

STUDY ON PARTIAL REPLACEMENT OF FINE AGGREGATE BY TANNERY SLUDGE IN CONCRETE

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in
Civil Engineering

by

P. ANANTH (Reg.no:37200005)

T.S. CIBIRAM (Reg.no:37200016)



**DEPARTMENT OF CIVIL ENGINEERING
SCHOOL OF BUILDING AND ENVIRONMENT**

**SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI-600119



SATHYABAMA



INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Jeppiaar nagar, Rajiv Gandhi Salai, chennai-600 119

www.sathyabama.ac.in

DEPARTMENT OF CIVIL ENGINEERING

BONAFIDE CERTIFICATE

This is certify that this project Report is the Bonafide work of **ANANTH.P (37200005)** and **T.S. CIBIRAM (37200016)** who is carried out the project entitled “**STUDY ON PARTIAL REPLACEMENT OF FINE AGGREGATE BY TANNERY SLUDGE IN CONCRETE**” under my supervisor from October 2020 to April 2021.

Internal Guide

(Dr. R. PADMAPRIYA, M.E.,Ph.D.,)

Head of the department

Submitted for viva voice Examination held on_____

Internalexaminer

External examiner

DECLARTION

We **ANANTH.P (37200005)** and **CIBIRAM T.S (37200016)** hereby declare that the Project Report entitled “**STUDY ON PARTIAL REPLACEMENT OF FINE AGGREGATE BY TANNERY SLUDGE IN CONCRETE**” done by us under the guidance of **Dr. R. PADMAPRIYA** at Sathyabama institute of science and technology is submitted in partial fulfillment of the requirements for the award of Bachelor degree of civil engineering.

DATE:

PLACE:

SIGNATURE OF THE CANDIDATE

ACKNOWLEDGEMENT

We are pleased to acknowledge our sincere thanks to Board of Management of SATHYABAMA for their kind encouragement in doing this project and for completing it successfully. We are grateful to them.

We convey our thanks to Dr. Devyani Gangopadhyay, B.Arch., M.T.P., Ph.D., Dean, School of Building and Environment and Dr. S. Packialakshmi, M.E., Ph.D., and Dr. R. Padmapriya, M.E., Ph.D., Head of the Department, Dept. of Civil Engineering for providing us necessary support and details at the right time during the progressive reviews.

We would like to express our sincere and deep sense of gratitude to our Project Guide Mrs. Dr. R. Padmapriya, M.E., Ph.D., for her valuable guidance, suggestions and constant encouragement paved way for the successful completion of our project work.

We wish to express our thanks to all Teaching and Non-teaching staff members of the Department of Civil Engineering who were helpful in many ways for the completion of the project.

ABSTRACT

Concrete is the most widely used "man-made" material globally for all types of civil engineering works. In India, there are many industries that produce large quantities of waste treatment plant waste sludge which causes disposal problems. The wastewater treatment plant sludge's final destination affects the environment. Therefore, alternative treatment is necessary to dispose of the sludge treatment. Experimental investigation related to casting and testing of specimens using the test method which will use fully compressive strength, split tensile test, flexure strength test with and without tannery sludge. The strength and durability properties are carried out for various mix designations are compared with normal conventional concrete. M25 grade is considered and the tannery sludge at 0%, 10%, 20%, 30% volume percentage are introduced into tannery sludge reinforced. The proposed sample will be tested at 7th day, 14th day and 28th day age of curing. The concrete cube size is 150 by 150 by 150mm. The concrete prism size is 100 by 150 by 500 mm. The concrete cylinder size is 150mm diameter, 300 mm height and mix ratio 1: 1: 2 was derived and used throughout the study. This result will show whether the tannery sludge is suitable for proper confinement or not for structures subject to extreme load conditions. The compressive and tensile strength of 30% tannery sludge replaced concrete were higher than the conventional.

TABLES OF CONTENTS

CHAPTER	TITLE	PAGE
	ABSTRACT	V
	LIST OF FIGURES	ix
	LIST OF TABLES	X
	LIST OF GRAPHS	Xi
	LIST OF SYMBOLS AND ABBREVIATIONS	Xii
1	INTRODUCTION	1
	1.1 General	1
	1.2 Need for study	2
2	LITERATURE REVIEW	3
	2.1 General	3
	2.2 Summary of Literature Review	3
3	SCOPE AND OBJECTIVES	11
	3.1 Aim	11
	3.2 Objectives	11
	3.3 Scope	11
4	MATERIALS AND METHODOLOGY	12
	4.1 General	12
	4.2 Methodology	12
	4.3 Materials collection	12
	4.3.1 Cement	13
	4.3.2 Fine Aggregate	13
	4.3.3 Coarse Aggregate	14
	4.3.4 Water	14
	4.4 Test on material property	15
	4.4.1 Cement	15
	4.4.1.1 Setting time	15
	4.4.1.2 consistency test	15
	4.4.1.3 Fineness test	15
	4.4.2 Fine Aggregate	15
	4.4.2.1 Sieve Analysis for fine aggregate	15

CHAPTER	TITLE	PAGE
	4.4.2.2 Specific Gravity	16
	4.4.2.3 Water Absorption	16
	4.4.3 Coarse Aggregate	16
	4.4.3.1 Specific Gravity	16
	4.4.3.2 Water Absorption	16
	4.4.3.3 Flakiness and elongation index	16
	4.4.3.4 Impact Value	16
	4.4.3.5 Abrasion value	16
	4.4.3.6 Crushing value	16
	4.4.4 Tannery Waste	17
	4.4.4.1 Analysis of sludge Properties	17
4.5	Trial Procedure	19
	4.5.1 General	19
	4.5.2 Mix Design	19
	4.5.5.1 Design Parameters	19
	4.5.5.2 test Data Materials	19
	4.5.5.3 Design Mix calculation	20
	4.5.5.4 Quality of Materials	21
	4.5.5.5 Mix Proportion Ratio	22
4.6	Casting and Curing	22
	4.6.1 General	22
	4.6.2 Casting	23
	4.6.2.1 Casting of Cubes	23
	4.6.2.2 Casting of Cylinders	24
	4.6.2.3 Casting of prisms	24
	4.6.3 Demolding	26
	4.6.4 Curing	27
4.7	Test on fresh Concrete	27
	4.7.1 Slump Cone test	28
	4.7.2 Compaction factor	30
	4.7.3 setting time of Concrete	31
4.8	Test on Hardened Concrete	32

CHAPTER	TITLE	PAGE
	4.8.1 Compression test	33
	4.8.2 Split Tensile Strength	34
	4.8.3 Flexural Strength of Concrete	36
5	RESUL AND DISCUSSION	38
	5.1 Experimental Test Results	38
	5.1.1 Compression strength Test	38
	5.1.2 Split Tensile Strength	39
	5.1.3 Flexural Strength of Concrete	40
6	COCLUSIONS	41
	6.1 General	41
	REFERENCES	42

