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Effects of Using Domestic Detergents Wastewater on Concrete Corrosion

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Abstract

The goal of this research is to study the corrosion of cement concrete under the influence of domestic washing Detergents. We conduct laboratory experiments to evaluate corrosion impacts and compare with available literature. We
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 show proposed sharp decline very resistant to detour - the pressure resistance by up to 30%.

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

INTRODUCTION

Typically, sewer pipes are made of concrete, and constructed underground. Domestic wastewater carry a range of chemicals that are reported to cause corrosion and rapid deterioration in pipes conditions (Boon, 2007; Bins, 2009, and Sokolovi, 1990).

Maintenance and repair of sewage pipes require expensive costs and pipe replacement works.

Repairing corrosion damages and leaks require excavation those pathways and at the end this will cause traffic stopping or congestions. So this will lead to great traffic problems and excessive costs for repairing those breakdowns. In addition, wastewater may leak and contaminate groundwater. Other impacts include noise and sound pollution and disruption of site visual image (Naser, 2009; Hana, 2008 ; and Awad, 2006)

The research goal is to evaluate the concrete pipes corrosion. In corrosive effect was assessed by measuring weight and mechanical resistance.

Under normal conditions corrosion impacts will take long time to develop. Therefore, in lab setting, concentration used will be higher levels.

LITERATURE REVIEW

The concrete pipes for sewer systems are selected for cost effectiveness but it is less resistant for corrosion due to chemicals in wastewater. Different types of wastewater and storm water are carried in the system. In addition to domestic wastewater, polluted storm water with salts and oils, and industrial waste may be disposed of in the sewer system.

It is well known that the essential connector in the normal concrete is the traditional Portland cement that is composed of the C35, the C2S, C3A and the C4AF .

Lime 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.

I) The result solution from the house usage: that comes out of water circles kitchens , bathrooms and washing the houses and stares... the assembling water of those has organic solution, metallic material and deferent solutions that gives and pollutes the water of deferent elements such as Phosphorus-Free detergents (Tahan, 1992; Frid. et al 2003)

Domestic wastewater have several active chemicals that cause corrosion. In this research we focus on common ingredients in cleaning detergents.

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.

There are several studies that focused on effect of chemicals in wastewater on corrosion. Literature show studies investigated acids, grease, salts, surfactant detergents, and heated wastewater (Zhao et al., 2010; Latexci and Rawlings, 1993) .

Those detergents are classified into 4 categories depending on the effective ingredients: Negative Anionic, alkaline materials, Sodium Parporates and the diluted chlorinated cleaners, Enzymes , Organic solvents (Latexci and Rawlings, 1993 , and F Ntuli et al., 2009).

Rawlings (1993) stated that Corrosion of concrete floors is caused by detergents when modern synthetic detergents are used. Ntuli et al (2009) stated that detergents with concentration of 1400 mg /L coupled with long residence time in the sewer caused severe corrosion of concrete sewers.

Terry (2010) evaluated corrosion of concrete or metal collection systems. Chunqiu (2010) evaluated concrete corrosion in sea water under the effect circulates of humid and the dryness with the sea water.

EXPERIMENT AND METHODOLOGY

Concrete samples with dimensions of 40x40x160 mm size are prepared. Sand used in concrete was analyzed according to ASTM. Changes in concrete samples shape are measured with Biacolyes with precision of 0.05 mm. Also change in weight was measured using a high precision scale. A compression testing device is used with 0.01 N accuracy.

The experimental plan :

Concrete samples are prepared and analyzed according to the following.

Samples are preserved at steady temperature 20^{o}C and preserved in water for 28 days.

Water used is typical tap water used in concrete mixing. Cement used is kind 1 of ordinary Portland according to the American classification. Sand used is typical local sand used in concrete mixes. Sieve analysis results for concrete mix.

