

Effects of some chemical detergents additions on concrete

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Abstract

Usually, the drainage network made of concrete and which fall under the infrastructure in cities. This research aims to study the corrosion of cement concrete under the influence of Washing Detergents, as well as determine the negative influence on some properties such as weight and mechanical resistance. The results showed that sodium phosphate salts by 27-35% of the weight of the detergent has led to weaken the resistance of the pressure of the cement mortar by 5%, and sodium sulphate salts and sodium chloride led to weaken on pressure resistance and inflexion by 15%. Corrosion Index showed proposed sharp decline very resistant to detour - the pressure resistance by up to 30%.

Keywords: Concrete. Detergent. Corrosion. Resistance. Mechanical resistance, Weight. Index.

1. Introduction

Mostly, all the sewage pipe nets are made of concrete, and concealed under land service, and mostly under the net pathways of the cities. So, if any breakdown of this sewage pipe nets will negatively reflect to the situation of the those pathways, as those negative situations may cause the leak of solutions out of the pipe net, this will cause the corrosion of the pavement layers, the necessity of repairing this leak will force to excavate those pathways and at the end this will cause traffic stopping or obstruction for a long time and this will cause traffic congestion on the others pathways. So this will lead to great traffic problems and excessive costs for repairing those breakdowns, besides those chemical solution might seep to the subsurface water and pollution might occurs in this water (as it actually occurs in some villages), and that will effect Mankind's health. Besides, pathway excavation will destroy the beauty of structures and the construction of those pathway, besides the effect of dust and noises pollution.

The study's goal of the concrete cement corrosion that forms the pipe nets of the sewage such as the concrete pipes, by using the detergent liquids and its effects. As well as, trying to show the negative effects of using the detergents upon the concrete characteristics such as the weight and the mechanical resistance, taking into consideration time problem for studying the concrete duration as using those detergents in the normal situation as the pollutant chemical solution will effect after a long range period on the concrete of the sewage pipe nets. Because of that, increased the concentration on the chemical detergents as experiments for approaching to the natural situation.

My study is separated into two main studies: Documentary study, Experimental study.

2- The documentary study:

The concrete pipes are considered to be the less resistance of corrosion rather than the pipes made of other materials, it is not allowed to be but except underground, it is used for installations of the rain water, the pollution watercourses and the industrial discharges and waste-water, it is also considered to be the most economically of other kinds.

It is well known that the essential connector in the normal concrete is the traditional Portland cement that is compounds of the C3S, the C2S, C3A and the C4AF. I refer that all those elements contains the Limy element, as almost of the Limy is connected with the Silica because of the water interplay for forming the C-H-S that is

responsible of the connect and gives the resistance to the concrete.

1) The result solution from the house usage: that comes out of water circles kitchens, bathrooms and washing the houses and stairs... the assembling water of those is contains organic solution, metallic material and deferent solutions that gives and pollutes the water of deferent elements such as Phosphorus-Free detergents (Frid. et al 2003)

2) Concrete corrosion by the effect of Chemical materials: there are too many studies emphasis on concrete corrosion by using chemical materials, specially acids, some salts and bacteria, the operation of activation the corrosion comes from quick sewers movement and effect of heat is high, because of newly coming out water from bathrooms and washing machines, is a high temperature water and that will cause the lightest negative effete on the concrete pipes within the buildings and under the pathways, because the high temperature water will help of detaching the concrete very quickly and increases the corrosion.

3) Compound of the chemical detergents: In general, some or all the following materials are a compound of the detergent's industry:

The Surfactant Detergents: as this will drop down the surface tightening of the water, that will cause the increase of water touch with the clothes' fibrous and the textiles, at the end it will take to untying the dirties, parting the greasy materials and also parting the oils. Those detergents are classified into 4 categories depending on the effectiveness material:

- a) The Negative Anionic, the Positive Cationic and the Neutral Nonionic.
- b) The alkaline materials: such as NaOH , NH_4OH , Na_2SiO_3 , and Na_3PO_4 .
- c) The whitish and the bleach materials: contains the Sodium Parporates and the light whitish.
- d) The tint materials: the blue grains are used for the white clothes' detergents.
- e) The scented : it gives the washed clothes a lovely continues scent for a long period of time
- t) Sticky and solvent materials : it contains Na_2SON , NaCl , KCl , $(\text{NH}_4)_2\text{SC}$, NH_4Cl .
- g) Preserving Materials: it contains
- h) Enzymes: to increases the strength of cleaning.
- i) Materials that help for dissolution: it is used in the liquefied detergents.
- j) Organic solvent materials: it is to be added to the artificial detergents
- k) Organic solvent that removes the hard water: such as $\text{CH}_3\text{CO}_2\text{H}$, $\text{CH}_3\text{-C-OH}$

A summary of some scientific studies that are connected with the corrosion of the concrete all over the world:

1- Durabilite' et performance des conduits... [11, by J.Q. Zaho et al 2010. It was a deeply Canadian study about the most important and the reference books in the world that are connected with the effected factors on the continues and performance of the free sewers piped.

2- Latexlei, EG Rawlings-Anti-corrosion Methods and Materials 1993. Corrosion of concrete floors is liable to detergents when modern synthetic detergents. This scientific study refers to the corrosion of the concrete floors by the detergents without experiment.

3- E. Ntuli et al 2009, detergents builders as 1400mg / l coupled with long residence time in the sewer have been identified as the major cause of sever corrosion of concrete sewers. This study referred to the detergent elements and the period of its long staying in the pipes as it was more dangerous because of the corrosion of those concrete pipes.

4- W. Zhenya et al 2007. A study on the corrosion of concrete by domestic. this study referred to the corrosion of the concrete because of the domestic pollutants.

5- V.P. Sokolovieh, 1990, more attention to the corrosion of concrete structures in alkaline soils. gypsum. acoustic soda reagent...

This book had referred to the concrete elements as a bases' in the alkaline soils and the gypsum and that is $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ and NaOH .

6- W. Sand, 1991, Biodeterioration of minerals by microorganisms. This article bad referred to Biological destmetion

for the concrete minerals matters by the Bacteria.

7- P.A. Terry, 2010, while corrosion of concrete or metal collection systems. recent studies investigated ozonation to increase ... the biodegradation of resistance textile wastewater containing dyes and detergents.

8- A comparative assessment of polymer concrete strength after degradation cycles, J.M.L. Reis, 2009

This research had studied the polymer concrete corrosion and not the ordinary cement with some solutions and had reached to the following:

Table 1. Corrosion sign and resistance factors.

Corrosion sign	Rf/Rc	Pressure Resistances	Resistance by Tension	pH	solutions
0	0.4680	52.845	24.734	7	Ref
4%	0.4489	51.937	23.364	5.1	Distillated water
8.5%	0.4284	51.723	22.158	1.1	H2so4

9- There are many studies concerning sewer pipes corrosion as: A.G.Boon or concrete corrosion in sea water under the effect circulates of humid and the dryness with the sea water that contains different salts.Li Chunqiu, 2010.

3- The used Materials and the Technological:

- Graded Sieves for the operation of analyzing the sand grains in accordance to ASTM.
- Organizational metal indicator molds : each mold allows to pour 3 samples measurements 4040160 mm.
- A length Measurement device (Biacolyes) precision of 0.05 nun.
- Delicate electronic balance precision of 0.2 0.
- Stove for drying the materials or the samples with heat of 110 centigrade
- A device for breaking the samples with deflect by a precision of 0.01 K. Newton.
- A device of breaking the samples with pressure by a precision of 0.1 K. Newton.

4- The experiment schedules :

in this primary studies and for the aim of declaring the effects of the chemical detergents on the concrete, experiments had been done upon an indicator samples of (cement paste) and was done in condition alike to the world standers of conditions of mixing, filling , shaking preserving and unloosing after 24 hours , and preserving in a 20 centigrade temperature water for 28 days , after that, started to put the samples for the reactivation with water or with water with detergents or with an element of a detergent.

4.1- Water: drinking water from the laboratory.

4.2- Cement: kind 1 of ordinary Portland according to the American classification.

4.3- Sand: its synthetic metal is a mix of quarry sands that is classified as less of SiO₂ and abundance of CaCO₃.

