as following:
- 9 cubes without additives
- 9 cubes with additive (BM2010)
- 9 cubes with additive (Addicrete dm2)

Group (1) plus Group (2) are (54 cubes). All cubes were cured in sulphate solution (9% NaCl + 12% Na₂SO₄) for 100 days after 28 days were cured in drinking water.

Concentration of surrounded sulphate & chloride solutions (Na₂SO₄ + NaCl): Specimens of group were cast and hardened in freshwater conditions until 28-days. After that, were immerged and hardened in concentration of sodium sulphate and sodium chloride solution for a period of 100 days as given in Table (1). Concentration of salt solution. 9%NaCl + 12%Na₂SO₄. All cubes were tested under axial static compression load

| Table (1): Concentrations of salt solution |
|------------------------------------------|
| Salts          | Concentrations by weight of water |
|---------------|-----------------------------------|
| NaCl          | 9%                               |
| Na₂SO₄        | 12%                              |

Test Procedure

(54 cubes) were cured in fresh water until of 28 days after that put in concentration of sulphate & chloride solutions for a period of 100 days. The testing machine (Control 1500 KN) was used. Each specimen was loaded axially and gradually keeping the rate of loading constant. The concrete specimens were tested under static axial compression loading after 28 & 128 days hardening in fresh water or in salt solutions.
Materials

Cement
1- Ordinary Portland cement (almohandes cement)

Table (2): Physical cement prop.

| Test                  | Result | ESS No.                  |
|-----------------------|--------|--------------------------|
| Cement expansion (Le Chatelier) | 1 mm   | < 10 mm                  |
| Specific gravity      | 3.15   |                          |
| Setting time          | Initial| 165 minute               | ≥ 45 minutes

Table (3): Chemical cement prop.

| Test                  | Result          | ESS No.                  |
|-----------------------|-----------------|--------------------------|
| Loss on ignition      | 1.0 -2.0%       | ≤ 5%                     |
| Insoluble residue     | 0.3 % - 0.6%    | ≤ 5%                     |
| % of sulphate ions content (So3) | 2.5 % - 3.0% | ≤ 3.5%                   |
| % of chloride ions content (Cl) | 0.02 - 0.04 | ≤ 0.1%                   |

Table (4): Cement compressive strength

| Test                  | Result          | ESS |
|-----------------------|-----------------|-----|
| Compressive strength  | 2 days 20.7 N/mm² | -   |
|                       | 28 days 42.7 N/mm² | 42.5 N/mm² |

2- Sulphate resistance cement (altameer cement)

Table (5): Physical cement prop.

| Test                  | Result | ESS No.                  |
|-----------------------|--------|--------------------------|
| Cement expansion (Le Chatelier) | 1.2    | < 10 mm                  |
| Specific gravity      | 3.15   |                          |
| Setting time          | Initial| 113 minute               | ≥ 45 minutes

Table (6): Chemical cement prop.

| Test                  | Result | ESS No.                  |
|-----------------------|--------|--------------------------|
| Loss on ignition      | 2.64   | ≤ 5%                     |
| Insoluble residue     | .39    | ≤ 5%                     |
| % of sulphate ions content (So3) | 2.5 | ≤ 3.5%                   |
| % of chloride ions content (Cl) | .04 | ≤ 0.1%                   |

Table (7): Cement compressive strength

| Test                  | Result          | ESS |
|-----------------------|-----------------|-----|
| Compressive strength  | 2 days 18.7 N/mm² | -   |
|                       | 28 days 42.9 N/mm² | ≥ 42.5 N/mm² |
**Water**

Drinking water was used for mixing concrete

**Aggregate**

The used coarse aggregate was basalt and local natural sand was used as fine aggregate in experimental work. The properties of the used aggregate are given in table (8)

**Concrete mixes**

Concrete mixes were used to produce high performance concrete having 28-days cubic compressive strength 600 kg/cm². Concrete mixes components shown in Table (8).

