EFFECT OF DOMESTIC WASTE WATER ON PHYSICAL PROPERTIES OF CONCRETE MIX

A PROJECT REPORT

submitted in partial fulfillment of the requirements for the award of the Degree of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

Under the supervision of

Dr. Amardeep

(Assistant Professor)

by

Vikas Verma (151684)

Saksham Sharma (151696)

to

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

WAKNAGHAT, SOLAN – 173234

HIMACHAL PRADESH, INDIA

MAY – 2019

STUDENTS' DECLARATION

We hereby declare that the work presented in the Project report entitled **"EFFECT OF DOMESTIC WASTE WATER ON PHYSICAL PROPERTIES OF CONCRETE MIX"** submitted in partial fulfillment of the requirements for the degree of Bachelor of Technology in Civil Engineering at **Jaypee University of Information Technology, Waknaghat** is an authentic record of our work carried out under the supervision of **Dr. Amardeep.** This work has not been submitted elsewhere for the reward of any other degree/diploma. We are fully responsible for the contents of this project report.

Vikas Verma	Saksham Sharma
151684	151696

Department of Civil Engineering

Jaypee University of Information Technology, Waknaghat, Solan

Date:

CERTIFICATE

This is to certify that the work which is being presented in the project report titled **"EFFECT OF DOMESTIC WASTE WATER ON PHYSICAL PROPERTIES OF CONCRETE MIX"** submitted in partial fulfillment of the requirements for the degree of Bachelor of Technology in Civil Engineering at **Jaypee University of Information Technology, Waknaghat** is an authentic record of work carried out by **Vikas Verma (151684) & Saksham Sharma (151696)** under the supervision of **Dr. Amardeep, Assistant Professor ,** Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat, Solan , (H.P.).

The above statement made is correct to the best of our knowledge.

Date:

Signature of Supervisor	Signature of HOD	Signature of Examiner
Dr. Amardeep	Dr. Ashok Kumar Gupta	External Examiner
Assistant Professor	Professor and Head	
Civil Engineering Department	Civil Engineering Department	
JUIT, Waknaghat	JUIT, Waknaghat	

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ABSTRACT

Portable water is very precious for the developed countries. Due to increase in construction work and rapid industrialization so that the large volumes of normal water is used. The partially treated and treated waste water to be reused where ever it is possible for sustainable development. Concrete technology is one of the large industries, which is consuming large amount of water for curing purposes .Water is both beneficial as well as detrimental effects on concrete.

The domestic waste samples were collected from the Sewage Treatment Plant (STP) Waknaghat, Solan . Concrete cubes cast in 150 mm x 150 mm x 150 mm cubes mold were used to show the effect of the waste water on concrete strength. M30 grade mix design was used for casting of cube. While, the water-cement ratio was 0.45 for mixing purposes. After removing from their moulds, cubes were cured using waste water. compressive strengths of all the cubes were tested for different time period i.e. 3, 7, and 28 days (based on their curing time) and the average value of the specimens was taken.

Domestic waste water was used with different ratios (i.e 20%,30%,40%,50%). Different tests were performed on these samples to check the properties. Different tests were also performed on different materials used in the concrete making process. Then Compressive strength of all different concrete mixes were calculated by using Compression Testing Machine. We get the targeted strength of the mix made with 20% waste water in normal tap water. Thus from our study it shows that 20% of waste water is acceptable in the concrete mix water.

Keywords: OPC,Compressive strength, Water-cement ratio, curing, waste water

TABLE OF CONTENTS

LIST OF FIGURE

LIST OF TABLES

CHAPTER -1

INTRODUCTION

1.1 GENERAL

In developing countries such as India, Brazil and many more, the wastes generated are discharged directly into the rivers and streams that which adversely affect the human health, animals health (i.e. fish etc.) and the environment also. The portable water is not even sufficient for drinking purposes or human consumption. According to ministry of water resources of India, during the summer months, there is not sufficient water for drinking purpose in different places in India like Rajasthan, Maharashtra, Delhi etc. As per the record the central water commission (CWC) , the total waste water generated from all the major industrial source is 82466 millions liter per day. From the study it was investigate that the water demand for industries in the year 2000 was 30 billion cubic meters. But it is projected to be as high as 120 billion cubic meters in the year of 2025. So that the demand of the treated waste water should be increase in the future for agriculture as well as in the construction purposes.

1.2 INTRODUCTION

Concrete the largest production of all man-made materials. To reduce the concrete cost, properties has to be improved, and we have to utilize waste material for sustainable construction of concrete, considerable work and significant studies. On addition of waste material in concrete. However, for recycling industrial wastewater into value added construction products few solutions were explored studied the replacement of fresh water by sewage treatment plant waste water reported that using recycled wash water has no adverse effect on the strength of concrete. In particular, no research efforts have focused on the replacement of fresh water by sewage treatment plant waste water in concrete mixes.

Today there a large extent of scarcity of fresh water as shown in figure 1.1. Therefore, there is need to arrange other source of water for concrete or construction of building units. This waste water which now a days drains in river which is very effective in pollution of water.In India there is large amount of waste water is generating. Portable water is very precious for the developed countries. And we know that large amount of portable to be used for curing purpose, so that used partially treated waste water for curing purpose and increase the the compressive strength .But due to large amount of heavy metals present in the non-portable water.

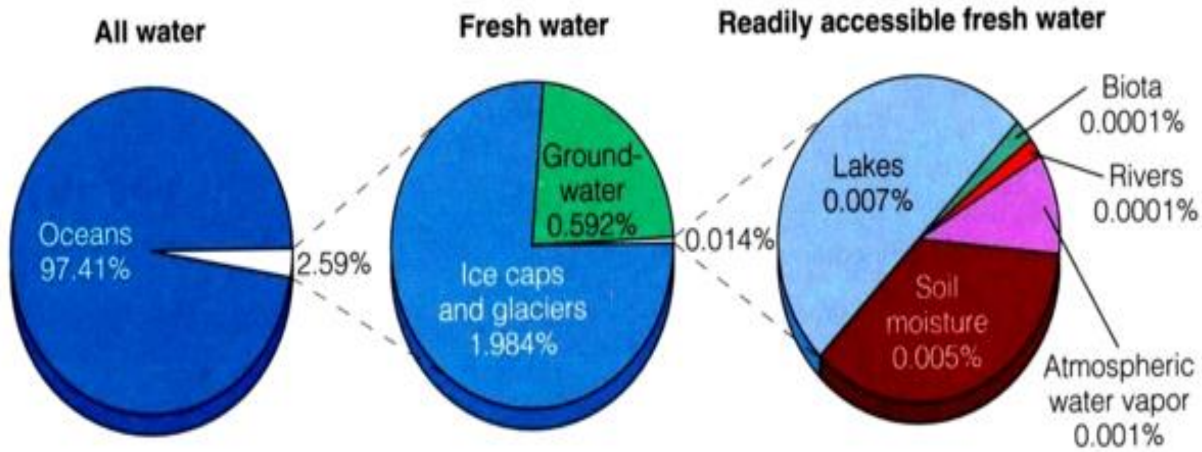

Fig. 1.1 Showing the percentage of fresh water available on earth

In the construction industry, huge volume of water is consuming nowadays. For creating $1m^3$ concrete, we need 150 liters of water in construction industry. As shown in Fig. 1, oceans contains about 97% of water in the earth and remaining 3% is fresh water. From this 3% fresh water, only 1% of water is available for humans i.e ground water and remaining 2% is present in the form of icecaps. Water is used for different purpose i.e domestic and industrial purpose and this all the water comes from surface water and underground water. There is a very big impact by construction industry on the environment because too much water is used in construction process. Thus, we need different alternative sources to solve this problem of fresh water

1.3 OBJECTIVE OF THE STUDY

1. Utilization of waste water (i.e. industrial waste or domestic waste) in curing and construction purposes in order to create an sustainable environment.

2. Examination of previous guidelines for the use of waste water in construction work if any.

3. Reduce the use of potable water in the construction purposes.

4. Propose guideline for the use of different waste water in construction work.
   Effect of waste water in properties of concrete mix.

5. To compare the compressive strength between the cubes using waste water curing and second is normal water.

CHAPTER -2

LITERATURE REVIEW

2.1 GENERAL

Firstly, the overall goal of this chapter is to establish the significance of the past studies conducted across the world. The bulk of the chapter was on critically evaluating the different methodologies used in this field so as to identify the appropriate approach for investigating the research. A detailed discussion regarding the same has been made in the next section of the present chapter.

2.2 SUMMARY OF LITERATURE REVIEW

Tay et al.(1989) conducted a study based on reclamation of waste water for concrete mixing. In the study, samples of reclaimed waste water and dewatered sludge were fired in the furnace at 600ºC for the removal of organic matter. Physical and chemical properties of samples were analyzed by following tests in the laboratory which are tabulated in Table 2.1.

Table 2.1 Different codes for different test.

Property Tested	Code Used
Specific Gravity	A.S.T.M. C128-84
Bulk Density	B.S. 812:1975
Setting Time	B.S. 12:1978
Shrinkage	B.S. 1881:1970
Slump	B.S. 1881:1970
Compression	B.S. 1881:1970
Chemical Composition	By Atomic Absorption Spectrophotometer

Concrete cubes of dimensions 100*100*100 cubic mm and 1:2:4 (cement: sand: coarse aggregates) with W/c ratio of 0.5 was used. According to B.S. 812, sieve analysis was carried out for fine particles. 20 mm size sieve was used for coarse aggregates. The W/c ratio were used to study the effect of reclaimed waste water. Several mixes were made by utilizing the waste water in various proportions i.e. 0%, 25%, 50%, 75%, 100%. Several batches were investigated by using different mixes of sludge and reclaimed waste water in different proportions to study the combined effect on the concrete. Curing was done with the help potable water. Cubes were tested again & again after a curing periods of 3, 7, 21, 28 days respectively for their compressive strength. Three specimens were tested for each test and average value was taken as their compressive strength.

El-Nawawy et al.(1990) conducted a study based the used of treated effluent in an arid climate. The arid region of Qatar lies where there is high amount of scarcity of fresh water . So that they used domestic waste water for irrigation as well as for construction . Five specimens were of 150 x 150 x 150 mm of each prepared with different concentration of water. They used 100 % of portable water for mixing and 80 % of portable water and 20 % of treated effluent , 60 % of portable water and 40 % of treated effluent ,40 % of portable and 60 % of treated effluent , 20 % of portable water and 80 % of treated effluent then 100 % of treated effluent and curing should be done. Different test were performed on the cement , waste water ,fine aggregates and coarse aggregates . The water is suitable if the it neither change the setting time by 30 min and not reduce the strength 20 % and results were compare with the specimens of portable water. From the tests have shown that the high amount of dissolved salts reduce the compressive strength 10 - 30 %. In the coastal sizes water contain large high amount of the chlorides which can causes the persistent dampness and surface efflorescence and it can also increase the corrosion in the reinforcing steel. A minimum setting time is of 45 min which is prescribed by BS 12: 1978 for the OPC and final setting time is 10 -12 hrs.In both the compressive and tensile strength should be decrease with increase in the the proportion of the waste water in the mixing of the concrete.

From the different experiments it was conclude that the cement mortar and concrete specimens of the mixer of the 20 % of waste water and the 80 % of portable water can we used for the constructions .So that the generally strength lies within the prescribed limits given in the different codes and specifications.

Ghusain et al. (2003) conducted a study based on utilization of municipal waste water . In the study total 17 major pumping station and 52 secondary pumping stations were used for pumping the waste water throughout the city.Waste water was treated through different treatment processes like coagulation flocculation, sedimentation, filtration, aeration and last chlorination. Later, this treated waste water was used in various proportions (i.e. 0%, 25%, 50%, 100%) to cast no. of cubes of having size equal to 100mm. For the same purpose mix was prepared in the proportion of 1:2:4 (cement, sand and aggregate respectively) with the water/cement ratio of 0.6.