Gradual grains: it is classified that it is out of the organizational package towards the softness, its installation is as follows:

Table 2. Sieve analysis by ASTM

Percent of Passing %	Side size of the sieve/ mm	No. of the sieve ASTM
100	2	10
73.72	0.850	20
43.08	0.425	40
27.50	0.180	80
21.86	0.125	120
17.28	0.072	200

4-4 the mix constituent of the mold:

C = cement weight: 450 G.

S= sand weight: 1350G. (S/C = 3) according to the standers.

W= water weight: 270 G. (W/C 0.6) that is because of the softness sand that was used.

Notice: for obtaining the actual results of this research, the sand that was used is the same kind of sand that is mainly used in the factories of concrete pipes.

4.5- The circle period is one week, as the water or the solution was changed (water + additional material) for each circle, 6 circles were made in the most of the circles.

5- Test Results: Effects of Detergents or Detergent compounds:

5.1- the effete of the strong acidity Sodium salts: NaCl and Na₂SO₄ : those two salts are considered to be a fill and sticky material within the detergents (the percentage weight, for instance : Na₂SO₄ in the detergent powder is about (22% ± 2%) the effect of those two salts were studied with a concentration of 1s of the water on samples of cement paste by the age of 28 days, after 6 circles it shows that the pressure resistance was dropped down 175s in ease of using NaCl ,and 13% in ease of using Na₂SO₄. That in according to the laboratory conditions of the two mentioned salts drop down the pressure of cement paste in an average of(15 - 2)%.

Form (H-K1) shows the change of the concentration of the Ions (Ca) and the relation with the numbers of circles.

From the beginning it is noticed that those salts are not pure , it contains NaCl about 14 mg Land Na₂SO₄ about 200 mg/L of the Ions (Ca) . but during time, and after the first week the concentration will drop dawn and the precipitation will increase specially with using the NaCl.

In general, the reactions of those two salts with water and the cement paste is converging regarding the chemical effect and the

exchange of the NaCl with (K) Ions in each circle , as the two salts will Precipitation the (K) and approximate the concentration to the concentration of the (K) in the drinking water, but also will exceed the concentration in the beginning of the fifth circle

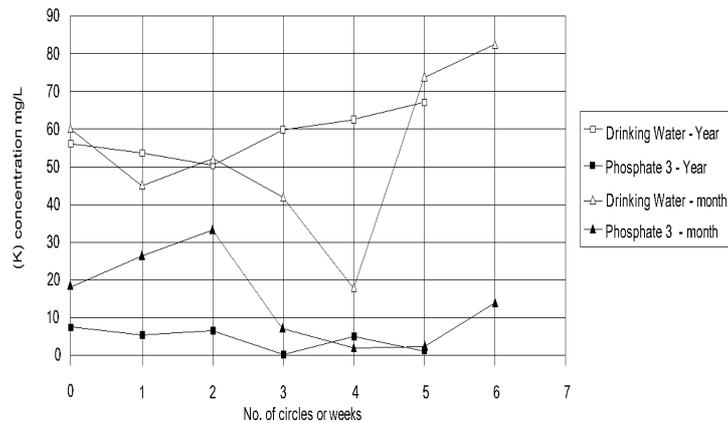


Figure 1. Effect of 1% phosphate 3 (Na Tripartite) on samples paste age of a year or month

5.2- the effect of the alkaline (Na) phosphate (Tripoli phosphate and tripartite phosphate salts on samples of paste cement by concentration of 1% and age of 28 days: those two salts are considered to be as an alkaline salts inside the detergents (in the weight percentage for Tripoli (Na) phosphate in the detergent powder about 25% - 5%), the percentage of those two salts may reach about 35% from the weight of the detergent powder. a study had been made on the effect of those two salts by concentration 1% from the water weight on samples of the paste cement by the age of 28 days , after 6 circles it shows that the resistance of pressure decreased up to 5% in ease of using Na triply phosphate and this Na triply phosphate will not effect on the resistance. Form (H-K2) shows that the triple phosphate Na precipitates the (K) Ions that is dissolved in water by comparison with the samples of paste consent that is kept in the water only. But Tripoli phosphate Na is precipitates a part of the water (K) in the moment of the beginning (because it is a commercial and not pure and its pureness might be about 95% m the powder of some detergents), then it is noticed that the concentration of the (K) will remain high and it is about 130 mg/L after all the circles and that refers to the ability of the triply phosphate Na of corrosion the cement and extracting the (K) from it, by evidential of decreasing the resistance and forming triply phosphate (K) . This material shows that it is not a precipitation material but it is dissolved with water.

