Effect of KCI on Strength of M20 Blended Cement Concrete with Silica Fume

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Abstract

In Recent years, construction industry has sparked as one of the developments on demand in the society, which is mainly due to the growing population. The major part of the construction is based on concrete mixture. During its survival, it is exposed to many environmental calamities along with some internal problems. This demands a necessity to develop resistant ingredients for the purpose in the aggressive environment of food industries, chemical, mineral and many other industries. There is necessary in the development of chemically resistant materials for the use in the aggressive environment of food manufacturing, mining, mineral processing, chemical, and other industries. The most durable building material is concrete that determines the life of a structure. The durability of concrete is threatened and may be lost by external affects. Some of the factors like thawing and freezing, corrosion of steel may leads to damage the concrete. There is a tendency to suffer damage that is micro cracks and spalling when concrete is treated with wet or moist medium. Because of various climatic conditions, concrete need to face lot of problems to withstand i.e to maintain pH level (carbonation or acidification due to different types of gases exist in the surroundings which leads to damage of the concrete). There is also problem for marine structures which are continuously treated with salt water attack. This may lead to salt crystallization and scaling damage. In this investigation, an experiment is done to study the nature of M20 grade concrete with blended cement in the presence of neutral salt KCl with concentrations of 0.5,2,4,6,8,10,12 and 14 by adding water for desired concrete.

Keywords: Carbonation Acidification KCI

I. INTRODUCTION

As we know that the water plays a major role in concrete mixing as well as in hydration of cement. It also gives workability to the concrete in a fresh state. The complex compounds present in the cement react with water because of its setting and hardening. The hydrolysis process is taken place when the anhydrous compounds brought into contact with water resulting in hydrated compounds.

Water gel is formed during the formation of strength with the help of water. So, it is necessary to observe and control the quality of water during concrete mixing. As we know that the most abundant and naturally available solvent is water. A large number of impurities present in water ranging from less to very high concentrations.

In practice, the properties of cement and aggregates are controlled frequently, but neglecting the properties of concrete. A popular measuring rod which is suitable is selected and used for mixing of concrete. If the water is suitable for drinking then it suits before concrete mixing. It may not be a true statement in every condition. Sometimes the water which is fit for concrete mixing may not fit for drinking water. Similarly, the water which contains sugar suitable for drinking water and it won't suit for concrete mixing. The water is not suitable for drinking if it contains pathogenic microbial contaminants and this type of water can be used in the concrete mixing.

II. RESULTS AND DISCUSSIONS

In the present investigation the results are presented in tabular and graphical forms. In order to facilitate the analysis and interpretation of results is carried out at the each phase of the experimental work. Based on the current knowledge available in the literature and also on the nature of results obtained, obtaining the interpretation of the results. The significance of the result is assessed with reference to the standards specified by IS 456-2000.

1) Comparison of the initial and final setting time of the three samples prepared with the mixing water which containing the varying concentrations of chemical component under consideration with the cement samples prepared with the deionised

water. The difference is negligible when it is less than 30 minutes, the change is considered significant when it is more than 30 minutes.

2) Comparing the compressive strength of 3 concrete cubes prepared by using water under consideration and the concrete cubes prepared by using deionised water. The difference of compressive strength is considered insignificant when it is less than 10 % and it is considered significant when it is more than 10%.
3) Comparing the average tensile strength of 3 concrete cubes prepared by using water under consideration and the concrete cubes prepared by using deionised water. The difference of tensile strength is considered insignificant when it is less than 10 % and it is considered significant when it is more than 10%.

The test results of the initial and final setting time and change in percentage of compressive strength and the tensile strength of the test specimens prepared with different mixing samples and deionised water are reported in the tables

As per IS code, the initial setting time should not less than 30 minutes and final setting time should not more than 600 minutes. The comparison of changes in the compressive strength and the tensile strengthof concrete specimens prepared with various chemicals of different concentrations with the specimens made with the deionised water and the results presented in the tabular form and graphical forms.