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

Concrete mix composition:

Ingredient	Weight	Comment
cement	450 G	
sand	1350G	
water	270 G	W/C 0.6

Corrosion Laboratory Analysis:

Both NaCl and Na_2SO_4 salts were added to water and samples were kept under water for 28 days.

The effect of those two salts were studied with a concentration of 1% of the water on samples of cement paste by the age of 28 days. Concrete at different ages was exposed to the two salts.

After 6 Testing circles it shows that the pressure resistance dropped by 17% when using NaCL and 14% when using Na_2SO_4. So under laboratory conditions of the two salts drop in the pressure of cement mix is 15% on an average.

The active ingredients in salts are not pure, and concentration of active chemicals is not steady. Detergents contains NaCI about 14 mg/ L and Na_2SO_4 about 200 mg/L. However, with time and after the first week the concentration will drop down and the precipitation will increase specially with using the NaCI (Chunqiu, 2010).

In general, the reactions of those two salts with water and the cement mix is visible and precipitation is clear in which there is chemical exchange of the NaCI with (K) Ions in each circle, as the two salts will Precipitate the (K) but also will exceed the concentration in the beginning of the fifth circle (Figure 1).

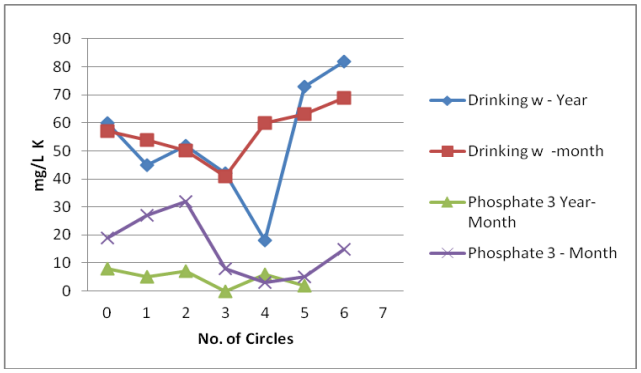

Figure 1. Effect of 1% phosphate 3 (Na Tripartite) on samples age of a year or month

Salts Long term Effects - 1% level

An additional experiment was done to study the effect of those two salts by concentration 1% from the water weight on samples of the cement mix at 28 days, after 6 testing circles it shows that the resistance of pressure decreased up to 5% with using Na triply phosphate and this Na triply phosphate will not effect on the resistance.

For the tri-phosphate Na precipitates the (K) ions dissolved in water. But Tri-phosphate Na precipitates a part of the water (K) in the beginning because it is a commercial grade. It was observed that the concentration of K remain high and it is about 130 mg/L after all the circles because the corrosive ability of the tri-phosphate Na which extracts K from concrete mix. This material shows that it is not a precipitation material but it is dissolved with water.

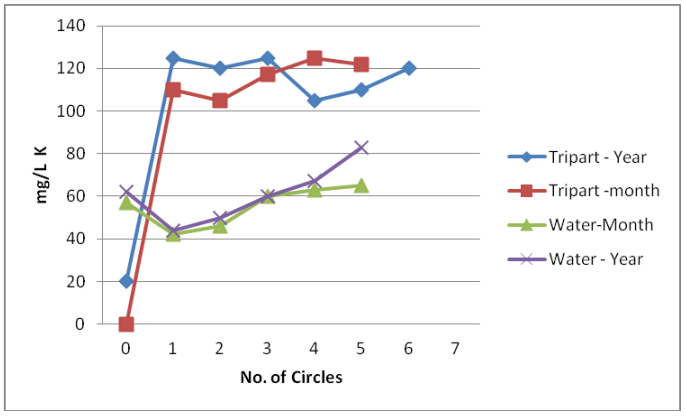

Figure 2. Effect of 1% of Tripartite phosphate on age of a year or month

Salts high concentration Effects - 5% level

A high detergent concentration of 5% is used on cement samples for treatment of 28 days: the effect of ordinary detergent which has high foam and commonly used.