LIST OF FIGURES

FIGURE	TITLE	PAGE
4.1	Cement	13
4.2	Manufacturing sand	14
4.3	Coarse Aggregate	14
4.4	Tannery sludge	18
4.13	Casting of specimens	23
4.14	Demolding of specimens	26
4.15	Curing of Specimens	27
4.16	Slump cone test	29
4.17	Compaction factor test	30
4.18	Compressive strength test	33
4.19	Split Tensile Strength Test	35
4.20	Flexural Strength Test	36

LIST OF TABLES

TABLE	TITLE	PAGE
4.4.1	Physical Properties of Cement	15
4.4.2	Physical Properties of Fine Aggregate	15
4.4.2.1	Sieve Analysis for Fine Aggregate	16
4.4.3	Physical properties of Coarse Aggregate	16
4.5.2.1	Design Parameters	19
4.5.2.2	Test date Materials	19
5.1.1	Compressive Strength Test for Cubes	38
5.1.2	Split Tensile Test for Cylinders	39
5.1.3	Flexural Strength Test for prism	40

LIST OF GRAPHS

GRAPH	TITLE	PAGE
5.1	Optimum Replacement of Compressive Strength Test	38
5.2	Optimum Replacement of Split Tensile Test	39
5.3	Optimum Replacement of Flexural Strength Test	40

LIST OF SYMBOLS AND ABBREVIATIONS

ACRONYMS

EXPANSIONS

Gm	grams
N	Newton
%	Percentage
°	Degree
KN	Kilo Newton
Mm	Millimetre
Km	Kilometre
OPC	Ordinary Portland cement
M	Meter
Fig	Figure

CHAPTER 1

INTRODUCTION

1.1 GENERAL

Nowadays utilization of secondary materials is being inspired in construction field. Various waste materials result from producing, waste product treatment plant, industries, households and mining. several of the wastes made nowadays can stay within the environmental for a protracted time. Selling and disposal of waste materials causes environmental and health issues. Therefore, employment of waste materials may be a nice potential in concrete business.

For several years, by –product like work waste were thought of as waste materials. Concrete ready with such a fabric showed improvement in workability and sturdiness compared to standard concrete and has been utilized in the development off power, chemical plants and under-water structures.

During this study, work waste is employed as partial replacement for fine mixture. By exploitation these materials, the performance of concrete is increased particularly their mechanical properties. This role of the substitution materials has a lot of useful effects of concrete.

1.1.1 Tannery sludge

Tannery sludge is major waste created in production of animal skin product in Asian country. Concerning 900 tanneries area unit gift in state. the quantity of waste created is tough to in disposal. The disposal of this waste results in land (or) pollution. So, avoid the pollution and scale back price of construction the experiment is dispensed. an endeavor has been taken to use the dangerous workplace sludge in concrete combine. the utilization of this kind concrete combine is projected considering the compressive strength found on action of serious

metals. This can be employed in tiny scale development and facilities that don't need higher strength.

A recent report has discovered that animal skin and animal skin product area unit one among the main external trade sectors, that contribute up to one.39% share on the entire export earnings. An oversized quantity of solid waste (about 69.1 T/day in lean period) is generated by animal skin producing method in Hazaribagh space.

1.2 NEED FOR STUDY

- ✓ This study makes an attempt to check the strength of parameters like compressive strength, split durability check and flexural strength check once sand is partial replaced by workplace sludge.
- ✓ To style and proportion, the concrete combine for M25 grade concrete.as per the advice.

CHAPTER 2

LITERATURE SURVEY

2.1 GENERAL

A literature review may be a scholar paper, which has the present data together with substantive findings, additionally as theoretical and method contributions to explicit topic. In such a case, the review sometimes precedes the methodology and result section of the work. The literature collected from varied sources collected for the in completion of the project is given below.

2.2 REVIEW OF JOURNALS PAPERS

M. Jothilingam, Pratheeba Paul, Janardhanan (2020) studied Options for Utilization of Tannery Sludge P. The present tannery sludge disposal methods like Composting, landfill, anaerobic digestion systems are not providing the satisfactory result. Reuse of industrial waste is advocated worldwide and in some of the countries as a remedial measure solidification and stabilization concept is adopted for reducing heavy metals from industrial waste. In this review the outcome of various research on the properties natural clay, ceramic and cement-based stabilization of the tannery sludge has been discussed and the research gap is also identified. When compared with pure metakaolin-based geopolymer the sludge base geopolymer are in same layer structure. This will prove that the solid products get higher compressive strength and impermeability's with geopolymer are the best process to reduce the tannery sludge waste, stabilize chromium ions, and convert wastes into reuse material. The presence of geopolymer it helps to harden the tannery sludge and used in the building material.

Jurgita Malaiškienė, et.al, (2019) studied on Tannery Sludge as a Raw Material for Cement Mortar. specimens containing 3–12% of tannery sludge by weight of cement and 3–9% of tannery sludge by weight of sand were tested. Flowability, density, ultrasonic pulse velocity (UPV), flexural and compressive strength, water absorption and sportively of the mortar were analyzed. X-ray diffraction (XRD) and scanning electron microscopy (SEM) analysis of tannery sludge and mortar are presented. The tests revealed that replacement of 6% of cement with tannery

sludge in the mix increased flexural and compressive strength and UPV values, whereas water absorption decreased. SEM and XRD analysis revealed that specimens with tannery sludge contained lower amounts of ettringite and higher amounts of portlandite; the obtained structure was denser and contained more calcium hydro silicates (C-S-H). Chromium leaching values in cement mortars were found not to exceed the limit values set forth in Directive 2003/33/EC. TS in construction mortars by replacing 6% of cement or natural aggregate—sand—with TS. Up to a 6% addition of TS reduced porosity and water absorption of the mortar, increased the strength up to 26% and increased density and ultrasonic pulse velocity by ~4%. In this way, the expensive binding material—cement can be saved.

Ms. V. Tamil Thendral et.al, (2018) studied Experimental Investigation on Tannery Waste with Partial Replacement of Coarse Aggregate in Concrete work. This experimental investigation is carried out to evaluate the compressive strength of concrete. An attempt has been taken to Analyse the use of tannery sludge in a suitable sludge stabilization process to reduce the heavy metal concentration in tannery sludge. The tannery sludge is partially replaced with coarse aggregate of 20mm size in M35 grade of concrete and the mixing ratio are 5%, 10% and 15% respectively. A large number of concrete cubes of size 150x150x150 mm were casted with tannery sludge as coarse aggregates and compressive strength values of the cube is determined for 7 days, 14 days and 28 days for different percentage of sludge in concrete. The sludge forms the tannery are harmful materials which has heavy metal concentration in it. The sludge which has been used is solidified by physical and chemical processes and presence of harmful metals has been reduced the replacement of sludge in concrete was based percentage of weight of the coarse aggregate used. The sludge is crushed manually and sieved; sieved sludge was used in concreting. The replacement of sludge in concrete was based percentage of weight of the coarse aggregate used. The sludge is crushed manually and sieved; sieved sludge was used in concreting.