A. Effect of Neutral Salt (Pottasium Chloride (KCl)):

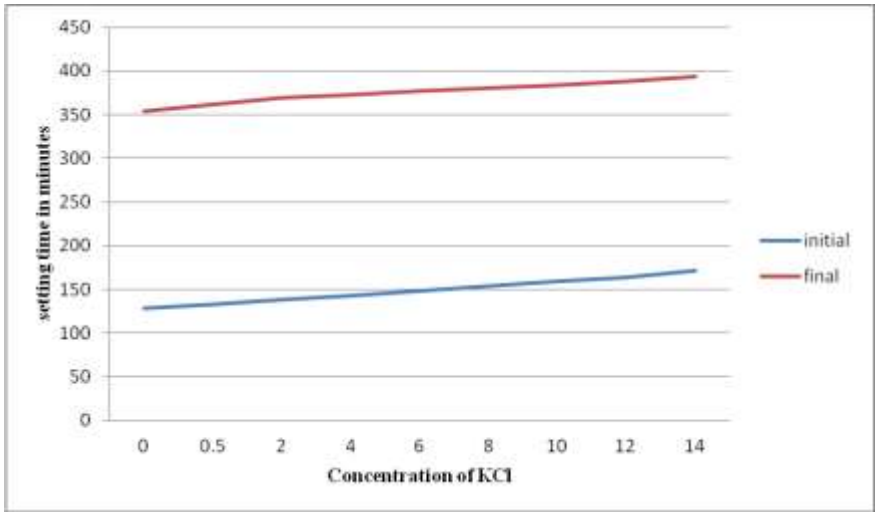
The chemical substances KCl is denoted as neutral salts. Following subsections discusses the effect of presence of these salts. There is an effect on the setting times, compressive strengths and the tensile strength of Blended Cement Concrete due to the presence of Potassium chloride (KCl) in the mixing water is presented in the following sub sections.

1) Setting Time of Cement

Table 5.1 and Fig. 5.1 show the effect of KCl on the setting times of concrete. It is observed that the initial and final setting time got retarded as the potassium chloride increases in the water i.e deionised water. In the setting times at the concentration of KCl i.e at 10g/l in the mixing water for casting the test blocks, differed significantly when compared with the experimental results obtained with deionised water. The initial setting time is 172 min when KCl concentration is 14 g/l, at the same concentration, the final setting time is 394 min, which is 40 min more than that of control water sample.

Table - 5.1
Variation of setting time of cement at the various KCl concentrations in deionised water

SI.No	*Water sample*	*Setting time in minutes*		*% variation*	
		Initial	*Final*	*initial*	*final*
1	*Deionosed water (control)*	*128*	*354*	*00*	*00*
2	*0.5 g/l*	*133*	*362*	*3.9*	*2.25*
3	*2 g/l*	*138*	*369*	*7.81*	*4.23*
4	*4 g/l*	*143*	*373*	*11.71*	*5.36*
5	*6 g/l*	*148*	*377*	*15.62*	*6.49*
6	*8 g/l*	*154*	*381*	*20.31*	*7.62*
7	*10 g/l*	*159 **	*384 **	*24.21*	*8.47*
8	*12 g/l*	*164*	*388*	*28.1*	*9.60*
9	*14 g/l*	*172*	*394*	*34.3*	*11.29*



Graph 5.1: Variation of setting times of cement corresponding to various concentrations of KCl in deionised water

2) Effect on Strength of portland Blended Cement Concrete

Following tables show KCl concentration effects the compressive strength and tensile strength of portland blended cement concrete. It is observed irrespective of KCl concentration that there is gain in compressive strength at early stages. With increase

in the concentration of KCl, increaseof compressive strength in the M20 grade concrete. The result is significant at the 10g/l concentration of KCl. when KCl concentration is 14g/l, the compressive strength increases to 26.04 for M20 grade concrete, comparision of cubes prepared with the water that consists of KCl and the cubes prepared by using deionised water. Similarly, significant increase in the tensile strength is observed when concentration is 10g/l. when KCl concentration is 14g/l, the increase in the tensile strength is 9.73% for M20 grade concrete, comparision of cubes prepared with the water that consists of KCl and the cubes prepared by using deionised water.