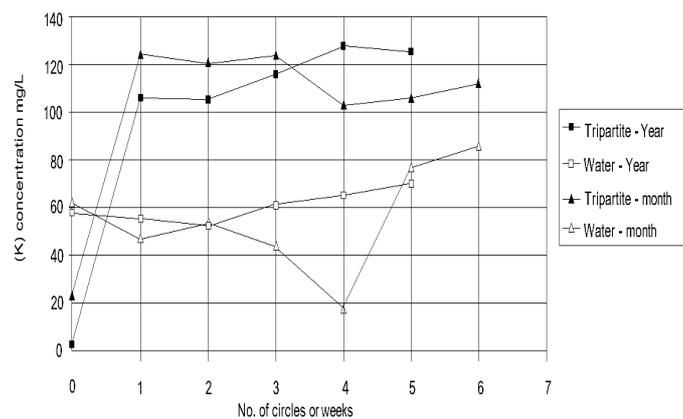


Figure 2. Effect of 1% of Tripartite phosphate on age of a year or month

5.3- a study of the effect of the 5% from synthetic detergent on samples paste cement by the age of 28 days: the

effect of ordinary or ordinary detergent (high foam : that can be used for all kinds and ways of washing and cleaning and for hand washing or by using the ordinary washing machine for garments only) is widespread and used that was manufactured by the Syrian standard No. 185 its component according to the manufactory bulletin is as follows: totality active material 18% as minimum Metal Carpoixy Seiloze 1% scent oils, triply phosphate Na (20 — 22)% , purport Na (10 15)% , brighten light 0.1%, Nasio2 8%, Naco3 4.8% , tender mat^orials, (K) solvate (20 40)% , Magnesium Seleeta 1%.

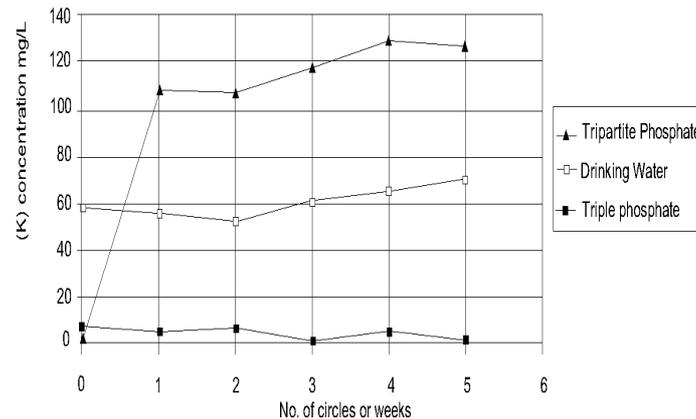


Figure 3. Effect of 1% of phosphate on the samples of cement past for year age

The result of the chemical analyses (Form H-K3) shows that the detergent was able to increase the concentration of the Ions (K) with water in the first and the second circles , but after that (the 3^o circle up to the circle) the results shows that the concentration of the (K) in the solved was less in the drinking water , and that refers to the precipitation of the (K) salts became more than the dissolved (K) salts in water from one side and on slowness of extracting the (K) tons in the last circles , uneasiness of plucking out (K) from cement as it was in the beginnings the first and the second circles. Of course , the mechanical resistance of the paste cement that is covered by detergent was weak Of paste that was kept in water that is because of the three collected materials corrossions the cement:

I-a totality active material

2-Tripoli phosphate Na (20 — 22) % 3-Na sulfite (20-40) %

5.4- a study of the detergent effect by a concentration of 5% on samples of paste cement of about one year old:

A chemical study was done for showing three kinds of detergents' powder that were used in wide for washing the garments by automatic washing machines (high price, mid-price and law price) that is manufactured in accordance to the Jordanian standards. The manufactory bulletin shows in this research, the compound of a garments detergent used in the automatic washing machines, it shows the following as it is written in the bulletin of the manufactory: not an effective soapy materials 14.7% minimum distributed between two kinds of effective materials: effective material with 90% concentration of a percentage of I 100, and effective with 80% concentration of a percentage of 6% . Tripoli phosphate Na by a concentration of 95% and percentage of 30% Na₂CO₃ 3% above the Porat Na, concentration of 95% percentage of 13% . Meta Silicate Na 7% , Carpoxy Metal cellulose 2% , scent 1% , Celecnnian oils 0.3%, secure coloreds 1%,o in addition to Enzymes and brightening light. It became clear that the concentration of the (K) Ions in the tripartite solved that contains drinking water , detergent and the cement samples continually remained the five circles that had been completed , is less that the (K) Ions in the drinking water with the cement samples only. Also those detergents having the ability to precipitate all the (K) Inns in the moment of starting, those Ions will increase as a result of the paste cement is corrosion.

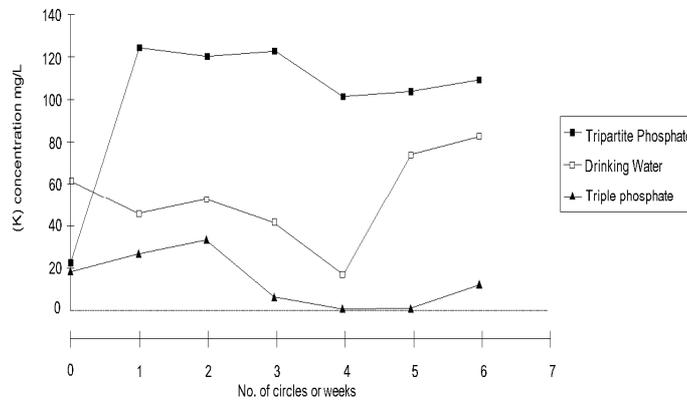


Figure 4. Results of Paste Cement

It is clear in the form (H-K4) in brief the chemical effects that the tripartite detergent corrodes the paste cements but on a different contrast degree between the large ability on the effect. For the high price detergent and the mid-price had the effects, but the low price detergent had less corrosion. For making sure of this samples were broken by detour tugging than by pressure the result of this experiments were as follows:

Table 3. Corrosion indicators

Lowering the percentage of pressure tug/resistance for the cement paste : corrosion indicator	The solved that the ordinary samples of the cement paste were put with after five circles (5 weeks)
30%	Drinking water + 5% high price detergent ,A
17%	Drinking water + 5% mid price detergent , B
6%	Drinking water + 5% low price detergent ,C
0	Drinking water only

The result of the mechanical experiments of the kept paste cement in the drinking water will be given only. Resistance of the tug in the dry situation Mpa 8.63, resistance of the pressure in the dry situation Mpa 40, resistance of the pressure in the water saturated situation Mpa 30, for remaining, the used sand that was normally used was soft, without being washed and this required (W/C = 0.6) and not 0.45 or 0.5 in accordance to the standards and the kind of cement was Mpa 32.5.

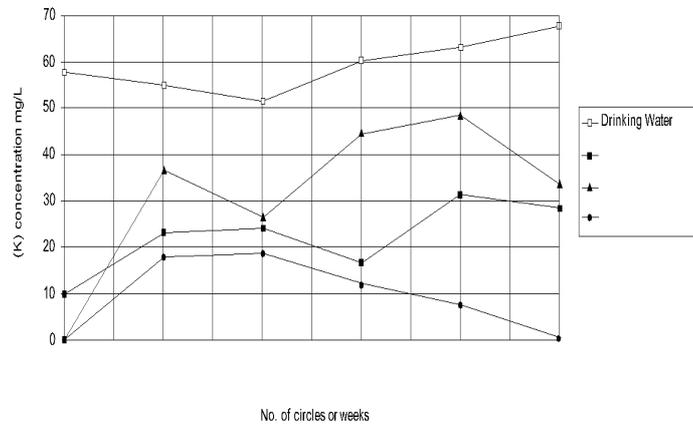


Figure 5. Changing in (K) concentration in solved (water + 5% mechanical detergent) for paste of cement samples aged one year.