Aleem Aijaz et.al, (2017) studied Effect of Latex Modified Concrete with Partial Replacement of Fine Aggregate with Tannery Shredded Waste Fine aggregate is also reducing day by day due to increase in the construction therefore the requirement of fine aggregate is more. On other hand tannery waste is abundant

in the world, if there is proper replacement of fine aggregate is made with tannery waste then the demand of the fine aggregate can be fulfilled. The concrete produced due to this replacement will have reduced weight as the density of tannery waste is lesser than the concrete so it will also result in light weight concrete. It was reported that 0-20% replacement of fine aggregate by tannery shredded waste decreases the density of the concrete from 2419kg/m³ to 1738 kg/m³ Styrene-butadiene rubber (SBR), a general-purpose synthetic rubber, produced from a copolymer of styrene and butadiene. SBR is a mixture of approximately 75% butadiene ($\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$) and 25% styrene ($\text{CH}_2=\text{CHC}_6\text{H}_5$). SBR Latex increases workability of concrete and decreases permeability. SBR Latex increases the compressive strength and flexural strength at 10% replacement of cement. Tannery Shredded Waste has less density than Fine Aggregate so there is decrease in permeability resulting in light weight concrete. Tannery Waste has less capacity to absorb water so they do not degrade easily. Tannery Shredded Waste is abundant in nature so its use will result in Economical as well as Environment friendly concrete. After reading all literature we find that there is no work on Tannery Shredded Waste and SBR Latex together.

S Vijay Aravind et.al, (2016) studied Utilization of Tannery Shredded Waste as Fine Aggregate in Concrete. Due to increase in the construction activities the requirement of fine aggregate is more. In other hand tannery waste is abundant in nature; a proper replacement of tannery waste over the fine aggregate will not only reduce the tannery waste but also reduce demand for fine aggregate. The concrete produced due to this replacement will have reduced weight and also possess higher strength than the conventional concrete. Tannery waste can be used effectively in the construction field. The disposal of tannery waste can be done safely without causing any pollution to the environment. There is reduction in the cost of construction and provides a new replacing material for the concrete. Increase in Tannery waste in concrete from 0% to 20% decreases the density of the concrete from 2419kg/m³ to 1738 kg/m³ Tannery waste concrete can reduce the use of river sand in concrete and results in light weight concrete.

Karthikeyan Muniraj et.al, (2015) studied application of fine aggregate replacement of tannery dry sludge in concrete to find out the feasibility of using sludge as fine aggregates in M25 grade of concrete performance by mechanical properties.

Thereafter, concrete specimens were produced with sludge content of 0, 5, 15 and 20% as replace alternate material for sand in concretes. By applying this type of alternative, solid waste could be disposed of in a better way without affecting the existing environment. To evaluate the effect of using dry sludge on compressive strength at different ages of curing 7 and 28 days was investigated. It has been observed that 5% replacement of dry sludge gives good compressive strength, increased 11.30% and 10.50% in 7 days and 28 days respectively to the concrete and gradually decreased. Noticeable reductions in compressive strengths are observed with increasing the percentage of dry sludge beyond 15%. The optimum dosage of dry sludge is 5% for M25 grade concrete. The average of split tensile strength was found to increase by 0.35% and 0.9% on 7 days and 28 days respectively. In the flexural strength result are reached around 1.5% to 2.5% when compared to control concrete. The percentage expansions of the specimens cast with partial replacement of dry sludge are within the permissible limits; hence the materials are safe for construction purpose. Use of dry sludge in concrete can save the natural sand and produce green concrete for construction.

Sonia Hassan et.al, (2014) Studied Effect of Using Tannery Sludge in Concrete 0%, 1%, 5%, 10%, 15%, and 20% of sludge were used by weight of cement replacing equal weight of the sand to prepare the mix. The sludge sample was oven dried, powdered and sieved to achieve a uniform gradation. 0.50 water/ cement ratio was used for all the mixes. Concrete Strength decreased with the increasing addition of sludge on the mixes. The result showed that the sludge/ cement ratio up to 5% met the requirement for both physical and chemical properties. The repeatability test also confirmed initial test results found for 5% of sludge/ cement addition in concrete. In both cases 15% compromise of strength was founded compared to the sludge free concrete. The main objective of this study was to assess the viability of using solidification technology to stabilize and convert the hazardous and toxic heavy metals present in the sludge into an inert, physically stable mass, with very low leachability. The secondary objective of the study was to assess the performance of the sludge added concrete to recommend a suitable concrete mix for minor construction work using sludge partially replacing the fine aggregate in concrete mix.

Dr.N.Vasudevan et.al, (2016) Reuse of Textile and Tannery Sludge in Concrete Fine Aggregates study the effect of addition of textile sludge and tannery sludge

as sand replacement material in the concrete blocks. In this study, control concrete blocks are made using ordinary Portland cement (M-53 grade). Textile and tannery sludge as industrial wastes used in this project contains some heavy metals which are hazardous in nature. So, the present study was to examine the utilization of textile sludge along with tannery sludge in the production of concrete blocks. An experimental study was designed to find the compressive strength of blocks at periodic intervals of 7 days and 28 days according to the testing standard. The results of the study will be helpful not only in reuse of waste as resource but also to reduce the impact due to disposal of tannery & textile sludges. Concrete is stable till after 15% replacement of sand with textile and tannery sludge together based on the strength on 7th and 28th days. The Water/cement ratio was inadequate for the 3rd mix ratio (70% tannery & 30% textile) which leads to improper bonding between sand and sludge. While using the textile lime sludge only as a sand replacement, concrete was stable up to 20% replacement of sand based on 7th day test. However, higher strength could be achieved at 30% replacement of sand for 28th day.

Sandeep Gupta et.al, (2013) Studies on Biological Treatment of Tannery Effluents in India. the cost and quality of treatment of tannery wastewater in India by two common effluent treatment plants (CETPs) constructed for two tannery clusters, at Jamaul (Kanpur) and at Unnao in the state of Uttar Pradesh, India. The Jamaul plant is up flow anaerobic sludge blanket (UASB) process-based, while the Unnao plant is activated sludge process (ASP)-based. Investigations indicated that the ASP-based plant was superior in all respects. Total annualized costs, including capital and operation and maintenance costs, for the UASB and ASP plants were Rs. 4.24 million/million liters per day (MLD) and Rs. 3.36 million/MLD, respectively. Land requirements for the two CETPs were 1.4 hectares/MLD and 0.95 hectares/MLD, respectively. Moreover, the treated UASB effluent had higher biochemical and chemical oxygen demand (BOD/COD) and considerable amounts of other undesirable constituents, like chromium (Cr) and sulfide, as compared with the ASP effluent, which had lower BOD/COD and negligible concentration of sulfide and Cr. Sludge production from

the UASB-based plant was also higher at 1.4 t/day/MLD, in comparison to the sludge production of 0.8 t/day/MLD for the ASP-based plant. Also, the entire sludge produced in the UASB-based plant was Cr-contaminated and, hence, hazardous, while only a small fraction of the sludge produced in the ASP-based plant was similarly contaminated. The results of this study are at variance with the conventional wisdom of the superiority of anaerobic processes for tannery waste-water treatment in tropical developing countries like India.