a) Effect on compressive strength of Blending cement

Table 5.2 and Fig 5.2, 5.3 show the effect of KCl on the compressive strength of PBC (fly ash based) concrete. The results indicate that there ia an early gain in compressive strength of the PBC (fly ash based) concrete irrespective of KCl concentration. In the case of PBC (fly ash based) concrete marked increase in compressive strength is obseved with increase in the concentration of KCl. when KCl concentration is 14g/l, the increase in the compressive strength is 13.16% at 90 days for M20 grade concrete, comparision of cubes prepared with the water that consists of KCl and the cubes prepared by using deionised water.

Table - 5.2

Variation of compressive strength of concrete corresponding to various concentrations of potassium chloride(KCl) in deionised water

SI.No	*Water sample*	*28 days*	*% variation*	*56 days*	*% variation*	*90 days*	*% variation*
1	*Deionosed water (control)*	*23.9*	*00*	*25.60*	*00*	*27.50*	*00*
2	*0.5 g/l*	*24.21*	*1.29*	*25.90*	*1.17*	*27.70*	*0.72*
3	*2 g/l*	*24.72*	*3.43*	*26.20*	*2.34*	*27.98*	*1.74*
4	*4 g/l*	*24.90*	*4.18*	*26.62*	*3.98*	*28.55*	*3.81*
5	*6 g/l*	*25.13*	*5.14*	*27.10*	*5.85*	*28.95*	*5.27*
6	*8 g/l*	*25.40*	*6.27*	*27.81*	*8.63*	*29.52*	*7.34*
7	*10 g/l*	*25.63*	*7.23*	*27.94*	*9.14*	*30.13*	*9.56*
8	*12 g/l*	*25.90*	*8.36*	*28.21*	*10.19*	*30.57*	*11.16*
9	*14 g/l*	*26.10*	*9.20*	*28.63*	*11.83*	*31.12*	*13.16*

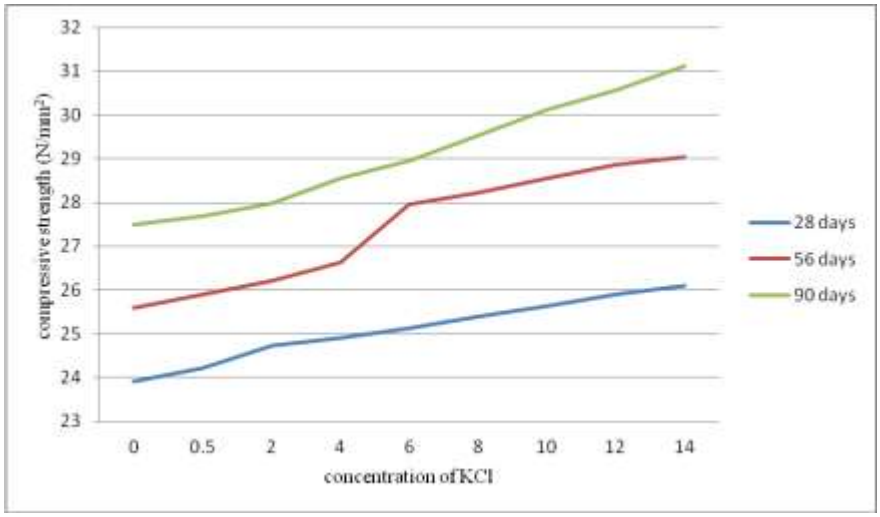
b) Effect on compressive strength of silica fume Cement Concrete

Table 5.3 and fig 5.4, 5,5 show the KCl concentration effect on the compressive strength of silica fume Cement Concrete. The results indicate that there ia an early gain in compressive strength of the fly ash concrete irrespective of KCl concentration. In the case of silica fume concrete, marked increase in compressive strength is observed as concentration of KCl increases. The result is significant at the 8g/l concentration of KCl. when KCl concentration is 14g/l, the compressive strength increases to 18.1% for M20 grade concrete, comparision of cubes prepared with the water that consists of KCl and the cubes prepared by using deionised water.