An increment in the compressive strength was observed with increase in the amount of treated waste water for all the samples. During the study no difference was found in the compressive strength of the cubes which were made by utilizing 100% of treated waste water and other ones which were made with the potable water which exhibits that the treated waste water can be used in order to prepare the mixes. After that, other two cubes were caste from potable water and curing is done for first cube in 100% treated waste water and one cube in potable water. When compressive strength of both the cubes was checked then it was observed that the compressive strength of cube whose curing is done with treated waste water is more than other cube. Its strength is 1.5% more than the cube whose curing is done in potable water after 28 days. Results of the study were shown in Fig.2.1 and Fig. 2.2.

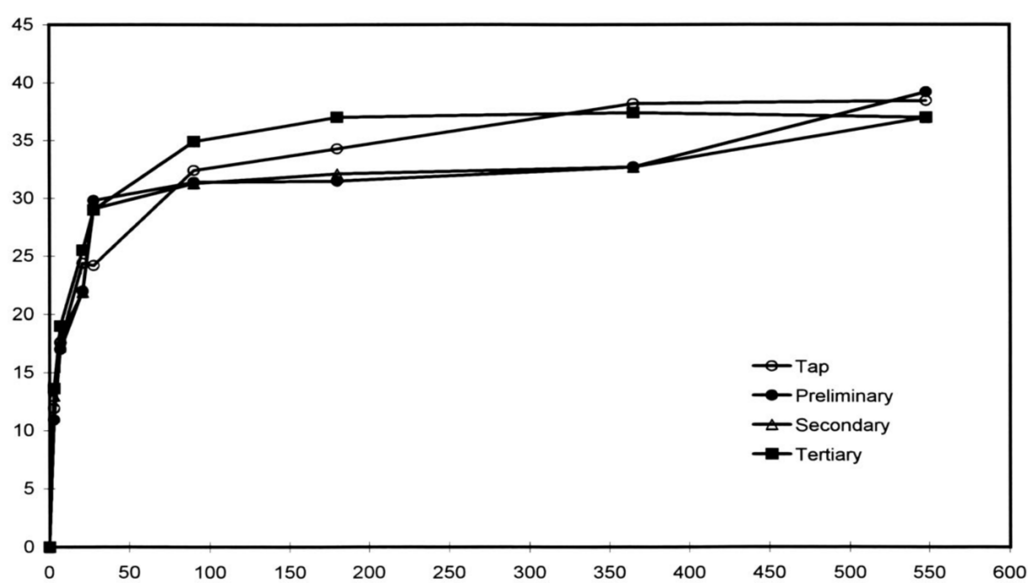

Fig 2.1 Compressive strength development for different type of concrete

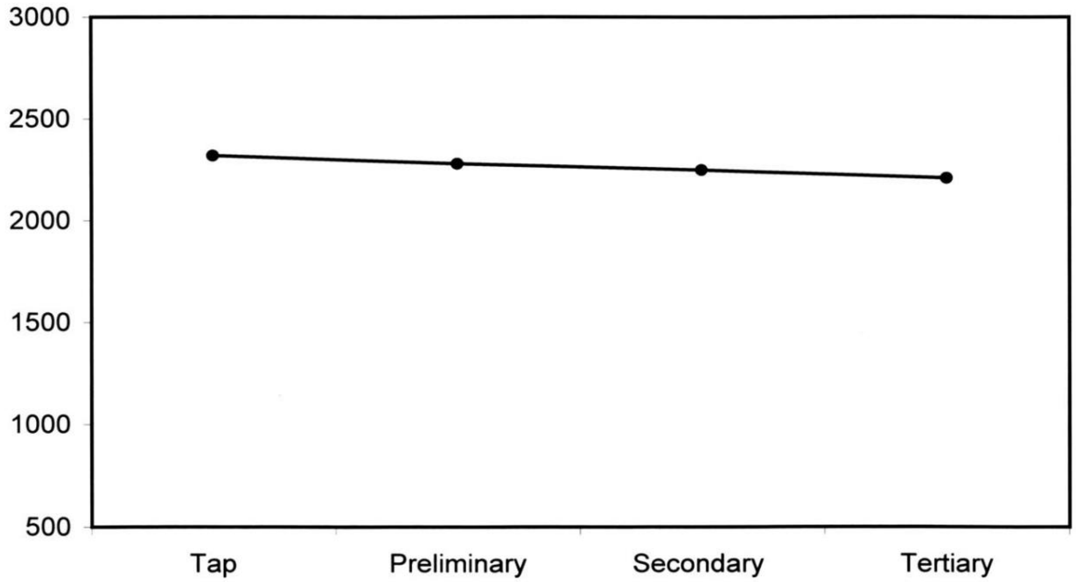

Fig 2.2 Effect of mixing water on concrete density

Al Yague et al.(2003) conducted a study to check the durability of concrete with the addition of dry sludge from waste water treatment plant. A sample was made which corresponds to a mass concrete of 25 MPa with characteristics strength, a soft consistency and a maximum aggregate size of 20mm .

Wet-Dry cycles in fresh water, sea water and water containing 5% K_2SO_4- Rather then having the specimen submerged constantly, wet dry cycle was choosen. With this procedure, there are three different solutions and consisted of 7 cycles of 28 days each. From the moisture chambers, the specimens were removed after 28 days and allowed to dry for 2 days. Then sample is submerged in an appropriate type of solution for 5 days. After 5 days, sample is dried for 2 days in lab and submerged again for 5 days. After 5 days, sample is again dried for 2 days in lab and submerged again for 12 days and calculated saturated weight of the specimen, the specimen with a 10% sludge content subjected to a standard curing, then strength of 20 MPa is obtained after 7 months and value of those which were treated with sulphate is increased by 25%.

Accelerated ageing cycles in an autoclave- A specimen was prepared using an autoclave. The specimen was heated up in an autoclave at a pressure of 0.2 MPa after 28 days of curing. One of the dimension of specimen was measured after curing and soaked for 48 hrs. After 4hrs of heating in an autoclave, the specimens were left to cool for 20 hrs and measured the change in the dimension using comparator. This procedure is repeated three times with same dimension of specimens. The difference in the shrinkage being very small in the concrete not containing sludge and 2.5% sludge and after 28 days of curing, shrinkage was minimum and there was no expansion in the concrete was observed in spite of drastic condition in test.

Accelerated carbonation- After 28 days of curing, the specimen was placed in a container. There were two openings on two opposite sides with stopcock to control the passage of CO_2 rich mixture. Cap was sealed so that only CO_2 rich mixture could enter. For the circulation of the mixture and to replace the air stopcocks were opened for 3 minutes. After that stopcocks were closed and specimens were immersed in a CO_2 rich mixture. This process was repeated for 3 days. After 30 and 60 days if immersion, the sample was broken using steel bars and surface of the breaks was painted with a phenolphthalein. In some areas of the specimen, phenolphthalein was colorless and in some areas phenolphthalein was colored. The rate and depth of advanced carbonation in the sample were obtained with the comparison in the colored and colorless specimens.

Rao et al.(2007) conducted a study used the industrial waste water for the mixing in the cement and check the effects on the constituents. They were used the deionised water (DI), industrial water and tap water for the casting and check there strength for the compressive and flexural also .As we know that the population in the India increase day by day and decreasing the portable water so that H. Surdarsana Rao used the industrial waste water for the construction purposes. But due to heavy metals were show in the waste water which effect to the setting time and hardening properties of the concrete .They were used the 43 grade ordinary Portland cement and different percentage of the cement as given by the IS: 456 -2000.

The properties of the fine and coarse aggregates were analysed and the cement to fine aggregates ratio was maintained at 1:3 for the casting purposes. The effects of waste water on the cubes were test for the different days and check the soundness , setting time , density. If the setting time was less then 30 min so that the change were considered as the insignificant and if the setting time was more then 30 min then change were considered as the significant. So that we can take the average value of the cubes .Initial and final setting time were increased when treated paint industrial waste water (TPIWW) replaced with the deionised water (DW) in the cement paste.Several types of impurities i.e. heavy metal concentration in the industrial waste water which are presented in Table 2.2.

Table 2.2 Impurities in water and there standard

Impurity Mg/l	**Tap Water (TW)**	**TPIWW standards as per CPCB**	**Existing concentrations in TPIWW**
Sulphate	15	_	_
Chloride	45	_	_
Zinc (Zn)	_	5.0	7.8
Copper (Cu)	_	2.0	4.5
Nickel (Ni)	_	2.0	5.2
Lead (Pb)	_	0.1	1.0

These are the some heavy metals which effect or decrease the compressive and flexural strength up to 90 days and then the strength were increased slightly more then the reference specimens. From the investigation it was conclude that there will be no effects on the density by mixing of different waste water. This was confirm the feasibility of using the treated paint industrial waste water (TPIWW) in cement mortar and the heavy metals positively interact with the cement mortar.

Chatveera et al.(2009) conducted a study based on the use of ready mix concrete plant sludge water in concrete containing an additive or admixture. Materials used in the study were cement (A standard Type 1 Portland Cement) , Mixing Water (tap water and sludge water obtained from a ready mix concrete plant) , Aggregates (the coarse aggregates was crushed limestone with a maximum size of 20mm and water absorption of 0.57%, the fine aggregates was river sand with a fineness modulus of 2.53 and water absorption of 0.71%) .

After this, basic properties like physical and chemical properties of mixing water were tested. Cement paste specimens were tested for properties of sludge water. Sludge water samples were passed through 0.30 mm sieve to maintain homogeneity. Specific Gravity and Total Solid Content were measured using 0.01g precision scale. Tap water was mixed with sample water to prepare a specimen with 0.5, 2.5, 7.5, 10, 12.5 or 15% Total Solid Content and W/c ratio of 0.3 was maintained for all the cement ratios. 7 day compressive strength test and initial and final setting time test were performed according to ASTM C109 (2004). From all this study, it was noticed that the slump of all the mixture lies between 8.0 to 9.3cm. The water requirements of every mixture were compared with control mix to determine the efficiency of water reduction when sludge water was used. The initial and final setting times were approximately 20 minutes longer than normal control mix. The compressive strength is increased as compared with control mixes.

Reddy et al.(2010) conducted a study based on the effects of heavy metals present in the mixing water of the cement mortar. Two specimens were made with two different water samples i.e one sample with deionised water and other sample with lead spiked demonized water. Comparison of strengths between these two samples shows that there was loss in strength having higher concentration of lead. These samples also shows that there is little increase in the setting time. Based on the study, it was concluded that when concentration of lead was above 3000 mg/litre , there is significant increase in the setting time. It was also concluded that when lead concentration of mixing water was 2000 mg/litre, early days compressive strength was less as compared with normal mix. But, there was little increased in the compressive strength of the mix. This study shows that lead concentration up to 2000 mg/lit. influence positively on the different properties of the mix.

Raman et al.(2011) conducted a study based on the effect of the heavy metals like lead (Pb) in the mixing of the water on compressive strength of concrete mix. As we know that the water has both beneficial and detrimental effects on the concrete. However the non portable water i.e.

industrial waste water presents the heavy metals like (Hg, Cu, Zn, Ni, Pb etc.) so that during the curing process the heavy metal presents on the surface of the concrete specimens after water evaporation which can be effect to the compressive strength of the concrete. In this if the initial and final setting time increase if the lead amount increase. At the maximum concentration of 5000 mg/l the test samples 67 min increase the initial setting time and the 74 min increase the final setting time which can be compared with the references specimens. For the concentration of the 500 mg/l .It was observed that the compressive strength for the 3 days of the specimens decrease slightly up to 2.4 % and for the concentration of 2000 mg/l the strength of 3 and 7 days decrease starting but after the 28 days of curing period the compressive strength was increase 1.82 % compared with the reference specimens. Based on the investigation and results it was concluded that the concentration 3000 mg/l and more the setting will be increase and the presence of lead in the water can we decrease the compressive strength of the concrete.