5.5- a study about the effect of 1% concentration alkaline on samples of cement paste aged about one year:

Also the chemical study had completed showing the effect of the phosphate salts by its two kinds (tripartite of phosphate Na and tripartite of Na phosphate) but on an aged of one year instead of about one month.

Forms (H-K5,6,7) shows that the effect of every salt of the mentioned phosphate salts on the samples by the age of one year are almost alike of effect of samples of 28 years old. Phosphate of tripartite Na continuously remains precipitating (K) salts without lowering the resistance , vise versa salt of the tripartite of phosphate Na that pulls out Ions of the (K) from the cement and it remains dissolved in water, this will cause the weaken of the cement paste resistance as mentioned.

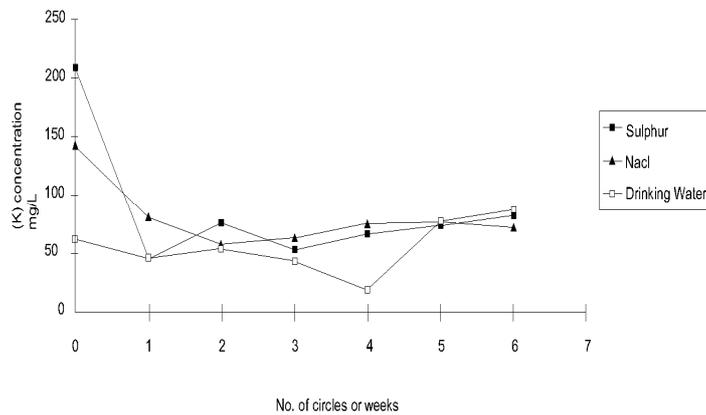


Figure 6. Results of Paste Cement

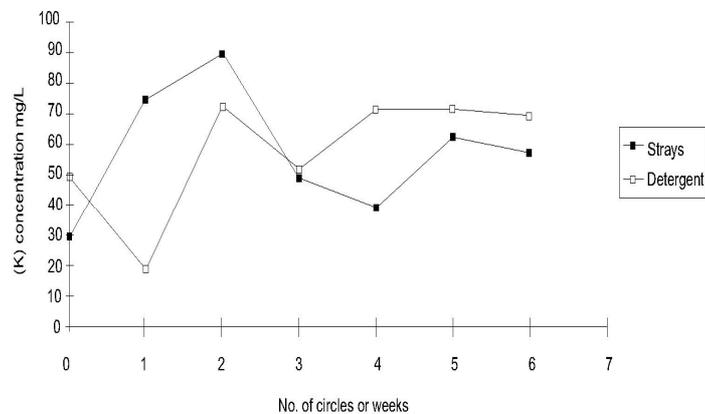


Figure 7. Results of Paste Cement

6- Conclusions and recommendations :

about the mentioned previously, it was noticed that there were too many elements and reasons that corrosions the concrete as a result , in general , in using the detergents of some of its elements , those elements during time passing, that will result to corrosion of the circumstances and the resistance of the concrete during the work, also as the corrosion of the concrete in the pipes will weaken the ability of the pipes and that will lead to be completely destroyed . So this research studied a documentary study and a laboratory study , the last studies shows some sides of this corrosions or the corrosion that came through using the physical, mechanical and chemistry as its circumstances.

It was shown from the results of those experiments in this study that the samples of paste cement of about one year old was less effected by using less detergents from the samples of cement paste of about one month old.

But the alkaline salts such as tripartite phosphate Na and that compound of 27% - 35% from the weight of the detergent, its chemical effect on the old samples like the effect on less old samples, and weakened the pressure of the ordinary paste cement for 5%. As also the salts of the NaCl weakened the resistance of the pressure for 15% in average.

The suggested indicator of the corrosion: the percentage decrease of the amount (the resistance of the detour / the resistance of pressure) was very large of one kind of the detergents, as it reached 30% , that is very dangerous . For that the following researches of this research will elucidate ways of preserving the concrete cement against water that contains detergents and some other harm chemical solved , this is presently under experiments and studies.

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