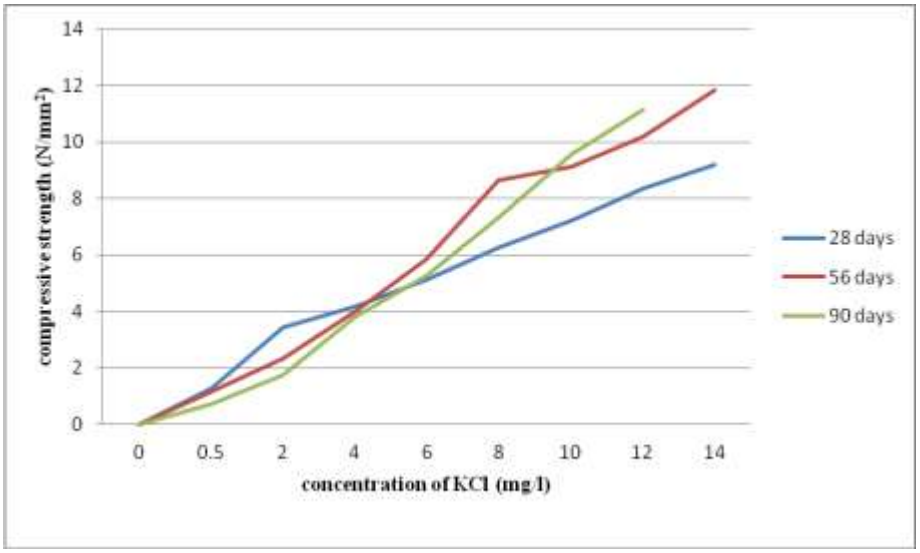
Table - 5.

Variation of compressive strength of Silica fume concrete corresponding to various concentrations of potassium chloride(KCl) in deionised water

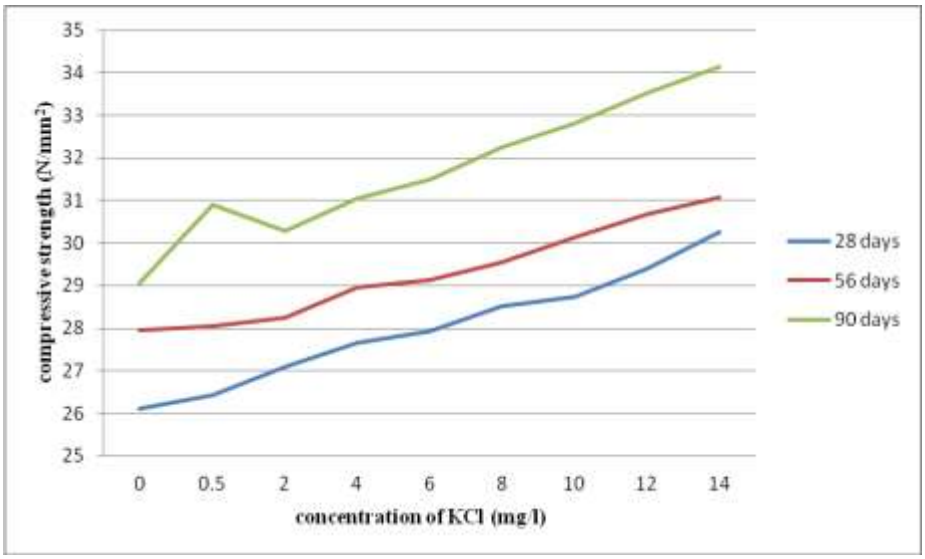
SI.No	*Water sample*	*28 days*	*% variation*	*56 days*	*% variation*	*90 days*	*% variation*
1	*Deionosed water (control)*	*25.11*	*00*	*26.24*	*00*	*28.05*	*00*
2	*0.5 g/l*	*25.42*	*1.23*	*27.05*	*3.08*	*29.09*	*3.70*
3	*2 g/l*	*26.08*	*3.86*	*27.25*	*3.84*	*29.29*	*4.42*
4	*4 g/l*	*26.65*	*6.13*	*27.96*	*6.55*	*30.05*	*7.13*
5	*6 g/l*	*26.92*	*7.20*	*28.12*	*7.16*	*30.50*	*8.73*
6	*8 g/l*	*27.52*	*9.59*	*28.54*	*8.76*	*31.25*	*11.40*
7	*10 g/l*	*27.74*	*10.47*	*29.13*	*11.01*	*31.81*	*13.40*
8	*12 g/l*	*28.41*	*13.14*	*29.67*	*13.07*	*32.52*	*15.93*
9	*14 g/l*	*29.25*	*16.48*	*30.06*	*14.55*	*33.15*	*18.1*