R. Swaminathan, et.al, (2000) Studied Solidification and Stabilisation of Tannery Sludge. The main purpose of any waste treatment is to reduce the toxicity of harmful components or the quantity of (certain) waste generated in order to minimize its impact on humans, flora, fauna and the general environment. Most treatment technologies can be readily adapted and modified to the requirements of any particular waste stream. Individual processes or a combination of several processes are (often) used as a prerequisite prior to disposal by landfilling or land treatment. Sometimes, the physical and chemical treatment methods are also required as a pre-treatment to few selective methods such as incineration, immobilization or disposal at sea. The sludge generated from tannery CETPs, like any other industry sectors, is currently stored within the CETP premises without any precautionary measures. This is perhaps due to the fact that suitable disposal site(s) have not been made available to the industries by the state regulatory authorities. As per the HWM Rules, 1989 in India, the state regulatory agency has to select and notify the disposal sites. Since the hazardous waste management is in infant stage and since no secure landfill design criteria are available for tropical countries, pilot demonstration secure landfills have been constructed by UNIDO at Ranita, Rani pet and is under consideration for Visitec, Melvis haram. The current project is aimed at assessing the efficacy of S/S technology for sludges from CETPs for tannery effluent. This has been considered due to its many advantages. The S/S technology may be acceptable to tanners if the native soil is used as admixture and hence it is cost effective. Considering the likely technical and economic advantages of S/S, the studies were carried out for the sludge collected from three CETPs located in Rani pet area in the state of Tamilnadu.

Dr. P. Partheeban et.al, (2020) studied Tannery waste is being utilized as a partial replacement for fine aggregates and the concrete produced is analyzed on the basis of Flexural, compressive and split tensile strength. The concrete produced with tannery waste as a substitute to fine aggregate will help in reducing the amount of M-sand and river sand used. The study concludes by identifying The optimal mix geopolymer concrete and the best mix for eco-friendly concrete that provides excellent strength in its properties is made by mixing 80% fly ash, 20% GGBFS and 80% M-sand and 20% tannery waste. The use of fly ash and GGBS has both environmental and economic benefits. The tannery wastes used for producing the binding system in concrete have environmental benefits at this optimal ratio. However, the use of Tannery Waste environmentally benefits, it fails in economic. The mix 3, mix 4 and mix 5 shows poor performance in its all-experimental properties as Tannery Waste steadily reacts with alkaline solution and changes the color of the concrete and does not allow the cementitious material to bind one another. Thus, results in lower strength of the hardened mortar. The optimal mix of eco-friendly concrete, which gives excellent strength in its properties, is therefore achieved by mixing 2 i.e., 80% fly ash, 20% GGBFS and 80% M-sand and 20% Tannery waste.

Dr. M. Vijaya Sekhar Reddy et.al, (2016) studied Partial Replacement of Fine Aggregate by Tannery Shredded Waste in Concrete an experimental investigation carried out to evaluate the compressive strength of concrete. An exploratory study on the suitability of the tannery shredded waste as partial replacement for normal fine aggregate in concrete works has been carried out. Physical and mechanical properties of tannery shredded waste and locally available normal aggregates have been determined and compared. The experimental results reveals that the maximum compressive strength achieved for seven and 28 days are 29.20 and 43.64 N/mm² by 10% replacement of tannery waste in fine aggregate the partial replacement of 10% of tannery waste over fine aggregate will eventually increase the strength of concrete and found to be optimum replacement Compressive strength of standard concrete with various trial mixes is comparatively increasing more than that of conventional concrete. Tannery waste concrete can reduce the use of river sand in concrete and results in light weight concrete. There is reduction in the cost of construction and provides a new replacing material for the

concrete. The disposal of tannery waste can be done safely without causing any pollution to the environment.

Jha, Sujant et.al, studied utilization of Textile Sludge as a Partial Replacement of Cement on the Properties of Cement Mortar Cement mortar is a building material which is prepared by homogenous mixing of cement and sand with appropriate amount of water. Cement mortars are used for plastering on the exposed surface of masonry, binding building blocks and bedding layer for building block. Textile sludge is an industrial bi-product which is obtained by treating the liquid waste during various wet processes in textile industry Cement mortar is a building material which is prepared by homogenous mixing of cement and sand with appropriate amount of water. Cement mortars are used for plastering on the exposed surface of masonry, binding building blocks and bedding layer for building block. Textile sludge is an industrial bi-product which is obtained by treating the liquid waste during various wet processes in textile industry.

CHAPTER 3

SCOPE AND OBJECTIVES

3.1 AIM

To determine the optimum usage of industrial by products in concrete by partial replacements with suitable concrete ingredients.

3.2 OBJECTIVES

- To determine the chemical properties of tannery waste.
- To determine properties of materials (cement, fine aggregate, coarse aggregate).
- To determine the mechanical properties of the concrete using tannery waste.

3.3 SCOPE

In this study, the properties of fresh and hardened concrete of M25 grade by partial replacement of fine aggregate by industrial waste material produced from the process of manufacturing leather. The fine aggregate was partially replaced by tannery waste which varied from 10% to 30% by the weight of the fine aggregate.

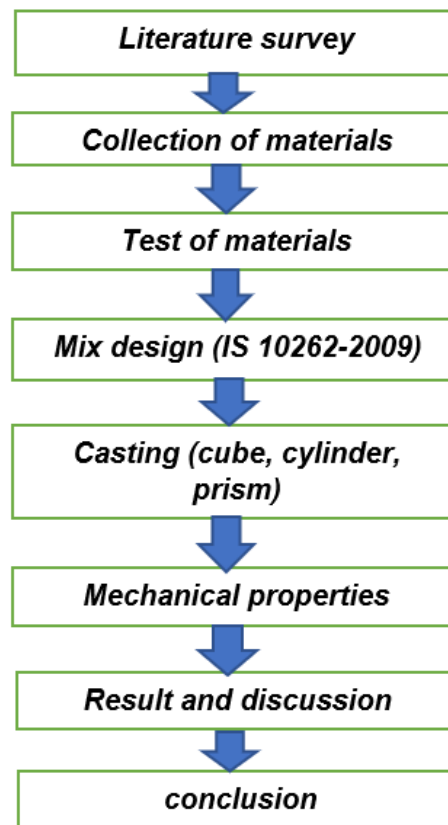
CHAPTER 4

MATERIALS AND METHODOLOGY

4.1 GENERAL

In this chapter, the methodology and materials collection have been discussed briefly.

4.2 METHODOLOGY



4.3 MATERIALS COLLECTION

The materials used for concrete are cement, fine aggregate, coarse aggregate, supplementary material tannery sludge and water. The above mentioned material was tested at an accredited laboratory about their physical and chemical properties to decide their suitability, for their utilization in concrete.

4.3.1 Cement

Ordinary Portland Cement (OPC) is the most preferred binder in the reinforcing of concrete, acquired locally as the Zuari OPC of 43 grade cement conforming to IS 269-2015 is used, as shown in fig. the cost of production isn't costly creating it the sought-after cement within the building business. They are wide used for the development of high-rise buildings roads, dams, bridges, flyovers. Also, normal cement is employed for creating grouts and mortars. OPC is good for the development of residential and industrial complexes. The physical and chemical take a look at properties were conducted as per IS 4031-1988 and IS 4032-1985.