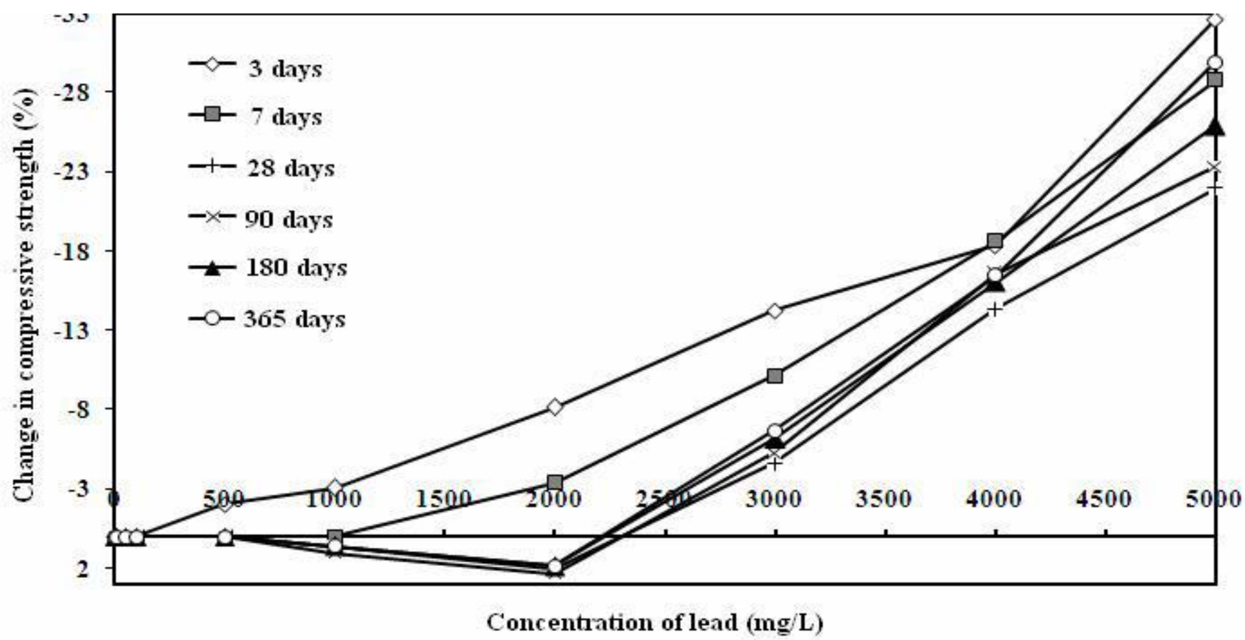

Fig 2.3 Change in the compressive strength of mortar specimens at different ages

Reddy et al.(2013) demonstrated that the heavy metals like zinc, magnesium sulphate present in the domestic waste which adversely affect to the compressive strength of the mix.From the testing of we get copper, nickel, iron, aluminium in the sample. Which also affect to the reinforcement in the concrete and decrease strength of the reinforcement which causes to collapse the structure after some times. 150 x 150 x 150 mm size of specimens were cast and check their strength for different days. Finally based on the investigation it was concluded that the starting day compressive strength was slow but after 28 days of curing they achived the targeted strength. Results of the study were shown in Fig 2.4 and Fig. 2.5.

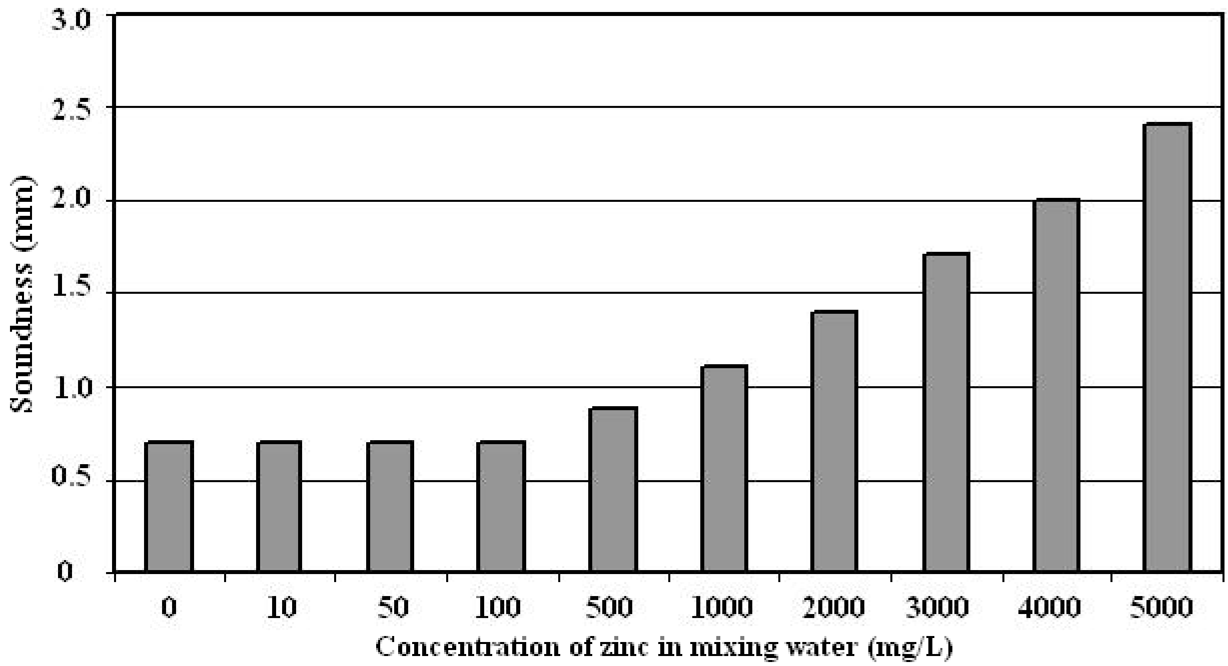

Fig 2.4 Effect of zinc on soundness of blended cement

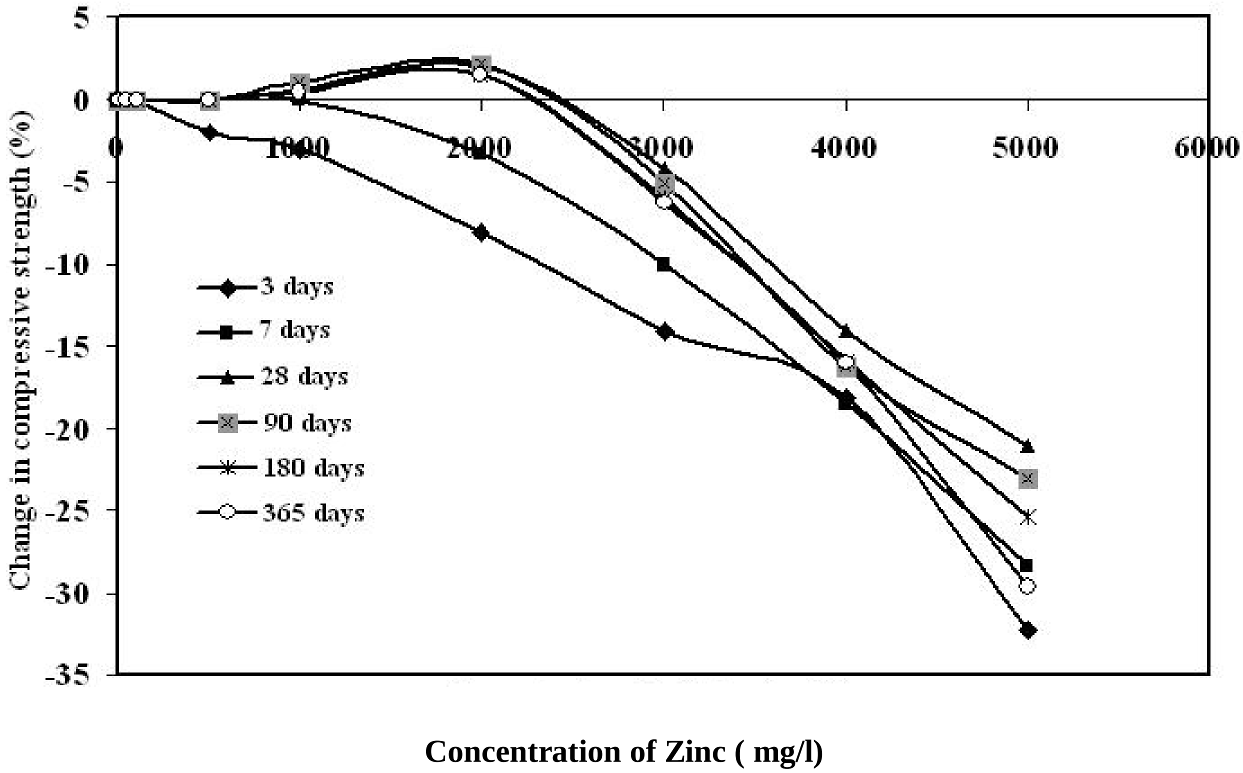

Fig 2.5 Change in the compressive strength with change in the zinc concentration

Asadollah et al. (2015) conducted a study based on using wash water from ready mix concrete trucks and a batching plant in the production of fresh concrete. Following experiments were carried out to analyze the quality of required material in the production of concrete: Physical and Chemical analysis of water and concrete fresh water, sieve analysis of the aggregates. By using a Los Angeles machine, the resistances of degradation in large size coarse aggregates were tested by abrasion and impact. By use of sodium sulfate or magnesium sulfate, soundness of the aggregates were examined. By using Vicat's apparatus , an autoclave expansion of hydraulic cement, the amount of water required for normal consistency of hydraulic cement paste and setting time of hydraulic cement. From Saveh cement factory, type 2 Portland cement produced was used to make concrete. Five types of water with different proportions which included 100% tap water, 70% tap water plus 30% concrete wash water, 50% tap water plus 50% concrete wash water, 30% tap water plus 70% concrete wash water, 100% concrete wash water were chosen to produce samples. After that according to ASTM C127 and ASTM C128, density of material was examined.

A duplicate concrete sample of dimension 150*150*150mm including 300,350 and 400 kg cement per cubic meter were made. Samples were made with different proportion of super plasticizers and different proportions of micro silica. Following tests were performed to assess the concrete samples: Slump, 42 days flexural strength, 28 days tensile strength, compressive strength at different ages and depth of penetration of water under pressure.With the help of this study, it was examined that compressive strength of concrete having 50% tap water and 50% concrete wash water was maximum and compressive strength of concrete having 100% concrete wash water was minimum. The workability of all the samples varied between 12cm and 15cm. It was also indicated that concrete wash water did not alter the flexural strength and tensile strength drastically. From all the result, it was indicated that concrete wash water might be practicable to use in production of fresh concrete.

Gadzama et al.(2015) conducted a test to utilized the waste water from savannah sugar factory which was used for the concrete curing purpose. The sugar waste water from the factory was found to be acidic and there were different types of heavy metal present, which effects on the compressive strength on concrete. According to Ashworth (1965) if the small amount of sugar (0.005 percent of mass of cement) will act as an acceptable retarder. When sugar is used as a controlled set retarder, early strength of concrete was severely reduced but beyond about 7 days, there is an increase in strength of several percent compared with non retarded mix. Concrete cubes were caste using tab water, Preliminary treated waste water, Secondary treated waste water, and Tertiary treated waste water. The Preliminary treated waste water and secondary treated waste water were effects on the retarding setting time. The TTWW also effect on the corrosion increased with the use of STWW and PTWW especially when a thinner cover to the reinforcing steel. They concluded that, if the pH value of water increase, the strength of concrete also reduces. The result was compared with that of portable water.