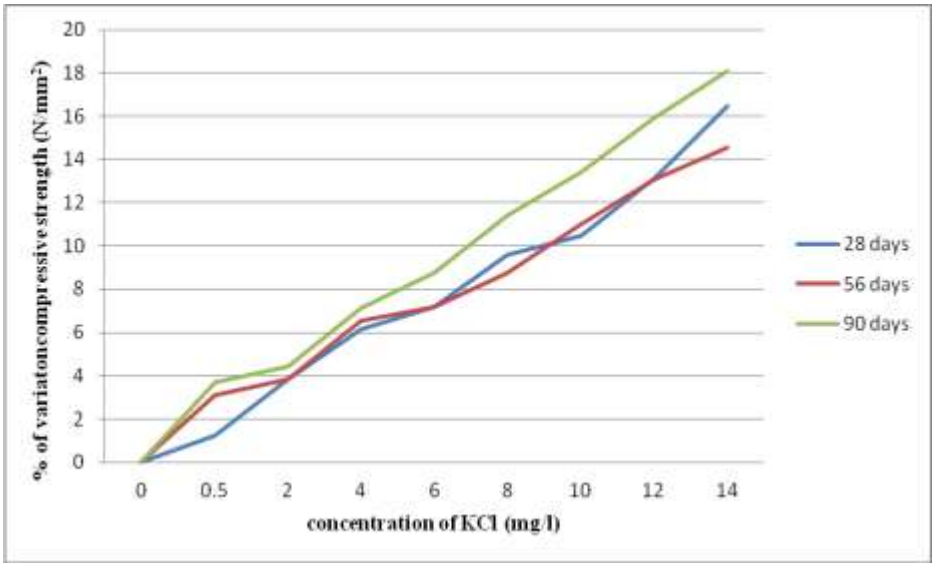
Graph 5.2: Compressive Strength of PBC Vs KCl in mixing water



Graph 5.3: % of Variation in Compressive strength of PBC Concrete Vs KCl in mixing water



Graph 5.4: Variation of Compressive strength of Silica Fume Concrete Blended Cement Concrete Vs KCl in mixing water



Graph 5.5: % of Variation in Compressive strength of Silica Fume Concrete Blended Cement Concrete Vs KCl in mixing water

c) Effect on Tensile Strength of Blended cement

Table 5.4 and Fig 5.6, 5.7 show the effect of KCl on the Tensile strength of PBC (fly ash based) concrete. The results indicate that there ia an early gain in Tensile strength of the PBC (fly ash based) concrete irrespective of KCl concentration. In the case of PBC (fly ash based) concrete marked increase in tensile strength is obseved with increase in the concentration of KCl. when KCl concentration is 14g/l, the increase in the tensile strength is 9.74% for M20 grade concrete, comparision of cubes prepared with the water that consists of KCl and the cubes prepared by using deionised water.

Table - 5.4

Variation of Tensile strength of concrete corresponding to various concentrations of potassium chloride(KCl) in deionised water