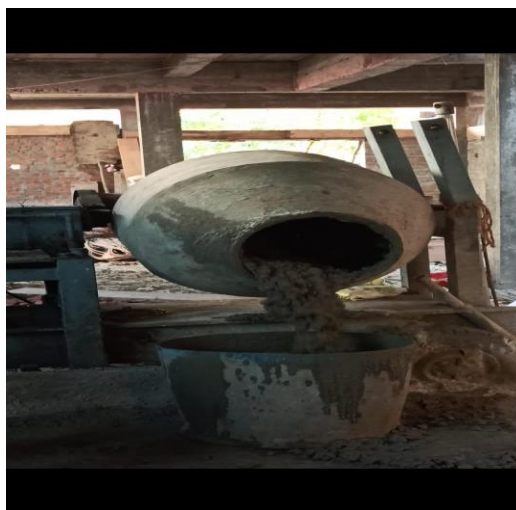
4.3.2 Fine aggregate

Crushed stone sand conforming to IS 383 - 2016 from SS crusher, Cheyyur is used as fine aggregates as shown in fig 4.2. Manufactured sand is produced from hard granite stone by crushing. The crushed sand is of cubical shape with grounded edges, washed and graded to as a construction material. The size of manufactured sand is less than 4.75mm. They are used in construction industry mainly for concrete production and mortar mix. This is mainly crushed fine aggregate produced from a source material with suitable strength, durability, and shape characteristics.



4.3.3 Coarse Aggregates

Crushed aggregates from SS device, Cheyyur conformist to IS 383 -2016 is employed as coarse aggregates as shown in fig four.3. Gravels represent the bulk of coarse mixture utilized in concrete with crushed stone creating up most of the rest. Coarse aggregates have many uses in construction. the foremost obvious is as a part of the combination in concrete. they're conjointly utilized in the preparation of the wet break underneath the block and vapor barrier. they're a part of the bottom preparation for driveways and roadways. Coarse mixture is that the portion of the concrete that is created from the larger stones embedded within the combine.



4.3.4 Water

FRFCF (Fast Reactor Fuel Cycle Facility) below Ground Sump water is employed as source of water for the planning combine as Water has been tested as per IS: 3025-1964 and confirms the need of IS: 456 - 2000. Potable water is suitable as compounding water for cement concrete, plain cement concrete for

road construction and alternative applications, since its chemical composition is thought and well regulated.

4.4 TESTS ON MATERIALS PROPERTY

4.4.1 Cement

The physical properties of cement used in this study were evaluated by standard tests such as setting time, standard consistency, compressive strength and specific gravity and the results were tabulated in table 4.4.1.1

Table 4.4.1.1 Physical properties of cement

S.No	Description of Test	Results	Limit as per IS 269/IS 456
1	Standard consistency (%)	29	-
2	Initial setting time(minutes)	180	30 (min)
3	Final setting time (minutes)	290	600 (max)
4	Specific gravity	3.14	3.15
5	Compressive strength (N/mm)	51.co43	45 (min) 58 (max)
6	Fineness of cement in 90mic sieve retained (%)	1.88	10(max)

4.4.2 Fine Aggregate

Crushed stone sand conforming to IS 383 - 2016 from SS crusher, Cheyyur are used as fine aggregates.

Table 4.4.2.1 Physical Properties of Fine Aggregate

S.No	Description of Test	Results	Limit as per IS 383: 2386
1	Material passing 75 microns by mass (%)	3.80	10.0 Max
2	Specific gravity	2.652	-
3	Water Absorption (%)	1.62	-

4.4.2.1 Sieve Analysis for Fine Aggregate

The sieve analysis check for fine combination is delineated as follows. Take one metric weight unit of sand from the laboratory sample. organize the sieves so as of IS sieves nos. 480, 240, 120, 60, 30 and 15, keeping sieve no. 480 at the highest and fifteen at the lowest and canopy the highest. Keep the sample within the prime sieve no. 480. Do the sieving within the set of sieves for not but ten minutes. Realize the load of the sample maintained in every sieve.

Table: 4.4.2.2 Sieve Analysis for Fine Aggregates

S.No	Sieve size in (mm)	Weight Retained in(gms)	Percentage of weight Retained in (gms)	Cumulative Percentage of weight Retained	Percentage of Passing
1	10	0	0	0	100
2	4.75	0	0	0	100
3	2.36	18	1.80	1.80	98.20
4	1.18	358	35.80	37.60	62.40
5	0.60	204	20.40	58.00	42.00
6	0.30	194	19.40	77.40	22.60
7	0.15	114	11.40	88.80	11.20
	pan	112	11.20	100	0
	Total	1000		364	

Fineness modulus of heavy weight fine aggregate = Sum of Cumulative % of retained / 100 Grading Zone: II F.M: 364 / 100 = 3.6

4.4.3 Coarse Aggregate

Crushed aggregates from SS crusher, Cheyyur conforming to IS 383 -2016 is used as coarse aggregates were tabulated in Table 4.4.3.1.

Table: 4.4.3.1 Physical and Chemical Properties of Coarse Aggregate

S.No	Description of Test	Results		Limit as per IS 383: 2386
		12.5mm	20mm	
1	Specific gravity	2.780	2.750	-
2	Water Absorption (%)	0.42	0.61	-

3	Flakiness (%)	3.21	5.8	25 (max)
4	Elongation (%)	6.08	8.15	25 (max)
5	Crushing Value (%)	14.97	14.97	30 (max)
6	Impact Value (%)	13.43	13.43	30 (max)
7	Abrasion Value (%)	13.2	13.2	30 (max)

4.4.4 Tannery waste

Sludge sample from leather industry was considered in this study. The pallavaram tanners indl effluent treatment co-operative limited was selected to collect sludge sample. This tannery has functional effluent treatment plant. With assistance of the tannery, authority, the sludge sample was collected directly from the effluent treatment plant . The sludge sample was founded in a partial degraded condition and had some flesh mixed with it. It was collected in poly bags, sealed and kept in cool dry place before analysis.



Fig 4.4 Tannery sludge

4.4.4.1 Analysis of Sludge Properties

The characteristics of the sludge sample were analyzed for preselected parameters to record the chemical properties and the leaching potential of the sludge in the open environment. These may influence the workability, strength and setting time of the resultant sludge mixed concrete as indicated in the literature. The properties analyzed include pH, alkalinity, and chloride, sulfide, sulfate, silica, nitrate, etc.

PH

The pH of the sludge sample was analyzed with colorimetric methods using litmus paper. A colorimetric method is a simple and practical procedure. The strip of the litmus paper was taken in and emerged in the raw sample. The color of the paper changed within a second into dark brown. The color of the litmus paper was matched with the colors of the color chart to determine the pH of the sample.

Alkalinity

Sludge and water were mixed 1: 2.5 ratio and stirred vigorously with magnetic stirrer for 30 minutes and allowed to settle for an hour. The supernatant liquid was filtered through filter paper 50 mL of extract was then titrated with (0.02 N) sulfuric acid. The alkalinity of the extract was determined and the result was expressed as mg CaCO₃/kg of sludge.