According to B.S.1881, casting, compacting and curing were accomplished. 36 cubes of dimensions 100mm*100mm*100mm were caste to determine the compressive strength of the mix. The cubes were caste immediately after the curing. 36 prisms of dimensions 70mm*70mm*380mm were caste for the determinations of flexural strength. According to

Ismail et al(2011) conduct a study based on assessing the recycling potential of industrial waste water to replace fresh water in concrete mixes. In the study, two types of concrete mixes (i.e. control mixes and PVAW concrete mixes) were prepared and designed in accordance with

ACI211.1.91. The control mix consisted of cement, sand, gravel, fresh water with a water cement ratio 0.40. In the PVAW concrete mix, fresh water was replaced using similar ratio of 0.40. Some other concrete mixes were also prepared by using different ratios i.e. 0.3, 0.35, 0.45, 0.50. Due to the high fluidity of mix having ratio 0.5 was not considered for further tests. After this, all the specimens were tested for the fundamental mechanical properties after 7 and 28 days of curing. BS1881, slump and hard density tests were accomplished. According to ASTM C293, flexural strength test were conducted using a 10 KN proving ring capacity and 0.01mm dial gauge.

From all these study, it is resulted that maximum slump was obtained on the concrete mix of ratio 0.35. After the ratio of 0.35, it decreases after 7 days or 28 days. Hard density test results revealed us that there is increment with the increase PVAW/c ratio after 7 days and 28 days curing. For the compressive strength test, it can be noticed that the compressive strength of PVAW mixes were nearer or higher than normal control mix after 7 days and 28 days curing. Thus it was noticed that there is no adverse effect of PVAW on the compressive strength of the concrete. For the Flexural strength test, it can be noticed that there is decrease with the increase in the PVAW/c ratio.

Ghrair et al.(2016) conducted a study based on influence of grey matter on physical and mechanical properties of mortar and concrete mixes. In the study, mix was designed according to proportion suggested by Jordanian standards. One sample is control mix i.e. with distilled water and two samples with two types of grey water. All the components in the mixture were kept constant except water type, which was added to obtain the same workability as the control mix in each sample. Flow table was used as a workability indicator for every mix during the design process. The mixing was performed according to BS-EN 196-1. After preparation of mixes, moulds were filled and compacted by Jolting table. After that, molds were covered with glass plate and kept in moisture curing cabinet at standard conditions at 20 C and R.H.>90% for 24 hrs. After 24 hrs curing process was started under standard temperature. For curing purpose, normal tap water was used and 24 prisms of dimensions 40mm*40mm*160mm were caste for each mortar mix.

Ramana et al.(2016) conducted study to the feasibility of waste water from small scale water treatment plant located in residential building and mix with the Ordinary Portland Cement (OPC).Most of the codes used the tap water or portable water for mixing and curing purposed. The aim of this work was to study the feasibility of waste water from a small scale water treatment plants. Fifteen samples were prepared and tested their initial and final setting time with the help of Vicat's apparatus. The quantity of cement, sand and mixing water for each specimen were 200g, 600g. Sixty mortar cubes with 50cm^2 cross sectional area and same number of square of 10X2.5X2.5 cm were cast for compressive and flexural strengths. Tests were performed at 3 days, 7 days, 28 days, and 90 days for compressive and flexural strengths. After 24 hours all specimens were to immersion and curing was continued remaining 27 days.

In India there was large amount of waste water is generating. Ramana et al.(2016) show different graphs for different test was conducted and show how graphs changed for setting time, compressive strength workability etc. The following conclusions was drawn on the basis of the results that the compressive and flexural strengths of the samples was less than the inferences available in the IS Code: 456-2000 and BS:3148-1980.

CHAPTER -3

METHODOLOGY OF THE STUDY

3.1 General

In this chapter, we look at the methods to be used in the effort to utilized waste water in concrete and compare properties and strength of both mixes i.e. conventional mix and other mix is with waste water. Consequently, we can check the properties of waste water if it can we used for construction purposes or not.

3.2 MATERIALS

The materials required for the cement and concrete testing are represented in Table 3.1

Table 3.1 Material required for cement and concrete testing.

Sr. No.	Material
1.	Cement (OPC)
2.	Coarse Aggregate
3.	Fine Aggregate

3.3 EQUIPMENTS USED

Preparation of cement and concrete samples required following equipment which are represented in Table 3.2

Table 3.2 Equipment used for preparation of Cement and Concrete samples.

Sr. No.	Equipment	Purpose
1.	Trowel	Gauging
2.	Tamping Rod	Compaction
3.	Measuring Cylinder	Measuring Water
4.	Sieve	Gradation of Material according to their particle size
5.	Weighing Balance	Weighing Materials
6.	Stop Watch	Note Down Time
7.	Vibration Machine	Compaction of Concrete

3.4 METHODOLOGY OF THE STUDY

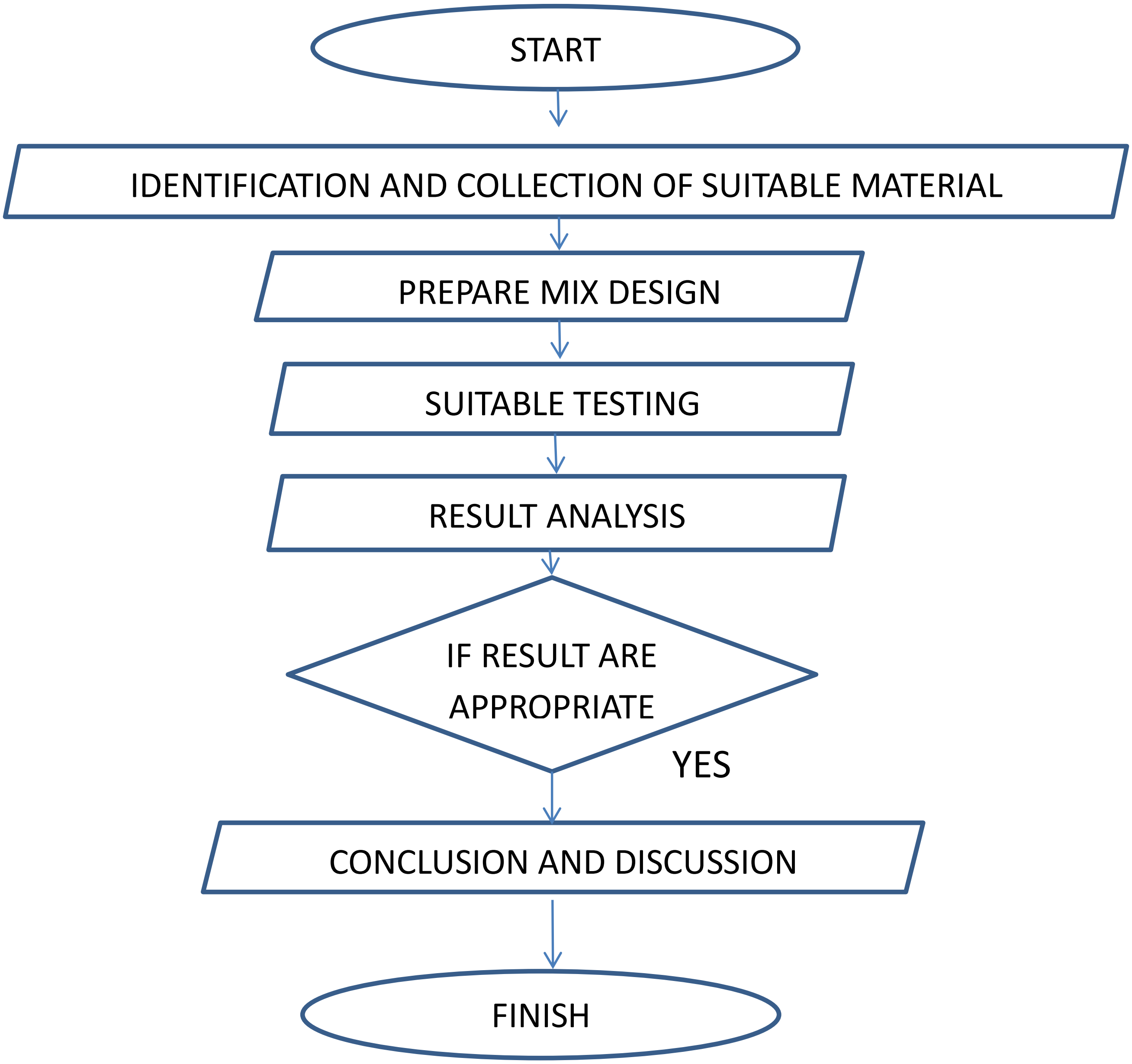

Fig 3.1 Flow chart of methodology

3.5 TESTING OF WASTE WATER

Different test was conducted for the waste water which used for the curing purpose and the tests are followings:-

1) pH test for waste water:-

Using pH papers:-

Dip a wide -range (0-14) pH-strip (paper) into the solutions whose pH to be found .The color of the litmus paper changes to thick red highly acidic waters to dark green for highly alkaline waters and any other color depending on the pH of the solution as shown in Fig.3.2 and results are shown in table 3.3

So that we take some amount of waste water into the weaker and dip the litmus paper into them and check the color change it was dark green it means solution was highly alkaline water.

Table 3.3 pH value at different percent of waste water

Different samples	**pH value**
50% waste water/50% normal water	10.3
40% waste water/60% normal water	9.2
30% waste water/70% normal water	8.5
20% waste water/80% normal water	7.9

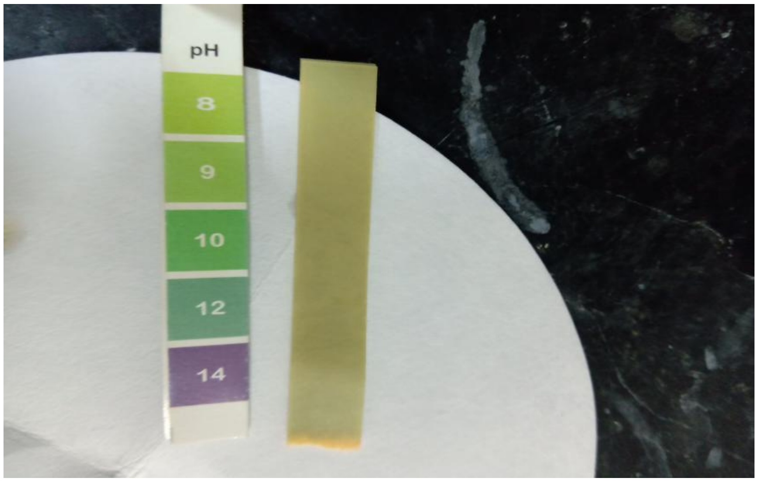

Fig 3.2 Find pH value by litmus paper

2) Alkalinity of given water sample:-

Procedure- We took 50ml of sample in a conical flask and put 2 drops of phenolphthalein indicator in it. After that, there is no change in the colour of the solution which shows us that phenolphthalein alkalinity is zero. Then we took another 50ml sample in a conical flask and put 2 drops of methyl orange indicator in it. Due to this, the sample turns yellow. Then, we titrate this solution with H_2SO_4 solution as shown in Fig.3.3 and note the volume. Results of this test are shown in table 3.4