It is composed of Metal Carpohixy Seiloze 1% scent oils, triply phosphate Na (20-22)% , purport Na (10 l5)°m , $NaSiO_2$ 8%, Naco3 4.8% ,tender materials, (K) solvate (20 40)% , Magnesium Silicate 1%.

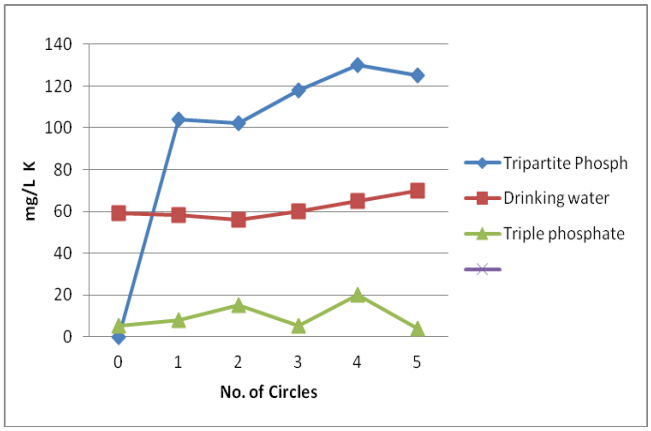

Figure 3. Effect of 1% of phosphate on the samples of cement past for year age

CONCLUSION

The chemical analyses show that detergent was able to increase the concentration of the ions (K) with water in the first and the second circles , but after that (the 3rd circle up to the 6 circle) the results shows that the concentration of the (K) in the solution is reduced in the drinking water because of precipitation of the (K) salts exceed the dissolved (K) salts in water from one side and on slowness of extracting the (K) in the last circles.

There is difficulty in extracting K out from cement as it was in the beginning the first and the second circles. Mechanical resistance of the cement mix that is covered by detergent was weak because of presence of Na (20 — 22) % 3-Na sulfite (20-40) %.

Analysis of the detergent effect at 5% concentration for samples of one year old

A laboratory study was done using three kinds of detergents' powder used for automatic washing machines (high price, mid-price and law price) that is manufactured in accordance to the Jordanian standards.

It became clear that the concentration of the (K) ions in the tripartite that contains drinking water. Detergent and the cement samples continually remained the five circles that had

been completed. It is less than the (K) Ions in the drinking water with the cement samples only. Also those detergents having the ability to precipitate all the (K) Ions in the moment of starting, those Ions will increase as a result of the cement mix corrosion.

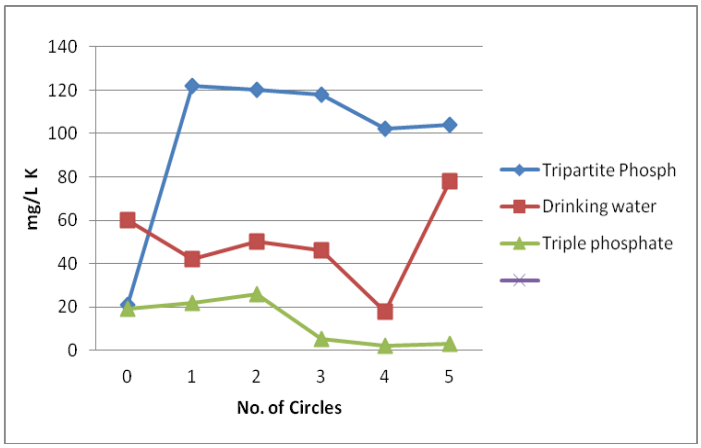

Figure 4. Results of Paste Cement

Variation due to Detergent Type

For the high price detergent and the mid-price we observed stronger corrosion effects than the law price detergent. 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% law price detergent ,C
0	Drinking water only

Effect of 1% concentration alkaline on samples of cement mix 1 year old

Also the laboratory analysis show the effect of the phosphate salts for the two kinds (tripartite of phosphate Na and tripartite of Na phosphate) on samples of one year.