4.5 TRIAL MIX PROCEDURE

4.5.1 General

The experimental program comprises of conducting trail mix for designing the grade of concrete, investigate about the consistency, wet density, preparation of specimen, curing and testing of the same. The stages mentioned above are explained individually.

Mix style is that the method of choosing appropriate ingredients of concrete and determinant their relative quantities through conducting preliminary laboratory takes a look at for getting the economical combine IS:10262-2009.

4.5.2.1 Design Parameters

Table 4.5.2.1 Design Parameters

1	Grade designation	M25
2	Types of cement	OPC 43 grade
3	Characteristic strength required	30 N/mm
4	Maximum nominal size of aggregate	20mm
5	Minimum cement content	320 Kg/m
6	Maximum water cement ratio	0.45
7	Shape of coarse aggregate	Crushed angular aggregate
8	Workability in terms of slump	110mm
9	Degree of quality control	good
10	Degree of exposure	serve

4.5.2.2 Test Data Materials

Table 4.5.2.2 Test Data Materials

1	Specific gravity of cement	3.15
---	----------------------------	------

2	Specific gravity of fine aggregate	2.65
3	Specific gravity of coarse aggregate	
	20mm	2.78
	12.5mm	2.75

4.5.2.3 Design Mix Calculations

To get a relative idea before starting of mix design the following formula is used for preliminary design calculation. Finally, to get the exact density it is fine-tuned based on adjustments applied over the weight of each material to satisfy the required consistency were tabulated in Table 4.5.2.1.

4.6.2.4 Quantity of Materials

- a. Volume of concrete = 1m^3
- b. Volume of cement = $\text{Mass of cement} / \text{Specific Gravity} \times 1/1000$
 $= 394/2.7 \times 1/1000 = 0.146 \text{ cu.}$
- c. Volume of water = $\text{Mass of water} / \text{Specific Gravity} \times 1/1000$
 $= 197/1 \times 1/1000 = 0.197 \text{ cu.m}$
- d. volume of aggregates = $a - (b+c) = 1 - (0.146+197) = 0.657 \text{ cu. M}$
- e. Mass of coarse aggregate = $d \times \text{Volume of coarse aggregate} \times \text{specific gravity of coarse aggregate} \times 1000$
 $= 0.657 \times 0.64 \times 2.7 \times 1000 = 1135.3\text{Kg}$
- f. Mass of fine aggregate = $d \times \text{Volume of fine aggregate} \times \text{Specific gravity of fine aggregate} \times 1000$
 $= 0.657 \times 0.36 \times 2.6 \times 1000 = 615\text{Kg}$

Table 4.5.2 mix proportion

Water = 197Kg Fine Aggregate = 615 Kg Coarse Aggregate = 1135.3Kg W/C Ratio = 0.5

Mix Proportion= 1 : 1.56 : 2.88

4.3 Calculation for PCC

a. Cubes:

$$\text{Volume of 3 cubes} = 3 \times 0.15^3 \times 1.2 = 0.0122\text{m}^3$$

$$\text{Cement} = 394 \times 0.0122 = 4.78 \text{ Kg}$$

$$\text{Fine Aggregate} = 4.78 \times 1.56 = 7.47 \text{ Kg}$$

$$\text{Coarse Aggregate} = 4.78 \times 2.88 = 13.78 \text{ Kg}$$

$$\text{Water} = 197 \times 0.0122 = 2.4 \text{ Liter}$$

b. Cylinder

$$\text{Volume of 3 cylinder} = 3 \times 0.785 \times 0.15^2 \times 0.3 \times 1.2 = 0.02\text{m}^3$$

$$\text{Cement} = 394 \times 0.02 = 7.56 \text{ Kg}$$

$$\text{Fine Aggregate} = 7.56 \times 1.56 = 11.73 \text{ Kg}$$

$$\text{Coarse Aggregate} = 7.56 \times 2.88 = 21.65 \text{ Kg}$$

$$\text{Water} = 197 \times 0.02 = 3.76 \text{ Liters}$$

C. Prism:

$$\text{Volume of 3 prisms} = 3 \times 0.1 \times 0.1 \times 0.5 \times 1.2 = 0.018\text{m}^3$$

$$\text{Cement} = 394 \times 0.018 = 7.10 \text{ Kg}$$

$$\text{Fine Aggregate} = 7.10 \times 1.56 = 11.10 \text{ Kg}$$

$$\text{Coarse Aggregate} = 7.10 \times 2.88 = 20.43 \text{ Kg}$$

$$\text{Water} = 197 \times 0.018 = 3.546 \text{ Liters}$$

Table 4.3: Amount of material required

Materials Mix	Cement	Fine Aggregate		Coarse Aggregate
		Tannery waste	Fine Aggregate	
Nominal mix	16.5kg	0kg	27kg	53.5kg
Mix 1	16.5kg	2.7kg	24.3kg	53.5kg
Mix 2	16.5kg	5.4kg	21.6kg	53.5kg
Mix 3	16.5kg	8.1kg	18.9kg	53.5kg
Total	66kg	16.2kg	91.2kg	214kg

4.6.2.5 Mix Proportion Ratio

SI No	CEMENT CONTENT	FINE AGGREGATE	COARSE AGGREGATE	WATER CONTENT
1	76 kg	101 kg	224 kg	33 kg
2	1	1	2	0.5

4.6 CASTING AND CURING

4.6.1 GENERAL

Testing plays an important role in controlling the quality of concrete work. Systematic testing of raw material, the fresh and hardened inseparable part of any quality control program for concrete which helps to achieve higher efficiency and Test Method should be simple, direct and convenient to apply.

In considering, all the above, the preparation test specimen is the major role. it involves, Batching and Weighing, Mixing, Casting, Demolding and Curing. These all activities should be carried out as per code recommendation and design mix requirement. The different kind of concrete test specimen is involved in preparation for evaluating the strength and durability parameters.

The additional care should be taken while preparing test specimen and nothing shall be neglected. The preparation test specimen should be with good

workmanship as well as strict supervision. The preparation of concrete test specimen of each activity is directly connected with strength parameters.

4.6.2.1 Casting of Cubes

The concrete cube specimens are casted by the consideration of following steps

1. Cube Mould

The cube Moulds of needed size a 150 x 150 x 150 metric linear unit for nominal size of aggregate not exceptional 38 mm. Cube Moulds shall be supplied with a base plate and they shall be as per IS:10262-2009.

Cement= 394 Kg/m³



Fig 4.6.2 casting of cubes

2. Tamping Rod

As per IS:10262-2009, the tamping rod shall be 16±0.5 mm diameter and 600±2 mm long with a rounded working end and shall be made of mild steel.

3. Casting Process

The cube Mould plates ought to be removed, properly clean assembled and every one the bolts ought to be absolutely tight. a skinny layer of oil then shall be applied on all the faces of the Mould. it's necessary that cube aspect faces should be parallel. After taking concrete samples and combination them, the cubes shall be solid as shortly as possible. The concrete sample shall be crammed into the

cube Moulds in layers approximately 5 cm deep. In inserting every scoop of concrete.

The news shall be affected round the prime edge of the Mould because the concrete slides from it, so as to make sure a symmetrical distribution of the concrete with within the Mould. every layer shall be compacted either by hand or by the vibration as delineate below.