Table (8): Details and properties of concrete mixes (Sulphate resistance cement)

| Mix No. | Cement (Kg/m³) | Sand (Kg/m³) | Coarse Agg. (Kg/m³) | Dose % of cement | Additives | Water (L/m³) | W/C |
|---------|----------------|--------------|---------------------|------------------|-----------|--------------|-----|
| 1       | 450            | 663          | 1162                | 2.0              | G NN-1    | 162          | 0.36|
|         |                |              |                     | 1.5              | +Fss      |              |     |
| 2       | 450            | 663          | 1162                | 1.6              | G NN-1    | 162          | 0.36|
|         |                |              |                     | 1.1              | +Fss      |              |     |
|         |                |              |                     | 0.9              | + BM      |              |     |
| 3       | 450            | 663          | 1162                | 1.6              | G NN-1    | 140          | 0.31|
|         |                |              |                     | 1.1              | +Fss      |              |     |
|         |                |              |                     | 0.4              | + Addic   |              |     |

Slump=15-20cm

Table (9): Details and properties of concrete mixes (Ordinary Portland cement)

| Mix No. | Cement (Kg/m³) | Sand (Kg/m³) | Coarse Agg. (Kg/m³) | Dose % of cement | Additives | Water (L/m³) | W/C |
|---------|----------------|--------------|---------------------|------------------|-----------|--------------|-----|
| 4       | 450            | 663          | 1162                | 2.0              | G NN-1    | 148 L        | 0.33|
|         |                |              |                     | 1.7              | +Fss      |              |     |
| 5       | 450            | 663          | 1162                | 2.2              | G NN-1    | 165 L        | 0.37|
|         |                |              |                     | 2.1              | +Fss      |              |     |
|         |                |              |                     | 0.9              | + BM      |              |     |
| 6       | 450            | 663          | 1162                | 2.2              | G NN-1    | 169 L        | 0.38|
|         |                |              |                     | 1.1              | +Fss      |              |     |
|         |                |              |                     | 0.4              | + WP      |              |     |

Slump=15-20cm

Table (10): Type & percent of admixtures

| Type of admixture       | Optimum dose (% of cement wt.) |
|-------------------------|--------------------------------|
| Control                 | 0                              |
| Addicrete dm2(control)  | 0.4                            |
| BM2010(suggested)       | 0.9                            |
Table (11): Physical, Mechanical and Chemical properties of used aggregate

| Property                                         | Gravel | ESS | Sand | ESS |
|--------------------------------------------------|--------|-----|------|-----|
| Volume weight (t/m$^3$)                          | 1.72   | -   | 1.62 | -   |
| Specific gravity                                 | 2.63   | -   | 2.5  | -   |
| % of clay & Fine (dust) by weight                | 0.85%  | 1.0%| 2.8  | ≤ 3%|
| Crushing value %                                 | 15.76  | ≤ 30| -    | -   |
| % of chloride ions content (Cl)                  | 0.018  | ≤ 0.04 | 0.06 | ≤ 0.06 |
| % of sulphate ions content (SO$_3$)              | 0.035  | ≤ 0.4% | 0.04 | ≤ 0.04 |
| F.M                                              | 6.2    | -   | 2.42 | -   |

Table (12): Results of sieve analysis of used aggregate

| Sieve size, mm | % Passing by weight |
|----------------|---------------------|
|                | Gravel | Sand |
| 37.5 mm        | 100    | -    |
| 20 mm          | 98.94  | -    |
| 10 mm          | 74.58  | -    |
| 5 mm           | 5.59   | 98.55|
| 2.36 mm        | 1.48   | 94.09|
| 1.18 mm        | 0.45   | 86.13|
| 0.60 mm        | -      | 65.68|
| 0.30 mm        | -      | 11.77|
| 0.15 mm        | -      | 1.66 |

Fig. (1): % Passing of Sand sieve analysis
Different types of admixtures:

1- Suggested organic admixture (type BM 2010).
2- Control admixture (commercial admixture) (type addicrete dm2)
3- Control sample (without admixture)

Suggested admixture (Type BM 2010) Which contained in its composition wastes from petroleum industries, silica fume, wastes of coke factory and pure water reduces permeability and produces considerably higher resistance to salt and attacking chemicals (Optimum dose 0.9% of cement weight). A.Razek (2014)

Commercial admixture (Addicrete dm2): is a chemical waterproofing admixture for concrete and mortar.

Description: It reduces permeability and produces considerably higher resistance to salt and attacking chemicals. Optimum dose 0.4% of cement weight. (From Company Technical data sheet).

Sedrete Gnn1: high range water reducing and super-plasticizer for concretes.

Description: is a high range water reducing and super-plasticizer and increases compressive strength and setting time.

Dosage: 0.6-3.5 liter for each 100 kg/m cement according to the required stress (From Company Technical data sheet).

Sedrete Fss: high range water reducing and super-plasticizer for concretes.

Description: is used as super-plasticizer that can reduce water, improve workability, and increase early and ultimate stresses.