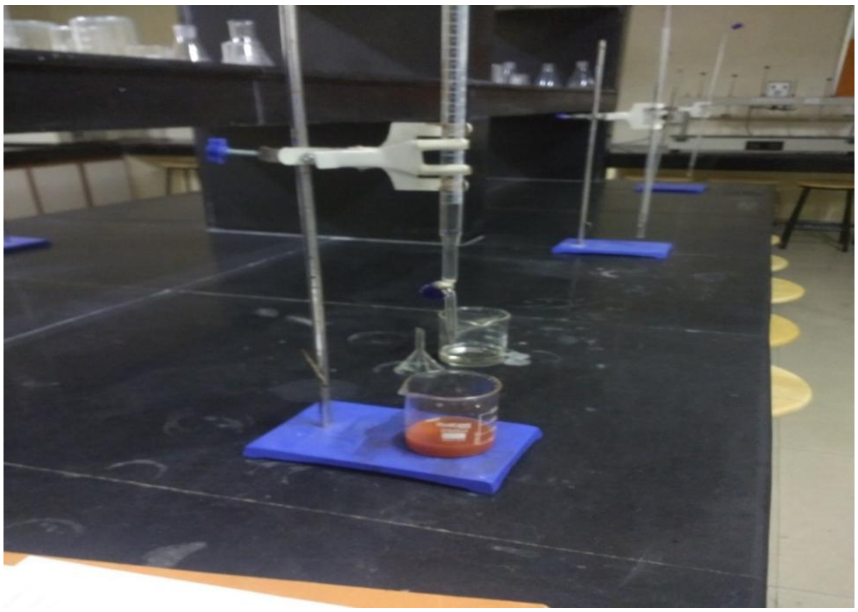

Fig 3.3 Titration of Alkalinity sample

Table 3.4 Alkalinity value at different % of waste water

Different Samples	Alkalinity (mg/lt.)
50% waste water/50% normal water	202
40% waste water/60% normal water	155
30% waste water/70% normal water	124
20% waste water/80% normal water	95

3) **Concentration of chlorides in given sample of water:-**

Procedure-

We took 50ml of sample in a conical flask and add potassium chromate indicator to get light yellow colour. Then we titrate it with standard silver nitrate solution till the colour changes from yellow to brick red as shown in Fig.3.4 and note the volume of the silver nitrate added. Chloride concentration of all the sample are tabulated in table 3.5

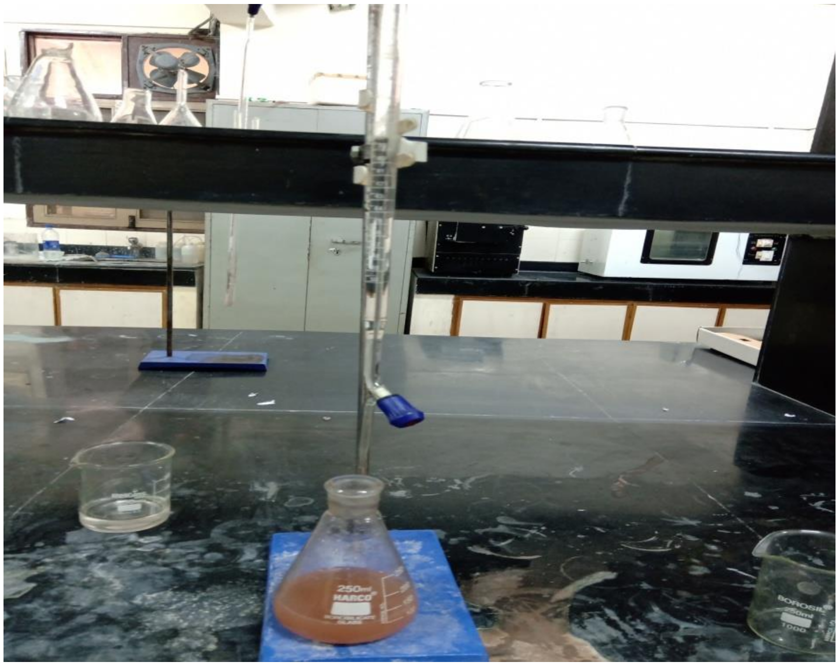

Fig 3.4 Titration of chloride content

Table 3.5 Chloride concentration in different percentage

Different Samples	**Chloride Concentration (mg/lt.)**
50% waste water/50% normal water	149
40% waste water/60% normal water	137
30% waste water/70% normal water	128
20% waste water/80% normal water	121

4) **Turbidity of sample water:-**

Procedure- First we switch on Naphelometeric turbidity meter to warms it up. Now this meter was calibrated with standard suspension. Now sample was shakened and put in the sample chamber and took the value on the scale as tabulated in table 3.6

Table 3.6 Turbidity values in waste water

Different Samples	**Turbidity (NTU)**
50% waste water/50% normal water	87
40% waste water/60% normal water	72
30% waste water/70% normal water	45
20% waste water/80% normal water	22

5) Specific Conductivity of sample water

Procedure-First we switch on the conductivity meter for 15 minutes. We washed the conductivity cell with distilled water and wipe it dry with a tissue paper. Then cell was calibrated with 0.1N KCl solution of conductivity 14.12 mmhos at 30^0C. Now we dipped the cell in the sample for 1minute and note the instrument reading which are shown in table no 3.7

Table 3.7 Specific conductivity value for different % for sample

Different Samples	**Specific Conductivity (millimoles)**
50% waste water/50% normal water	0.612
40% waste water/60% normal water	0.584
30% waste water/70% normal water	0.529
20% waste water/80% normal water	0.473

6) Specific Gravity of sample water

Procedure – First we took the sample water from the source and fill the specific gravity bottle with the sample and weigh it as shown in Fig.3.5. Then we fill the specific gravity bottle with distilled water having equal volume . Results of this test is shown in Table 3.8

Specific Gravity = Weight of sample water /Weight of distilled water

Fig 3.5 Specific gravity bottle filled with water

Table 3.8 Specific gravity for waste water sample

Different Samples	**Specific Gravity**
50% waste water/50% normal water	1.002
40% waste water/60% normal water	1.0015
30% waste water/70% normal water	1.0012
20% waste water/80% normal water	1.0008

7) Determination of Total Solids

Procedure –

First we took a clean porcelain dish and wash it. Then we dried it and put in an oven for 2 hrs. at 105^0 C. After 2 hrs. we weight (W1) that dish and then put 50 ml (V) of sample water in it. After that, we put the dish in the oven for 2-3 hrs. at 105ºC. Then we put that dish in the desiccators for cooling. We weight (W2) the dish with the sample and calculate by using formula as given below and concentration is shown in Table 3.9

$$\text{Total Solids} = (1000*1000(W2-W1))/V$$

Table 3.9 Solid particles present in sample

Different Samples	**Total Solids (mg/lit.)**
50% waste water/50% normal water	1042
40% waste water/60% normal water	1014
30% waste water/70% normal water	997
20% waste water/80% normal water	985

8) Determination of Total Dissolved Solids

Procedure – We took a filter paper and weigh (W1) it. Then we filter our sample water from this filter paper and put in the oven for 24 hrs. at 103-105ºC. After 24 hrs. weigh the filter paper (W2) as shown in Fig. 3.6 and calculate using formula as mentioned below. Results of the tests were shown in Table 3.10

$$\text{Total Dissolved Solids} = W2-W1$$

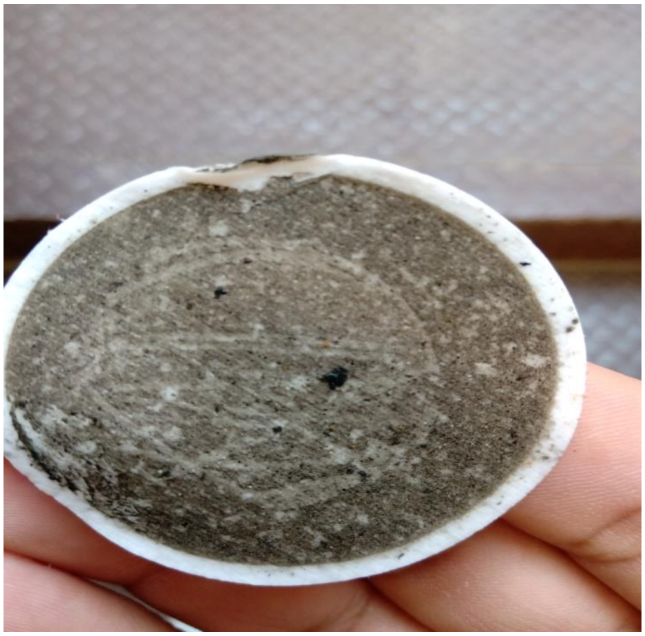

Fig 3.6 Filtration of solid particles from waste water

Table 3.10 Total Dissolved Solids present in domestic waste water

Different Samples	**Total Dissolved Solids (mg/lit.)**
50% waste water/50% normal water	813
40% waste water/60% normal water	798
30% waste water/70% normal water	782
20% waste water/80% normal water	772

9) Determination of Total suspended Solids

Total Suspended Solids = Total Solids-Total Dissolved Solids. Results of the samples were shown in Table 3.11

Table 3.11 Total Suspended Solids for the sample

Different Samples	**Total Suspended Solids (mg/lit.)**
50% waste water/50% normal water	229
40% waste water/60% normal water	216
30% waste water/70% normal water	215
20% waste water/80% normal water	213

3.7) Metal Detection analysis of the waste water

Steps for the metal detection analysis are the followings:

1) Collections of waste water samples from the STP Waknaghat Solan (Sewage Treatment Plant) shown in Fig. 3.7

Fig 3.7 Source of waster water

Fig 3.8 Filtration of waste water

2) Filtration process is done by using filter paper of size 0.42 and 0.45 as shown in Fig. 3.8 .

3) We took 50 ml sample of waste water for the metal detection analysis process.

4) We used the AAS (Atomic absorption spectroscopy) to find the concentrations of heavy metals.

3.6 Atomic Absorption Spectroscopy

The AAS (as shown in Fig. 3.9) was largely developed during the 1950s and it is the most common method used for detection of metals. In this system, flames are used as the most common atomizer .

Acetylene(C_2H_2) gas is used as a fuel source and Air is used as an oxidant in AAS system.

There are two flames in AAS system. One is Air Acetylene flame of temperature about 2300^o C and other is nitrous oxide(N_2O) -acetylene flames of temperature about 2700^o C.

The length of the these flames is approximately 5-10 cm as shown in Fig. 3.10.

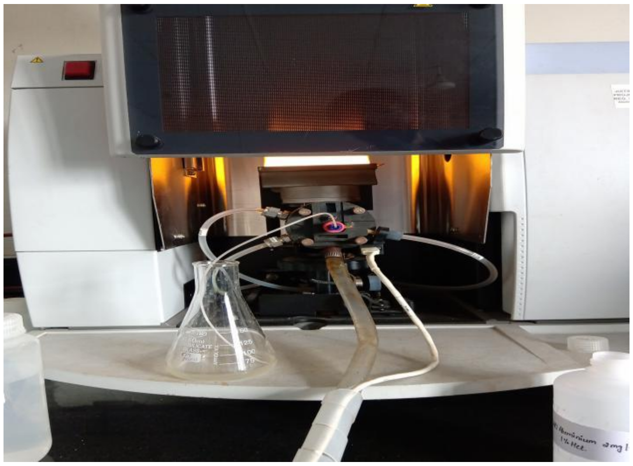

Fig 3.9 Atomic Absorption Spectroscopy machine **Fig 3.10** Flames during testing of waste water

'WinLab 32 AA flame' software is used in AAS to calculate the concentration of metals in the given sample.