4. *Compaction by Hand*

Each layer of the concrete stuffed within the Mould shall be compacted by not but 35 strokes by tool. The strokes shall be penetrating into the underlying layer and also the bottom layer shall be rodded thought its depth. wherever voids are left by the tool the edges of the Mould shall be abroach to shut the voids.

4.6.2.2 *Casting of Cylinders*

The material properties of concrete can only be properly evaluated if test specimens are made and cured according to standards. Concrete cylinders are typically made to evaluate the compressive strength of the concrete as well as Spilt tensile strength.

1. *Cylinder Mould*

Metal 150 x 300 mm cylinder Moulds are used for casting concrete test specimens in the field. Before filling, they should be placed on a smooth, firm, level surface.

2. *Tamping Rod*

If 150mm diameter Moulds are used then it ought to be stuffed in three equal layers and each layer rodded uniformly twenty-five times with a sixteen-millimeter diameter x 450 - 600-millimeter long hemi spherically tipped steel rod.

3. *Casting Process*

The strokes shall be distributed uniformly over the cross-sectional of the Mould. The bottom layer shall be rodded throughout its depth. for every higher layer, the rod shall penetrate regarding 25 mm into the underlying layer. If voids are left by the rod, the edges of the Mould ought to be tapped to shut voids before adding the Ext layer of material.

4.6.2.3 *Casting of Prisms*

According to standards Concrete beam are casted to evaluate the flexural strength of the concrete. The casting and testing procedure to be followed as Indian standard code IS 10262-2009.

1. Prism Mould

The Mould standard size will be 100 x 100 x500 made out of metal. The tamping bar shall be a steel bar weighing 2kg, 40 cm long and shall have a ramming face 25 mm square. The test specimen shall be made as soon as practicable after Mixing and in such way as to produce full compaction of concrete while neither segregation nor excessive laitance.

2. Casting Process

The compaction shall be distributed uniformly over the section of the Mould. The bottom layer shall be rodded throughout its depth. For each upper layer, the rod shall penetrate about 25 mm into the underlying layer. If voids are left by the rod, the sides of the Mould should be tapped to close voids before adding the next layer of material.



fig 4.6.1 casting of cylinders

4.6.3 DEMOULDING

Test concrete take a look at specimens ought to be demolded between sixteen and twenty-four hours when they have been created. If when this area of your time the concrete has not achieved enough strength to modify demolding while not damaging the specimens then the demolding should be delayed for an additional twenty-four hours. once removing the concrete specimens from the Mould, take the Mould apart fully. beware to not harm the specimens because, if any cracking is caused, the all-strength parameters could also be reduced. When demolding, every take a look at concrete specimens ought to be marked with a fair identification on the highest or bottom employing a waterproof crayon or ink. The Mould should be thoroughly clean when demolding. make sure that grease or dirt doesn't collect between the faces of the flanges, otherwise the 2 halves won't match along properly and there'll be outflow through the joint Associate in Nursing an on an irregular basis formed could result.

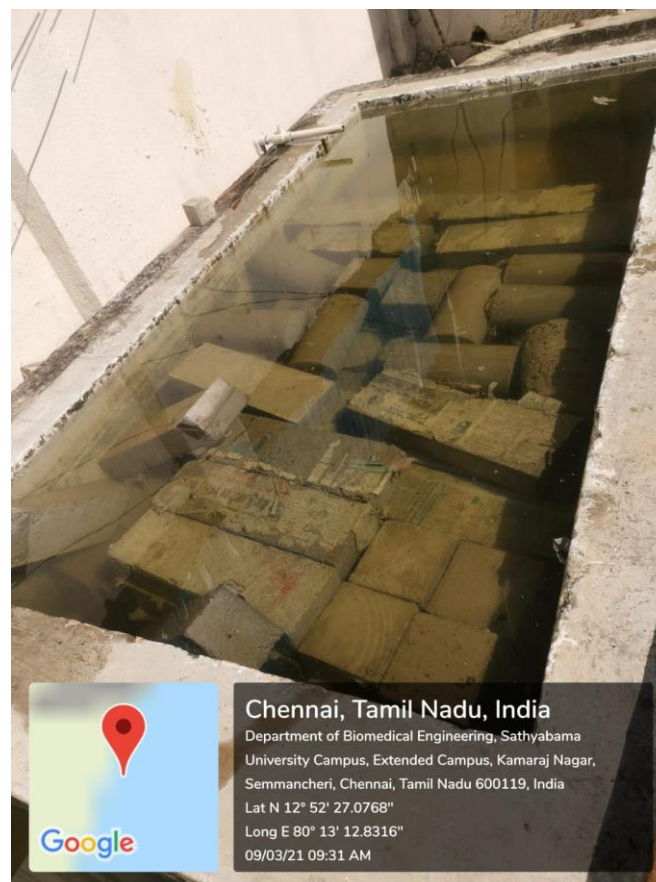


fig 4.6 demoulding

4.6.4 CURING

Curing plays an important role regarding concrete strength development and sturdiness. Curing of Concrete may be a technique by that the concrete is protected against loss of moisture needed for association and unbroken inside the suggested temperature vary. Curing can increase the strength and reduce the Permeableness of hardened concrete. Curing is additionally helping in mitigating thermal and plastic cracks, which may severely impact durability of structures.

Curing follow involves keeping the concrete damp or wet till the association of concrete is complete and strength is earned. natural process of concrete ought to begin presently after initial setting time of concrete. As per IS 456 – 2000 concrete shouldn't be cured but seven days for standard Portland Cement, and it should be a minimum of ten days for concrete with mineral admixtures or integrated cement are used. just in case of atmospheric condition and extremely dry temperature conditions, the natural process shouldn't be but ten Days for OPC and fourteen days for concrete with integrated cement & mineral admixtures.



4.7 TESTS ON FRESH CONCRETE

The fresh concrete test is defined as a Green property of concrete which is carried out by the method of workability slump cone test, Vee Bee test, compaction test, flow table test which are described as follows.