SI.No	*Water sample*	*28 days*	*% variation*	*56 days*	*% variation*	*90 days*	*% variation*
1	*Deionosed water (control)*	*3.08*	*00*	*3.30*	*00*	*3.42*	*00*
2	*0.5 g/l*	*3.11*	*0.97*	*3.33*	*0.90*	*3.45*	*0.87*
3	*2 g/l*	*3.16*	*2.59*	*3.37*	*2.21*	*3.49*	*2.04*
4	*4 g/l*	*3.20*	*3.89*	*3.40*	*3.03*	*3.52*	*2.92*
5	*6 g/l*	*3.25*	*5.51*	*3.44*	*4.24*	*3.56*	*4.09*
6	*8 g/l*	*3.29*	*6.81*	*3.50*	*6.06*	*3.62*	*5.84*
7	*10 g/l*	*3.30*	*7.14*	*3.56*	*7.87*	*3.70*	*8.18*
8	*12 g/l*	*3.36*	*9.09*	*3.61*	*9.39*	*3.76*	*9.94*
9	*14 g/l*	*3.38*	*9.74*	*3.66*	*10.90*	*3.81*	*11.40*

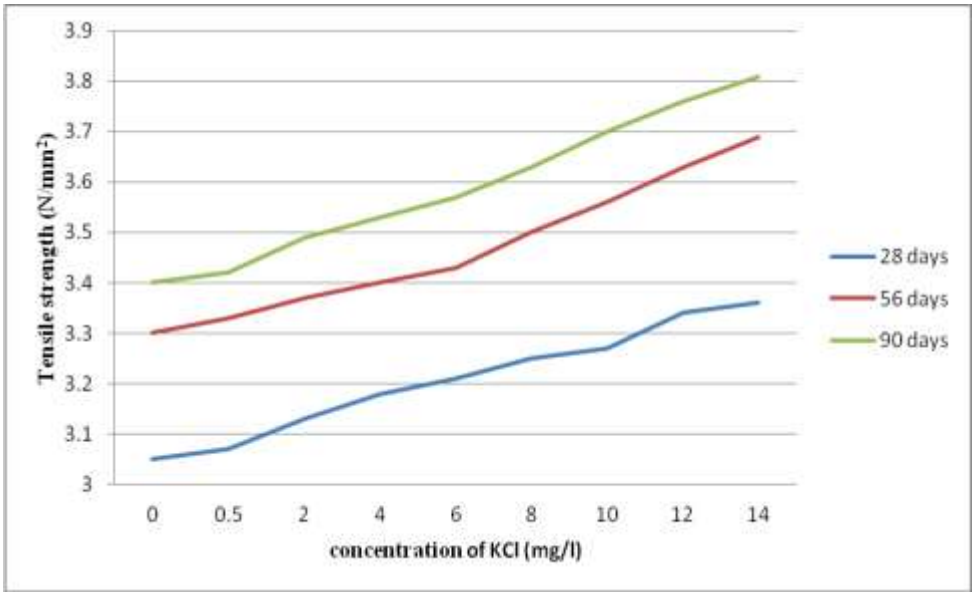
d) Effect on Tensile strength of silica fume Cement Concrete

Table 5.3 and fig 5.15 show the KCl concentration effect on the tensile strength of silica fume Cement Concrete. The results indicate that there ia an early gain in tensile strength of the fly ash concrete irrespective of KCl concentration. In the case of silica fume concrete, marked increase in tensile strength is observed as concentration of KCl increases. The result is significant at the 8g/l concentration of KCl. when KCl concentration is 14g/l, the tensile strength increases to 10.57% for M20 grade concrete, comparision of cubes prepared with the water that consists of KCl and the cubes prepared by using deionised water.