Dosage: 0.6-4 % litter for each 100kgm cement according to the required stress. (From Company Technical data sheet).

3. Results and discussion

The main variables studied in this research on concrete mixes and hardened specimens were:- Effect of Two different types of organic admixtures, Suggested (BM2010), commercial admixture (Addicrete dm2) and control (without admixture) which cured on salt solution with concentration of (9%NaCl + 12% Na₂SO₄) for a period of 128 days. Two types of cements were used (S.R.C), (O.P.C) & high-performance concrete. Fifty four cubes were used in this research (2 types of cement×3 types of admixtures×9cubes/admixture).Test results of all cubic concrete specimens which hardened in aggressive environmental condition are presented in Tables (11 , 12), fig. (1,2).
Effect of optimum dose of each admixture on compressive strength and absorption of concrete specimens cured in salt solution with concentration of (9%Nacl, 12% Na$_2$SO$_4$) for (S.R.C) & (O.P.C) in table (11), (12).

**Table 13 (S.R.C)**

| Additive type   | Fc28 | % increase | Fc128 | % increase | Absorption |
|-----------------|------|------------|-------|------------|------------|
| Without         | 633  | 0          | 713   | 0          | 0.97       |
| BM2010          | 641  | 1.3%       | 752   | 5.5%       | 0.97       |
| Addicrete dm2   | 614  | -3%        | 589   | 17.4%      | 1.25       |

![Cubic compressive strength Fc28 Kg/cm$^2$](image1)

**Fig. (3):** Cubic compressive strength of concrete specimens versus age of concrete (fc28) for (S.R.C) with salt solution (9%Nacl+12% Na$_2$SO$_4$)

![Cubic compressive strength Fc128 Kg/cm$^2$](image2)

**Fig. (4):** Cubic compressive strength of concrete specimens versus age of concrete (fc128) for (S.R.C) with salt solution (9%Nacl+12% Na$_2$SO$_4$)
Fig. (5): Absorption of concrete specimens after 128 days age cured in (9%NaCl, 12% Na₂SO₄) for (S.R.C)

Table (14) (O.P.C)

| Additive type   | Fc28 | % increase | Fc128 | % increase | Abs.  |
|-----------------|------|------------|-------|------------|-------|
| Without         | 442  | 0          | 467   | 0          | 0.88  |
| BM2010          | 553  | 25.1%      | 596   | 27.6%      | 0.92  |
| Addicrete dm2   | 642  | 45.2%      | 603   | 39.1%      | 0.77  |

Fig. (6): Cubic compressive strength of concrete specimens versus age of concrete (fc28) for (O.P.C) with salt solution (9% NaCl + 12% Na₂SO₄)

Fig. (7): Cubic compressive strength of concrete specimens versus age of concrete(fc128) for (O.P.C) with salt solution (9%NaCl+12% Na₂SO₄)
Compressive Strength of Concrete Specimens Exposed to Salt Solutions:

Compressive strength of all types of concrete containing the admixtures and cured in salt solution with concentration of (9%NaCl + 12% Na₂SO₄) are shown in Tables (11, 12), fig. (3,4,6,7).

The suggested organic admixture (BM 2010) has a good effect on increasing compressive strength of concrete cured in aggressive condition (9%NaCl + 12% Na₂SO₄) either in (S.R.C) or (O.P.C) cement type and helped the concrete specimens successfully to reach to high performance concrete. Tables (11, 12), fig. (3,4,6,7).