The given Figures show 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 precipitate (K) salts without lowering the resistance, also the tripartite of phosphate Na that extract Ions of the (K) from the cement and it remains dissolved in water, this will cause weaker cement resistance.

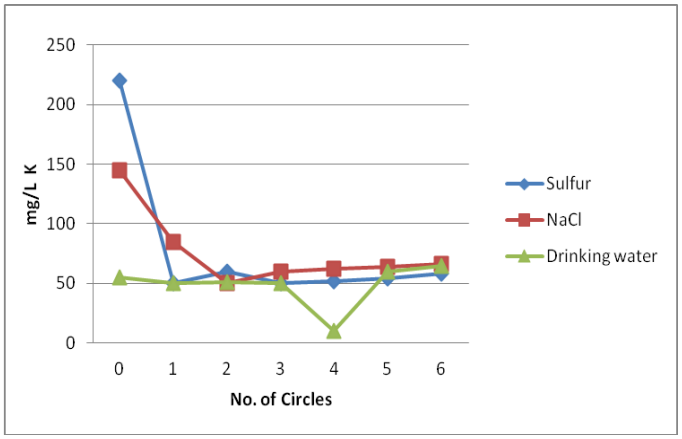

Figure 6. Results of Paste Cement

RECOMMENDATIONS

It was noticed that there were various elements causing corrosion in concrete. Exposure time is a main factor and concrete mix resistance.

Our literature review show various impacts on concrete due to corrosion. The environmental conditions affect the rate of corrosion with time.

It was shown from the results of those experiments in this study that the cement mix samples of about one year old was more resistant to corrosion compared to young aged concrete (1 month).

The impact of alkaline salts such as tripartite phosphate Na and that composed of 27% - 35% from the weight of the detergent was evaluated. Its chemical effect on the old samples like the effect on young age samples, and weakened the pressure of the ordinary cement mix for 5%. Also, the salts of the NaCl weakened the resistance of the pressure for 15% in average.

Corrosion level can be evaluated by measuring the percentage decrease of the mass (the resistance of the detour / the resistance of pressure) was large for one kind of the detergent, as it reached 30% , that is very dangerous . Future research

have several issues to evaluate and conduct laboratory analysis.

REFERENCES

[1] Fahed Naser, 2009. general chemistry for the engineers, civil engineering faculty, Teshreen University.

[2] Bassam Hana, 2008. Constriction Materials, civil engineering faculty, Al- Ba'th University. Hums.

[3] Adel Awad, 2006. The basement of the environmental engineering civil engineering faculty, Teshreen university.

[4] Wahid Al-Tahan, and Abdelkareem Kafi Jenat, 1992. Detergents manufacturing — scientific methods of manufacturing the liquid deter the shampoo and the soaps , first issued , 1992, Ruins page 81.

[5] Etude J. O. Zhao. S.Kuraoka. THW Balker. JF Masson, 2010. Durabilité et performance des conduits a écouienieut libre: - CNRC gc.Ca

[6] Latexci, and EG Rawlings, 1993. Anti corrosion Methods and Materials, 1993, emeraldingsight.com. Corrosion of concrete floors is liable to detergents.

[7] F Ntuli et al., 2009. Characterization of Effects from Textile Wet Finishin, proceeding of the aieng.org.

[8] V.P. Sokolovi 1990, Soil Mechanic and foundation Engineering, More attention to the ecology during chemical , Springer.

[9] J.M.L. Bins, 2009. A comparative assessment of polymer concrete strength a degradation cycles, Mechanic of Solid Journal in Brazil , pp437-444.

[10] A. G. Boon (Fellow), 2007. Septicity in sewers: causes. Consequences and containment. article online 26 Jul.2007, Water and Environment.

[11] Li Chunqiu, 2010. Under draying-wetting cycles, concrete transport in cover chloride. Journal of Chinese ceramic society.