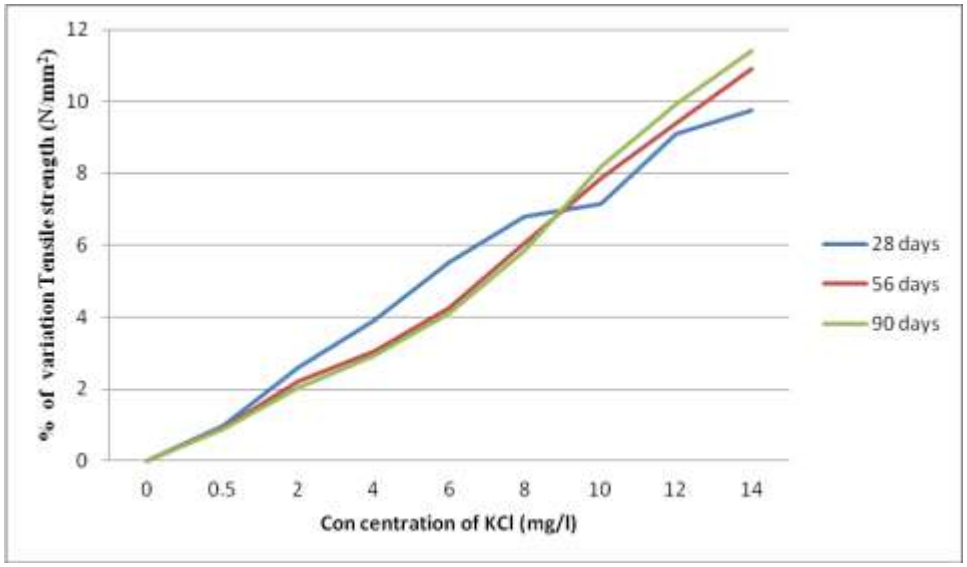
Table - 5.2

Variation of tensile strength of Silica fume concrete corresponding to various concentrations of potassium chloride(KCl) in deionised water

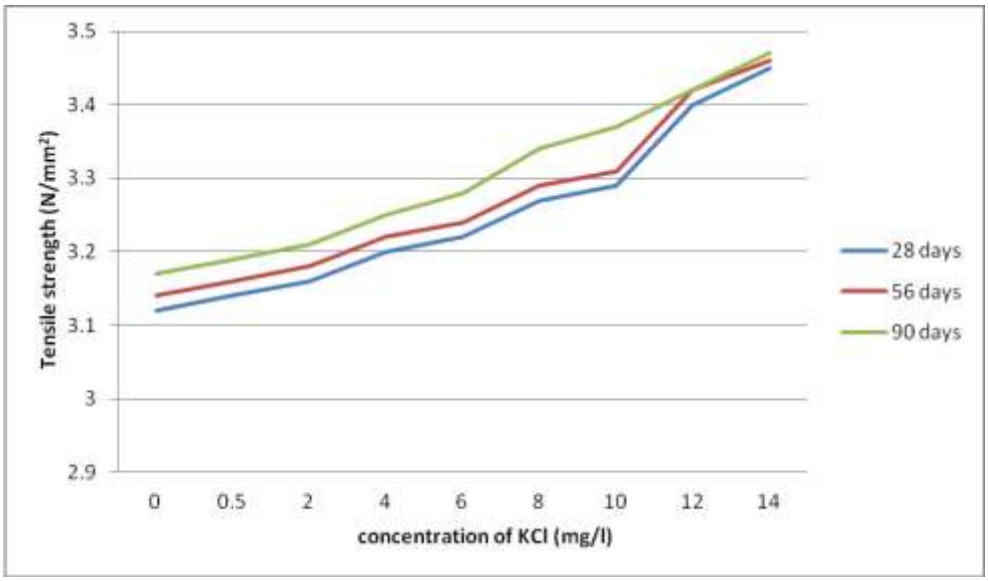
SI.No	Water sample	28 days	% of variation	56 days	% of variation	90 days	% of variation
1	Deionosed water (control)	3.12	00	3.14	00	3.17	
2	0.5 g/l	3.14	0.64	3.1	0.63	3.19	0.63
3	2 g/l	3.16	1.28	3.18	1.27	3.21	1.26
4	4 g/l	3.20	2.56	3.22	2.54	3.25	2.52
5	6 g/l	3.22	3.20	3.24	3.18	3.28	3.47
6	8 g/l	3.27	4.80	3.29	4.77	3.34	5.36
7	10 g/l	3.29	5.44	3.31	5.41	3.37	6.30
8	12 g/l	3.40	8.97	3.42	8.91	3.43	8.20
9	14 g/l	3.45	10.57	3.46	10.19	3.47	9.46