(1.) Detection of Copper metal

Procedure- We took 50ml of sample in a conical flask. Then we made 3 standard sample to calibrate the machine of different concentration by using these solution shown in table no. 3.12

Table 3.12 Making standard solution of HNO_3

S.No.	Concentration of 2 mg/lit.	Concentration of 5 mg/lit.	Concentration of 15 mg/lit.
1% of HNO_3	49.90 ml	49.75 ml	49.25 ml
Copper Atomic Absorption standard solution	0.10 ml	0.25 ml	0.75 ml

Then we calibrate the machine with these samples. After calibration, we check the reading of the ASS of our sample water as shown in Fig. 3.11 and Fig.3.12 and calculated concentration were shown in Table3.13..

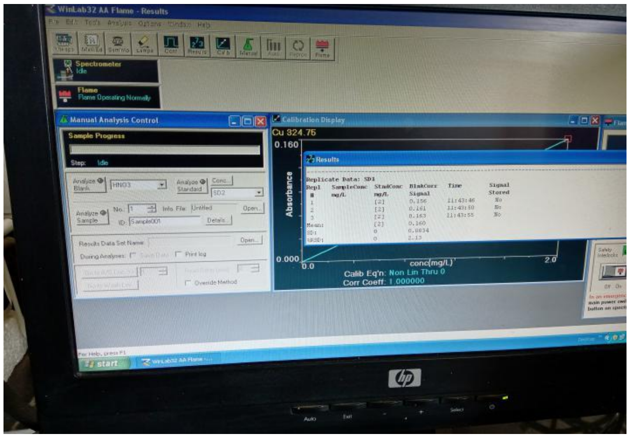

Fig 3.11 Mean value of copper metal

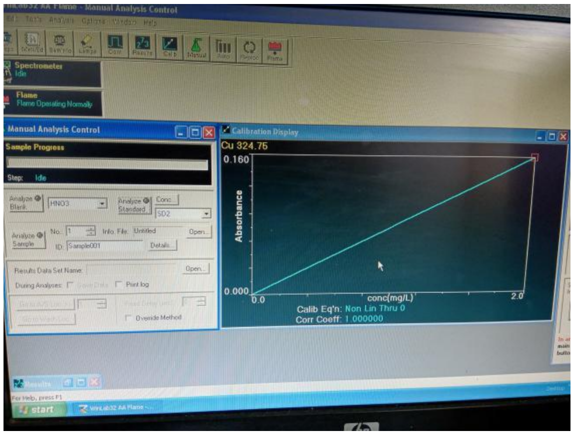

Fig 3.12 Graph of copper metal

Table 3.13 Atomic Absorption Spectroscopy reading for copper

S.No.	AAS Reading (mg/lit.)
(1.)	2.172
(2.)	1.830
(3.)	1.739

Mean Reading = (2.172+1.830+1.739)/3 = 1.914 mg/lit.

Copper Content = (C*V)/1000 = (1.914*50)/1000

= 0.0957 mg/ml

(2.) Detection of Iron metal

Procedure- We took 50ml of sample in a conical flask. Then we made 3 standard sample to calibrate the machine of different concentration by using these solution as shown in table no 3.14

Table 3.14 Concentration of 1% of HNO_3 Iron

S. No.	**Concentration of 2 mg/lit.**	**Concentration of 5 mg/lit.**	**Concentration of 15 mg/lit.**
1% of HNO_3	49.90 ml	49.75 ml	49.25 ml
Iron Atomic Absorption standard solution	0.10 ml	0.25 ml	0.75 ml

Then we calibrate the machine with these samples. After calibration, we check the reading of the ASS of our sample water and calculated concentration was shown in Table 3.15.

Table 3.15 Atomic Absorption Spectroscopy results for Iron

S.No.	**AAS Reading (mg/lit.)**
(1.)	0.339
(2.)	0.403
(3.)	0.377

Mean = (0.339+0.403+0.377)/3 = 0.373

Iron Content = (C*V)/1000 = (0.373*50)/1000

= 0.01865 mg/ml

(3.) Detection of Zinc metal

Procedure- We took 50ml of sample in a conical flask. Then we made 3 standard sample to calibrate the machine of different concentration by using these solution as shown in Table 3.16.

Table 3.16 Making standard solution for Zinc

S.No.	**Concentration of 1 mg/lit.**
1% of HCl	49.95 ml
Zinc Atomic absorption standard solution	0.05 ml

Then we calibrate the machine with these samples. After calibration, we check the reading of the ASS of sample water as shown in Fig.3.13 and calculate concentration .

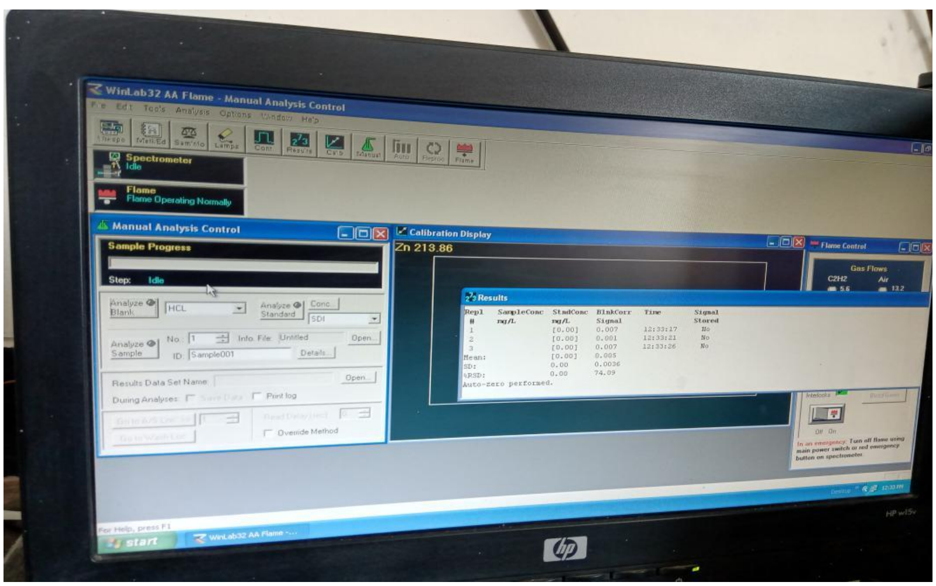

Fig 3.13 Showing the mean value of Zinc metals

Then we calibrate the machine with these samples. After calibration, we check the reading of the ASS of our sample water and calculated concentration were shown in Table 3.17.

Table 3.17 Atomic Absorption Spectroscopy results for Zinc

S.No.	AAS Reading (mg/lit.)
(1.)	0.314
(2.)	0.153
(3.)	0.135

Mean = (0.314+0.153+0.135)/3 = 0.201 mg/lit.

Zinc Content = (0.201*50)/1000

= 0.01005 mg/ml

(4.) Detection of Nickel metal

Procedure- We took 50ml of sample in a conical flask. Then we made 3 standard sample to calibrate the machine of different concentration by using these solution were shown in Table 3.18.

Table 3.18 Making standard solution for Nickel

S.No.	**Concentration of 2 mg/lit.**	**Concentration of 5 mg/lit.**	**Concentration of 15 mg/lit.**
1% of HNO_3	49.90 ml	49.75 ml	49.25 ml
Nickel Atomic Absorption standard solution	0.10 ml	0.25 ml	0.75 ml

Then we calibrate the machine with these samples. After calibration, we check the reading of the ASS of our sample water and calculate the concentration. Then we calibrate the machine with these samples. After calibration, we check the reading of the ASS of our sample water and calculated concentration were shown in Table 3.19.

Table 3.19 Atomic Absorption Spectroscopy results for Nickel

S.No.	AAS Reading (mg/lit.)
(1.)	2.125
(2.)	2.198
(3.)	2.166

Mean = (2.125+2.198+2.166)/3 = 2.163 mg/lit.

Nickel Content = (2.163*50)/1000

= 0.10815 mg/ml

(5.)Detection of Aluminium metal

Procedure- We took 50ml of sample in a conical flask. Then we made 3 standard sample to calibrate the machine of different concentration by using these solution were shown in Table 3.20.

Table 3.20 Making standard solution for Aluminium metal

S. No.	Concentration of 2 mg/lit.	Concentration of 5 mg/lit.	Concentration of 15 mg/lit.
1% of HNO_3	49.90 ml	49.75 ml	49.25 ml
Aluminium Atomic Absorption standard solution	0.10 ml	0.25 ml	0.75 ml

Then we calibrate the machine with these samples. After calibration, we check the reading of the ASS of our sample water and calculated concentration as shown in Fig. 3.14.

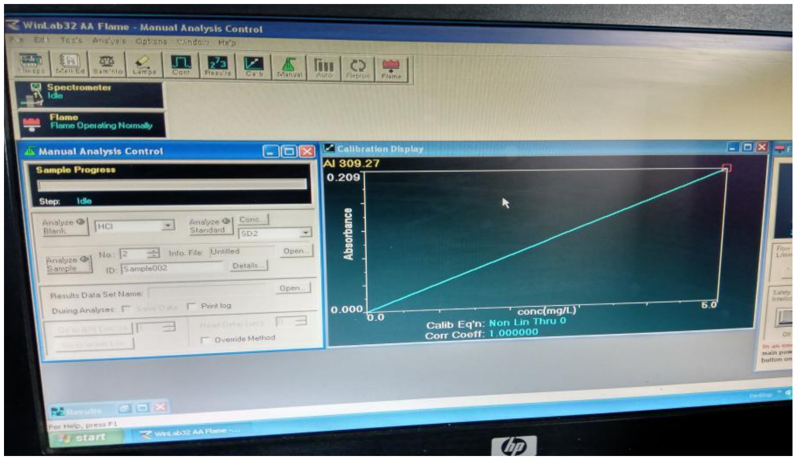

Fig 3.14 Showing graph of aluminium metal

Then we calibrate the machine with these samples. After calibration, we check the reading of the ASS of our sample water and calculate the concentration. AAS results are tabulated in Table 3.21.

Table 3.21 Atomic Absorption Spectroscopy results for Aluminium

S.No.	**AAS Reading (mg/lit.)**
(1.)	4.992
(2.)	4.998
(3.)	4.987

Mean = (4.992+4.998+4.987)/3 = 4.992

Metal Content = (C*V)/1000 = (4.992*50)/1000

=0.2496 mg/ml

3.8 Testing of construction materials

1) Specific gravity of sand

Specific gravity of sand calculated by using the Pycnometer method

Empty weight of Pycnometer (W1) = 607.3 g

Pycnometer + Sand (W2) = 807.5g

Pycnometer + Sand + Water (W3) = 1690.1g

Pycnometer + Water (W4) = 1573.8g

Specific gravity of sand = W2 - W1/(W4 - W1)- (W3 - W2)

=2.5

2) Normal Consistency Test

The consistency of cement test follows the IS 4031 (4) -1988. The test for determining the consistency of cement was performed using Vicat’s apparatus and consistency plunger. The water paste of cement was prepared using the waste water mix and was filled in the Vicat’s mould. The water cement ratio was taken as 25%. The gauging time should not be more than 5 minutes and should not be less than 3 minutes. The penetration value should lie between 7 to 5 mm and that water percentage is considered as consistency of cement.

Weight of cement = 400g

Water Required = 100 ml

Normal Consistency (P) = 35.5%

3) Initial & Final setting time

The initial & final setting time test for cement follows IS 4031 (5) - 1988. The test for determining the initial and final setting time of cement was performed using vicat’s apparatus and setting time needles. The water must be added “0.85P” by weight of cement, where “P” is the standard consistency of cement. The initial setting time of cement was measured using 1mm penetration needle failed to penetrate at 5 -7 mm from bottom of the mould. And, the final setting time of cement is the time at which 1mm penetration needle makes an impression on the mould 5 mm assembly failed to make any impression on the mould.