- Compared with control specimens (Addicrete dm2) the organic admixture (BM 2010) increase the compressive strength by about 4.4% & 28% at 28 &128 days respectively for specimens immersed in salt solution with concentration (9%NaCl + 12% Na₂SO₄) in case of use (S.R.C) (Tables 11, fig.3,4).
- Compared with control specimens(without admixture) the organic admixture (BM 2010) increase the compressive strength by about 1.3% & 5.5% at 28 &128 days respectively for specimens immersed in salt solution with concentration (9%NaCl + 12% Na₂SO₄) in case of use (S.R.C) (Tables 11, fig.3,4).
- Compared with control specimen (Addicrete dm2) The organic admixture (BM 2010) decrease the compressive strength by about 14% & 1% at 28 & 128 days respectively for specimens immersed in salt solution with concentration of (9% NaCl + 12% Na₂SO₄) in case of use (O.P.C) (Tables 12, fig. 6,7).
- Compared with control specimen (without admixture) The organic admixture (BM 2010) increase the compressive strength by about 25% & 28 % at 28 & 128 days respectively for specimens immersed in salt solution with concentration of (9% NaCl + 12% Na₂SO₄) in case of use (O.P.C) (Tables 12, fig. 6,7).
- The organic admixture(BM 2010) increase the Concrete compressive strength for specimens of(S.R.C) after 28,128 days by about 16&26% respectively more than (O.P.C) for specimens immersed in salt solution with concentration of (9% NaCl + 12% Na₂SO₄) (Tables 11 , 12 , fig.3,4, 6,7).
- The organic admixture (BM 2010) decrease the absorption for specimens of (O.P.C) after 128 days by about 5% less than (S.R.C) for specimens immersed in salt solution with concentration of (9%NaCl + 12% Na₂SO₄). This meaning the organic admixture (BM 2010) increase the permeability resistance of water in case of (O.P.C) more than (S.R.C) in like this aggressive condition (Tables 11 , 12 , fig. 5,8).
- Compared with control specimens(Addicrete dm2) & control specimens (without admixture) the organic admixture (BM 2010) decrease the absorption by about 29% after 128 days in case of (Addicrete dm2) but in case of control specimens (without admixture) it is equal (this is for...
specimens immersed in salt solution with concentration (9% NaCl + 12% Na₂SO₄) in case of use (S.R.C) (Tables 11 fig.5).

- Compared with control specimens (Addicrete Wp) & control specimens (without admixture) the organic admixture (BM 2010) increase the absorption by about 16% after 128 days in case (Addicrete dm2) but in case of control specimens(without admixture)it is increase by about 4% (this is for specimens immersed in salt solution with concentration (9%NaCl + 12% Na₂SO₄)) in case of use(O.P.C) (Tables 12 fig.8)

- The organic admixture (BM 2010) decrease the absorption for specimens of (O.P.C) after 128 days by about 5% less than (S.R.C) for specimens immersed in salt solution with concentration of (9% NaCl + 12% Na₂SO₄). This meaning the organic admixture (BM 2010) increase the permeability resistance of water in case of (O.P.C) more than (S.R.C) in this aggressive condition (Tables 11, 12 , fig.5,8).

4. Conclusion

The results of the experiments carried out on the concrete mixes and specimens with different additives (Suggested additive (BM2010), control additive (Addicrete dm2) and control (without additive ) and cured in salt solution with concentration of (9% NaCl + 12% Na₂SO₄) for a period of 128 days, the following conclusions can be drawn out:

1- Compressive strength of concrete specimens modified with the organic admixtures (BM2010) at age of 128 days cured in (9% NaCl + 12% Na₂SO₄) increases by about 28% compared to the control specimen (Addicrete dm2) for (S.R.C) type.

2- Concrete specimens compressive strength modified with the organic admixtures (BM2010) at age of 128 days cured in (9% NaCl + 12% Na₂SO₄) increases by about 5.5% compared to the control specimen (without admixture) for (S.R.C) type.

3- Concrete specimens compressive strength modified with the organic admixtures (BM2010) at age of 128 days cured in (9% NaCl + 12% Na₂SO₄) increases by about 1% compared to the control specimen (Addicrete dm2) for (O.P.C) type.

4- Concrete specimens Compressive strength modified with the organic admixtures (BM2010) at age of 128 days cured in (9% NaCl +12% Na₂SO₄) increases by about 28% compared to the control specimen (without admixture) for (O.P.C) type.

5- The absorption of concrete specimens modified with the organic admixtures (BM2010) at age of 128 days cured in (9% NaCl + 12% Na₂SO₄) increases by about 28% compared to the control specimen (Addicrete dm2) for (S.R.C) type.

6- The absorption of concrete specimens modified with the organic admixtures (BM2010) at age of 128 days cured in (9% NaCl + 12% Na₂SO₄) equals compared to the control specimen (without admixture) for (S.R.C) type.

7- The absorption of concrete specimens modified with the organic admixtures (BM2010) at age of 128 days cured in (9% NaCl + 12% Na₂SO₄) equals compared to the control specimen (Addicrete dm2) for (O.P.C) type.

8- The absorption of concrete specimens modified with the organic admixtures (BM2010) at age of 128 days cured in (9% NaCl + 12% Na₂SO₄) increases by about 4% compared to the control specimen (without admixture) for (O.P.C) type.

9- (BM2010) is better than (Addicrete dm2) in case of using (S.R.C) for fc28 and fc128 and absorption.

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