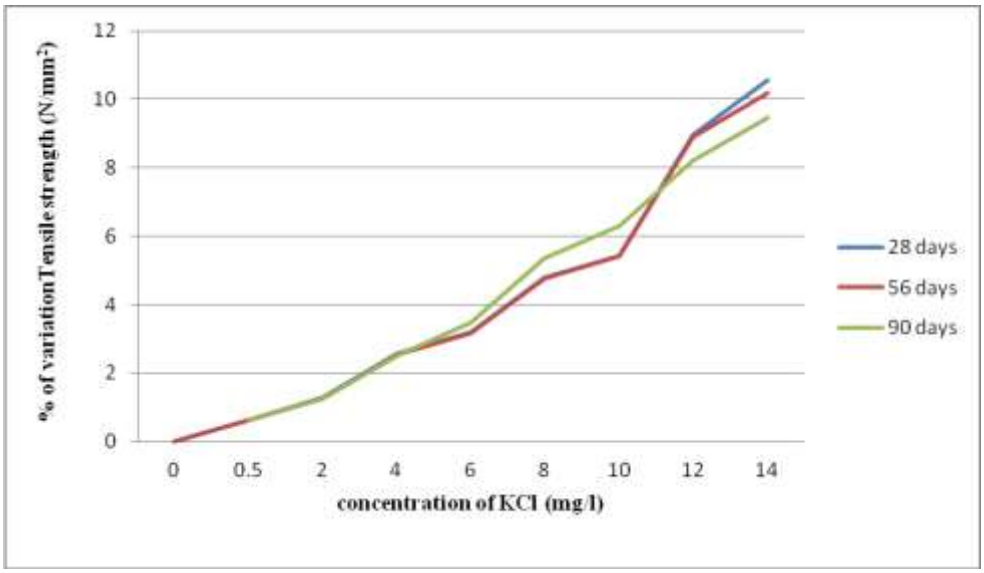
Graph 5.6: Tensile strength of PBC Vs KCl in mixing water



Graph 5.7: % of Variation in Tensile strength of PBC Concrete Vs KCl in mixing water



Graph 5.8: Tensile strength of PBC with silica fume Vs KCl in mixing water



Graph 5.9: % of Variation in Tensile strength of PBC with silica fume Concrete Vs KCl in mixing water

B. Summary of effects of Neutral salts

Generally, the neutral salts present in the water are KCl. The effect of the KCl concentration present in deionised water on the initial setting and final setting times of the cement and the compressive strength and tensile strengths of concrete is already discussed in the above sections. The behavior of neutral salts is elucidated in a comprehensive manner as follows:

KCl in deionised water accelerates initial as well as the final setting process at all concentrations.

KCl in deionised water increases the compressive strength and Tensile strength of PBC specimen significantly at 28 days, 56 days and 90 days.

The predominant effect of KCl on the compressive strength and tensile strength slowly decreases for 90 days concrete specimen as compared at 28 day specimen.

III. CONCLUSION

Based on the results obtained in this investigation the following conclusions can be drawn

- Initial setting time ans the final setting time significantly accelerated due to the presence of KCl in the deionised water when the concentration is equal to 8 g/l and 10 g/l respectively.
- There is significant increase in compressive strength and tensile strength PBC concrete at the concentration of 8 g/l and 12 g/l

A. Scope for Future Study:

The same investigation can be attempted on other mixtures of concrete such as Silica fume, Metakaolin, Rice husk etc to evaluate the result of these chemical compounds on strength and especially on durability of concrete.

The presence of biological substances in water, which is not studied in this project, has also impact on setting properties and strength of cement and concrete that can be researched further.

The constraints on the usage of water found at different places consisting distinct components can be analyzed in concrete construction.

The same investigation can be done to get knowledge about the effect on flexural strength of concrete along with durability.

The industrial effluent water can be treated to make use of such water in constructing a structure with desired limitations.

The affect of neutral, alkaline and acidic compounds present in water on permeability of concrete demand an analysis because it is particularly utilized in effective seepage control.

Advanced X-ray diffraction can be looked forward for more accuracy in the formation of various critical compounds and quantitative analysis which influence the characteristics of cement and concrete.

To formulate the standards of water usage, the different chemicals present in water can be analysed by checking the impact on corrosion of reinforced cement concrete.