4) Specific gravity of coarse aggregate

The test for determining the specific gravity of coarse aggregate follows IS 2386 (3) – 1963. Using the wire bucket, the specific gravity test for coarse aggregate was performed.

3.7 PREPARE MIX DESIGN

M30 Grade Concrete for OPC (Ordinary Portland Cement).

Characteristic compressive strength required in the field at 28 days grade designation — M 30

3.7.1Test of material

Specific Gravity of Cement : 3.15

Specific gravity of Fine Aggregate (sand) : 2.70

Specific gravity of Coarse Aggregate : 2.80

Step By Step Procedure For Concrete Mix Design Of M30 Grade Concrete

Determining The Target Strength For Mix Proportioning

F'ck = fck + 1.65 x S

Where,

F'ck = Target average compressive strength at the time period of 28 days

Fck = Characteristic compressive strength at the time period of 28 days

S = Assumed standard deviation in N/mm2 = 5 (as per table -1 of IS 10262- 2009)

= 30 + 1.65 x 5.0 = 38.25 N/mm2

Note : Under control conditions if Target average compressive strength is achieved then at field the probability of getting compressive strength of 30 MPa is very high.

Selection of Water-Cement Ratio:-

In the present study water/cement ratio was finalized based on the guidelines given in the Indian standards (IS 456:2000) as represented in Table no. 3.22.

Table 3.22 Assumed standard deviation value for grade of concrete (IS 456:2000)

S No.	**Grade of concrete**	**Assumed Standard Deviation**
(1.)	M10	3.5
(2.)	M15	3..5
(3.)	M20	4.0
(4.)	M25	4.0
(5.)	M30	5.0
(6.)	M35	5.0
(7.)	M40	5.0
(8.)	M45	5.0
(9.)	M50	5.0
(10.)	M55	5.0

Table 3.23 Water cement ratio for different grades (IS 456:2000)

Minimum grade of concrete	**Maximum free water-cement ratio**
M20	0.55
M25	0.50
M30	0.45
M35	0.4
M40	0.40

We take water – cement ratio = 0.45

As per (IS 456:2000) given in codes as given above in Table 3.23

Selection of Water Content

Maximum water content for 20 mm aggregate = 186 kg (for 25 to 50mm slump)

As per (IS 456:2000) given in codes as tabulated on Table 3.24

Table 3.24 For maximum water content per cubic metre of concrete for nominal maximum size of aggregates

Nominal maximum size of aggregates (mm)	Maximum water content (kg)
10	208
20	186
40	165

We are targeting a 100mm of slump, thus we required to increase the water content. To increase 25mm slump we required to increase water content by 3% and so on

Estimated water content = 186+(6/100) X 186 = 197 litre

Calculation of Cement Content

W-C Ratio = 0.45

Water content from Step – 3 i.e. 197 liters

Cement content = Water content / “w-c ratio” = (197/0.45) = 437.78 kg

From Table 5 of IS 456,

Minimum cement Content for moderate exposure condition = 300 kg/m^3

437.78 kg/m^3 > 300 kg/m^3, hence, OK

Estimation of Concrete Mix Calculations

The mix calculations per unit volume of concrete shall be as follows:

Volume of concrete = 1 m^3

Volume of cement = (Mass of cement / Specific gravity of cement) x (1/100) = (437.78/3.15) x (1/1000) = 0.138 m^3

Volume of water = (Mass of water/Specific gravity of water)*(1/1000)

Table 3.25 Volume of waste water and normal water for concrete mix

Different Samples	**Volume of water**
50% waste water/50% normal water	0.19660m^3
40% waste water/60% normal water	0.19670m^3
30% waste water/70% normal water	0.19676m^3
20% waste water/80% normal water	0.19684m^3

Total Volume of Aggregates = 1- (b+c)

Table 3.26 Volume of aggregate for concrete mix

Different Samples	**Total Volume of aggregates**
50% waste water/50% normal water	0.6654
40% waste water/60% normal water	0.6653
30% waste water/70% normal water	0.66524
20% waste water/80% normal water	0.66516

Mass of coarse aggregates = d X Volume of Coarse Aggregate X Specific Gravity of Coarse Aggregate X 1000

Table 3.27 Mass of coarse aggregate for mix

Different Samples	**Mass of coarse aggregates (kg/m^3)**
50% waste water/50% normal water	1117.872
40% waste water/60% normal water	1117.704
30% waste water/70% normal water	1117.6032
20% waste water/80% normal water	1117.4688

Mass of fine aggregates = d X Volume of Fine Aggregate X Specific Gravity of Coarse Aggregate X 1000

Table 3.28 Mass of fine aggregate for concrete mix

Different Samples	**Mass of fine aggregates**
50% waste water/50% normal water	718.632
40% waste water/60% normal water	718.524
30% waste water/70% normal water	718.4592
20% waste water/80% normal water	718.3728

Concrete Mix Proportions

Table 3.29 Weightage of Aggregate, sand , cement for casting

Different Samples	50% waste water/50% normal water	40% waste water/60% normal water	30% waste water/70% normal water	20% waste water/80% normal water
Cement (kg/m^3)	437.78	437.78	437.78	437.78
Water (kg/m^3)	197	197	197	197
Coarse Aggregates (kg/m^3)	1117.872	1117.704	1117.6032	1117.4688
Fine Aggregates (kg/m^3)	718.632	718.524	718.4592	718.3728
Water/ Cement Ratio	0.45	0.45	0.45	0.45

Fig 3.15 Hand mixing of concrete

Fig3.16 Cubes during in moulds

3.8) Compressive strength of concrete

The test for the compressive strength of concrete blocks can be checked by compression testing machine after 3,7 and 28 days of curing. The concrete cubes are of dimension 150 mm x 150 mm x 150 mm were prepared using mix waste water. Before casting the cubes, the cubes mould should be cleaned properly and coat inside with oil. Waste water is used for curing process. Casted cubes were shown in Fig. 3.16 and Cubes in curing tanks were shown in Fig. 3.17

Fig 3.16 Cubes before the curing process

Fig 3.17 Cubes during curing process

3.9) Flexural Strength of Concrete

Flexural Strength of the concrete is the banding strength which is used to resist the bending od the material. It is very important property of the concrete. We calculate this property by using formula as shown below:

Flexural Strength = $0.7*(Fck)^{1/2}$

Where Fck is Compressive Strength of the concrete

CHAPTER- 4

RESULT ANALYSIS

4.1 GENERAL

Different tests were performed for waste water , cement and mixes (I.e. with varying proportion of waste water and potable water and the results obtained from these tests were compared with the references specimens and check there strength after 3 ,14 and 28 days of curing.

4.2 RESULTS

Different tests were performed for testing OPC and the results obtained from these tests were compared as shown in Table 4.1.

Table 4.1 Values of different results test

S.No.	Experiment	Experimental Values
1	Normal consistency of cement	35.5%
2	Initial setting time of Cement	45 min
3	Final setting time of Cement	610 min
4	Specific Gravity of Cement	3.15
5	Specific Gravity of Fine Aggregate	2.7
6	Specific Gravity of Coarse Aggregate	2.8

4.2 Concrete testing results

Using compression-testing machine after 3 days, 7 and 28 days the compressive strength and flexural strength of the concrete samples (i.e. with varying proportion of waste water and fresh water) were tested as shown in figure 4.1. to 4.10. The result are tabulated in table 4.1 to table 4.5.

Table 4.2 Final results of compressive strength for 50% waste water/50% normal water

S. No.	Days	Compressive Strength (MPa)	Flexural Strength (MPa)
1.	3	17.47	2.92
2.	7	21.35	3.23
3.	28	24.68	3.47

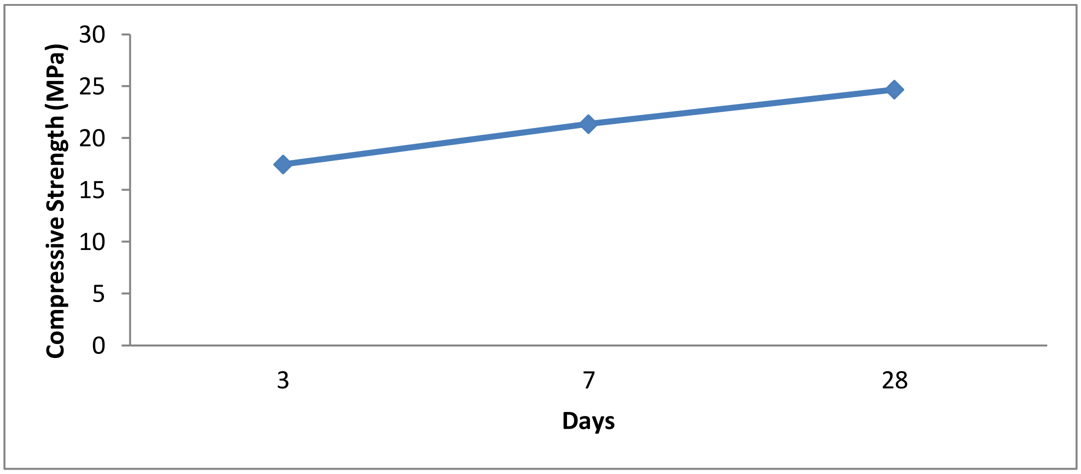

Fig 4.1 Variation in compressive strength with 50% waste water in 50% portable water

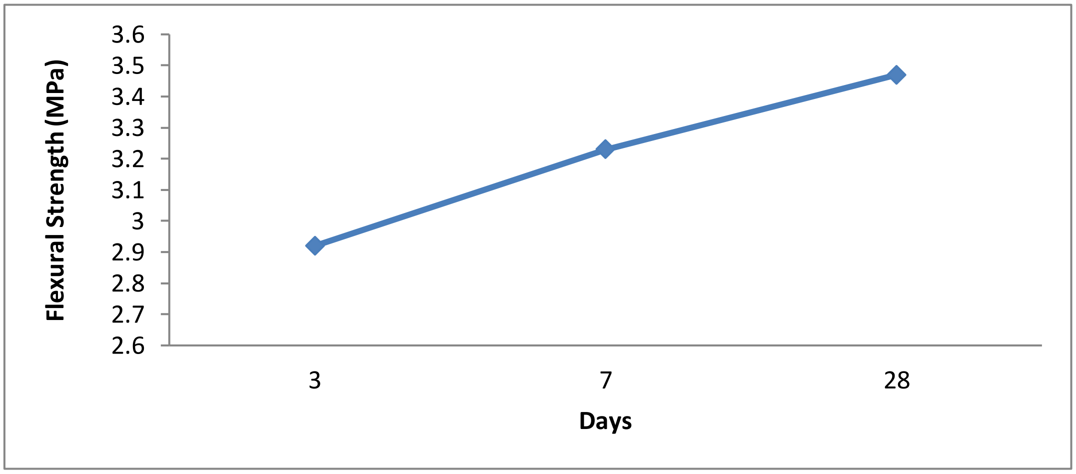

Fig 4.2 Variation in flexural strength with 50% waste water in 50% portable water

Fig 4.3 Load applied on cubes

Fig 4.4 Compression Testing Machine

Table 4.3 Final results of compressive strength and flexural strength for 40% waste water

S. No.	Days	Compressive Strength (MPa)	Flexural Strength (MPa)
1.	3	17.54	2.93
2.	7	21.86	3.27
3.	28	26.12	3.57

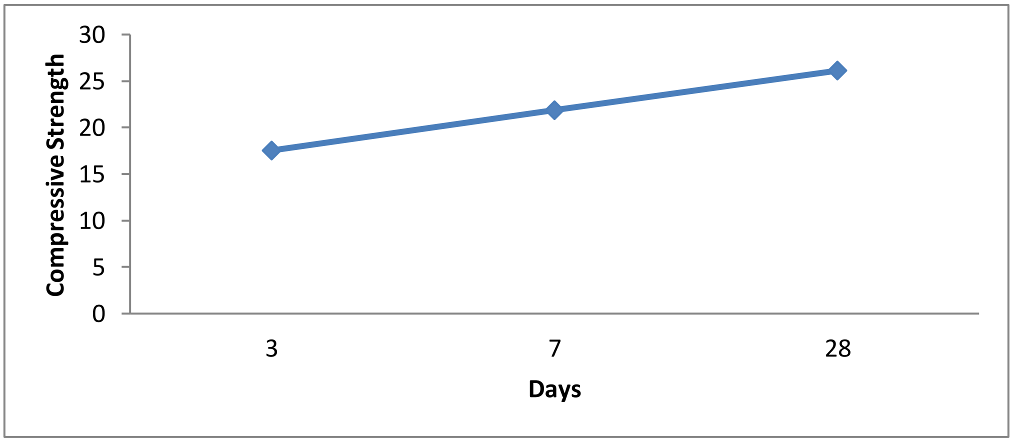

Fig 4.5 Variation in compressive strength with 40% waste water in 60% portable water

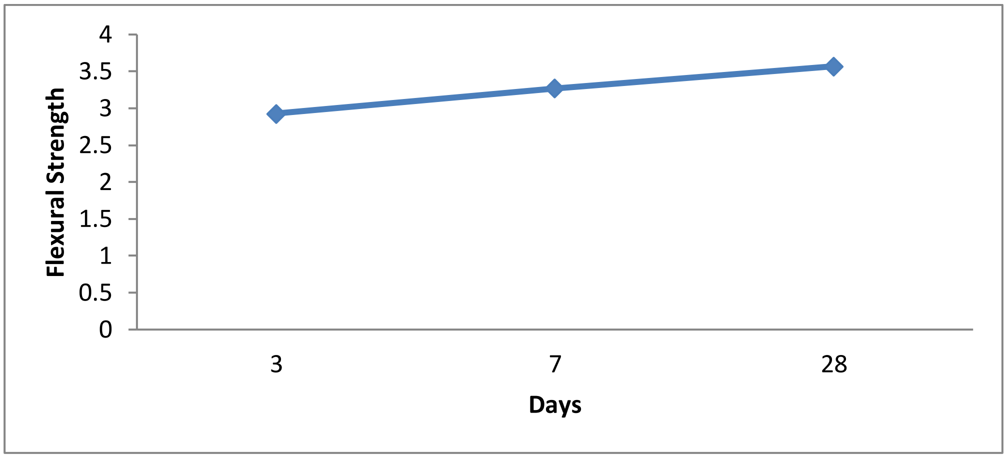

Fig 4.6 Variation in Flexural strength with 40% waste water in 60% portable water

Table 4.4 Final results of compressive strength and flexural strength for 30% waste water

S. No.	Days	Compressive Strength (MPa)	Flexural Strength (MPa)
1.	3	18.72	3.02
2.	7	23.05	3.36
3.	28	29.47	3.80

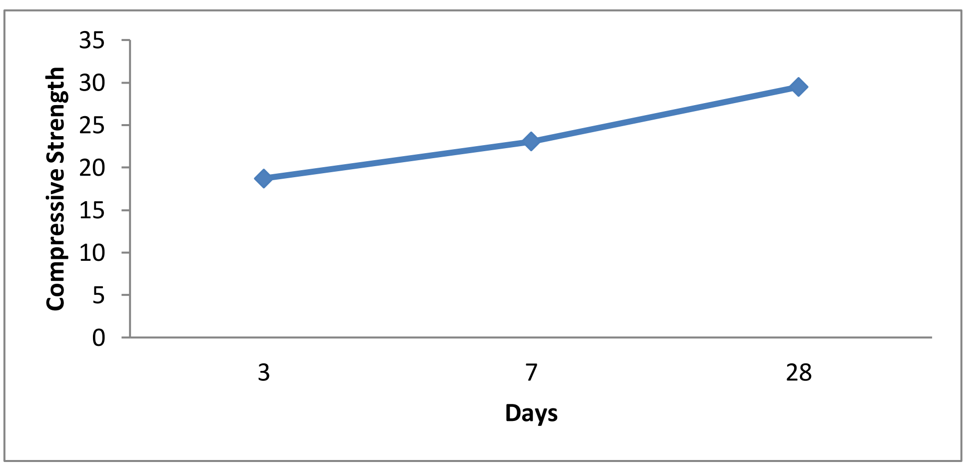

Fig 4.7 Variation in compressive strength with 30% waste water in 70% portable water

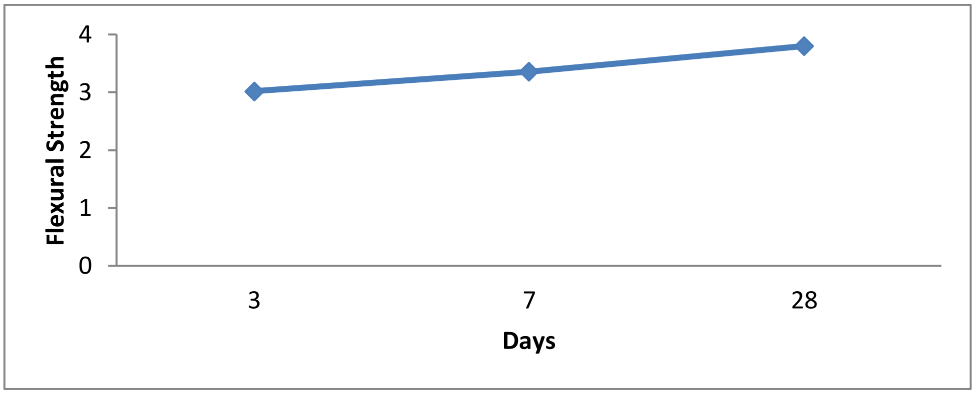

Fig 4.8 Variation Flexural strength with 30% waste water in 70% portable water

Table 4.5 Final results of compressive strength and flexural strength for 20% waste water

S. No.	Days	Compressive Strength (MPa)	Flexural Strength (MPa)
1.	3	18.92	3.04
2.	7	24.41	3.45
3.	28	32.63	3.99

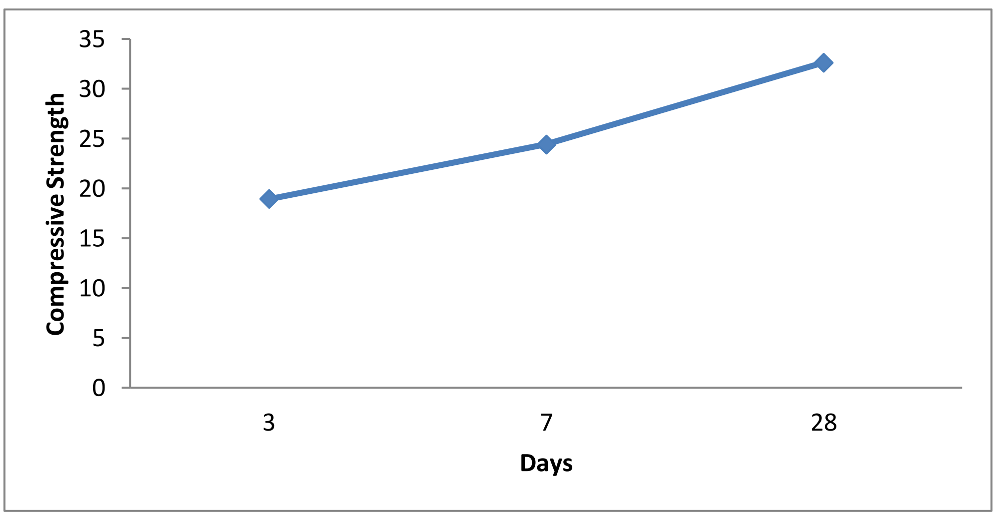

Fig 4.9 Variation in compressive strength with 20% waste water in 80% portable water

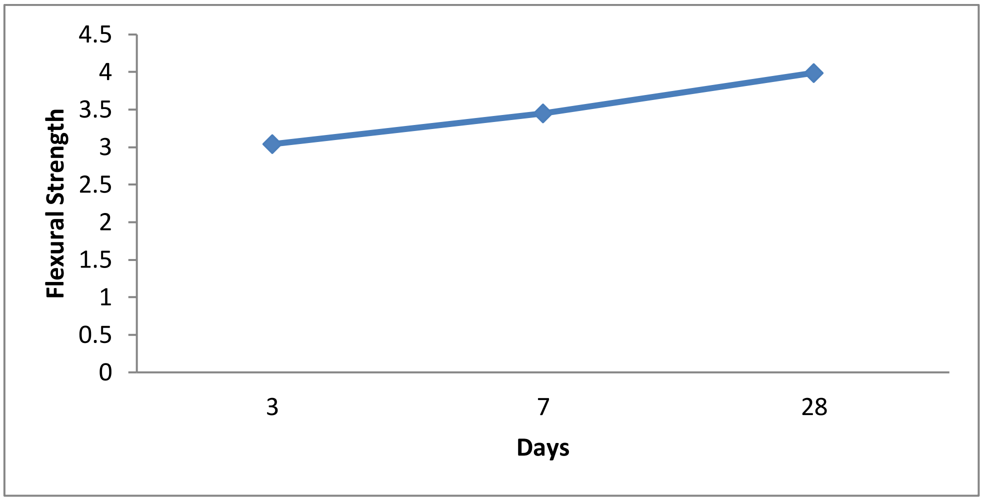

Fig 4.10 Variation in Flexural strength with 20% waste water in 80% portable water

CHAPTER-5

DISCUSSION AND CONCLUSION

5.1 DISCUSSION

The results of our study shows that up to 20% of waste water is acceptable for making any concrete mix. Some properties of the mix were changed because of the presence of solids present in the sample water and other different properties of waste water but their concentration is below the maximum limit thus, they are acceptable. Many heavy metals are also present in the sample water as shows above but their concentration is also acceptable for the mixing and curing water of the concrete. Some little change that are coming in our results is only because of these properties of waste water. But, at the end we get our targeted compressive strength with all these slight changes in the properties of waste water.

5.2 CONCLUSION

Finally, on the basis of the results, it was concluded that there is change in the initial and final setting time of different mix. So it was found that there is significant increase in the setting time of cement with increase in the waste water due to the presence of the heavy metals which adversely affect the properties of the concrete mix. It was also concluded that there was a change in the compressive strength of the concrete as compared to the normal mix. With increase in the waste water content in the concrete mixing water there is decrease in the compressive strength. Based on the findings of the study, it was found that the addition of 20% of waste water in normal tap water resulted in the increment in the compressive strength while the addition of h 30% or more waste water resultant in the decrements in the targeted compressive strength. It is to note that the early days compressive strength (3,7 days) of the concrete mix prepared by utilising waste water was found to be more than the conventional mix. But, 28 days compressive strength of the concrete mix was found to be decreased with the increase in the replacement of fresh water with waste water (i.e. more than 20 percent). Another important finding of the study was that the waste water can be ustilised for the curing purposes also (i.e. by keeping the same proportioning of waste and fresh water as did for concrete mix).

The methodology proposed in the present study can be investigate by implementing the same in the field. The present study can be extended by increasing the percentage of waste water up to 100 percent replacement of fresh water with or without treatment. Secondly, study can be extended by utilising the waste water for curing purposes in varying proportion.

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