4.7.1 Slump cone test

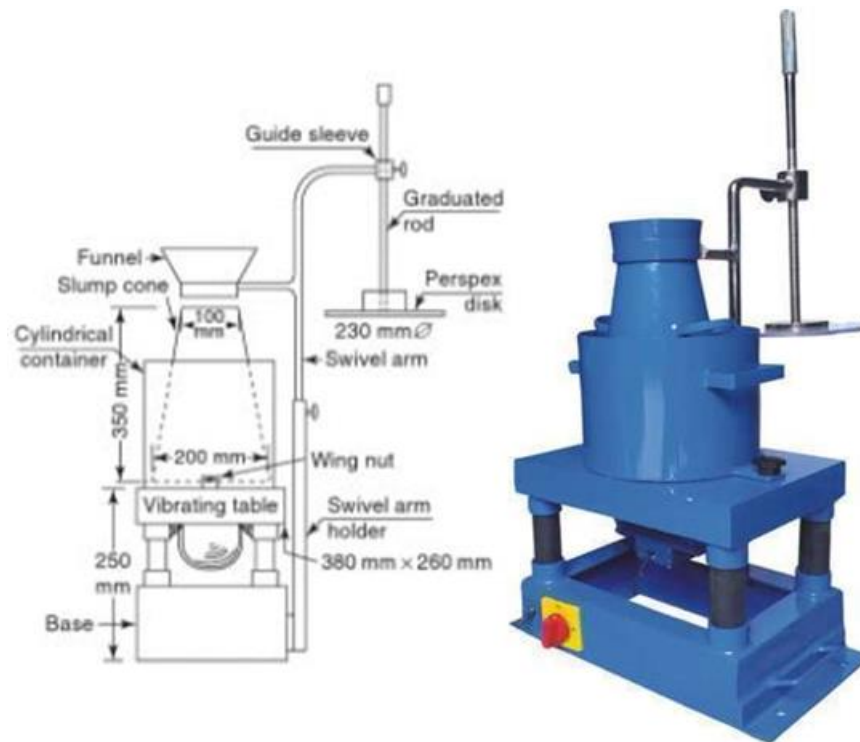
This procedure covers the tests method of determining the workability of plastic concrete by using slump cone apparatus in laboratory. The internal surface of the Mould shall be thoroughly cleaned and free from moisture before commencing the test. The Mould shall be placed on a smooth, horizontal and carefully levelled nonabsorbent metal surface. The Mould shall be filled in four equal layers with concrete sample and each layer shall be stamped with twenty-five strokes of the rounded end tamping rod of 16mm diameter and 600mm long as shown in fig 4.13. The strokes shall be distributed uniformly over the crosswise of the Mould and for the second and succeeding layer shall penetrate into the underneath lying layer. The bottom layer shall be tamped throughout its depth. when the highest layer had been rodded, the surplus amount of concrete shall be affected off and level with a trowel or the tamping rod, in order that the Mould is precisely crammed. Any mortar which can have leaked out between the Mould and therefore the base plate shall be cleansed away. The Mould shall be removed from the concrete at once by raising it slowly and thoroughly in vertical direction. The slump shall be measured at once by deciding the distinction between the height of Mould which of the best purpose of the specimen being tested. The slump measured shall be recorded in terms of millimeters of subsidence of the specimen throughout the check.

Slump

The height of the slump cone = 300mm

The height of concrete after subsidence = 110mm

Hence, the slump measured = 180mm



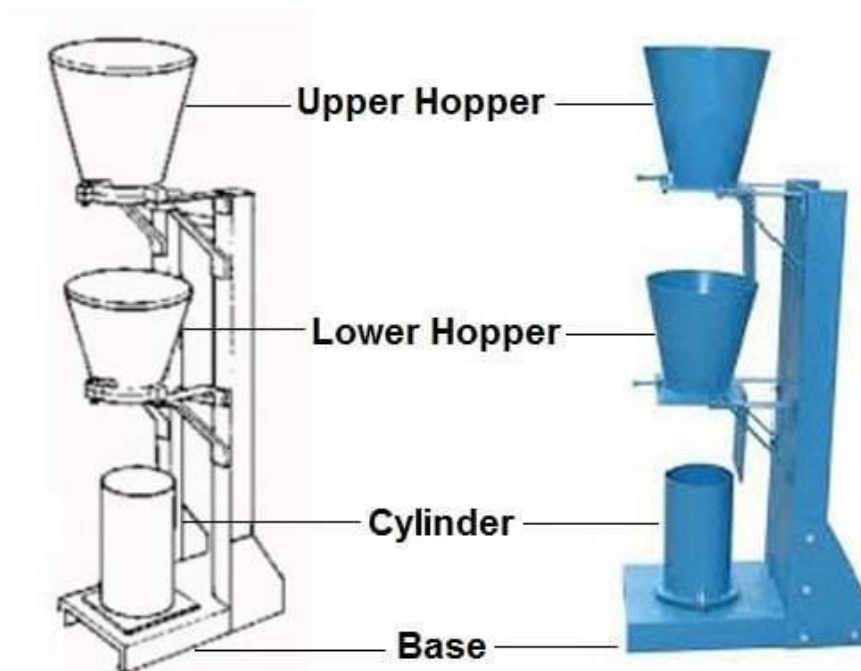
Procedure

1. Slump test as described in "IS 1199:1959 Specifications for Concrete Slump Test Apparatus (Fourth revision). Reaffirmed- Dec 2013". is performed, placing the slump cone inside the sheet metal cylindrical pot of the consistometer.
2. The glass disc attached to the swivel arm shall be moved and placed just on the top of the slump cone in the pot and before the cone is lifted up, the position of the concrete cone shall be noted by adjusting the glass disc attached to the swivel arm. The cone shall then be lifted up and the slump noted on the graduated rod by lowering the glass disc on top of the concrete cone. The electrical vibrator shall then be switched on and the concrete shall be allowed to spread out in the pot.
3. The vibration is continued till such a time as the conical shape of the concrete disappears and the concrete assumes a cylindrical shape. This can be judged by observing the glass disc from the top for disappearance of transparency.
4. Immediately when the concrete fully assumes a cylindrical shape, the stop watch is switched off. The time required for the shape of concrete to change

from slump cone shape to cylindrical shape in seconds is known as Vee Bee Degree.

5. This method is very suitable for very dry concrete whose slump value cannot be measured by Slump Test, but the vibration is too vigorous for concrete with a slump greater than about 50 mm.

4.7.2 Compaction factor



Compaction Factor Test on Concrete

Procedure of Compaction Factor Test on Concrete

1. Prepare M25 grade concrete. The mixture with 1: 1: 2 by mixing the required amount of water according to the water cement ratio and mix the fresh concrete.
2. See that the inner surface of the conical hopper should be free of moisture and apply grease to it. Close the trap door of the upper/top hopper.
3. Then measure the weight of the empty bottom cylinder as W_1 .
4. Fill fresh concrete into the upper/top conical hopper without disturbing the sample.
5. After this, the trap door of an upper hopper is opened. Thus, the concrete falls on the lower/bottom hopper.
6. Wait for 2-3 seconds and check if the entire concrete has fallen from the top hopper to the bottom hopper. If not, a slight tamping is done until the entire concrete falls into the bottom hopper.

7. Now open the bottom hopper trap door, and the entire concrete has fallen on the cylinder. Using the trowel, remove excess concrete on the top surface of the cylinder.

8. Weigh the cylinder with partially filled concrete as W_2 .

9. Then the cylinder is emptied, and the concrete sample is filled again in 3 layers, each layer being given 25 blows using a steel rod. Now, the concrete inside the cylinder is completely compacted.

10. Measure the weight of the cylinder completely with concrete as W_3 .

Calculation of Compaction Factor Value:

The compaction factor is defined as the ratio of the weight of partially compacted concrete to the weight of fully compacted concrete.

Compacting Factor = (weight of partially compacted concrete) / (weight of fully Concrete Concrete)

$$= W_2 - W_1 / W_3 - W_1$$

Here,

W_1 = Weight of empty cylinder.

W_2 = Weight of partially compacted concrete.

W_3 = weight of fully Concrete.

4.7.4 Setting time of concrete

The setting time of concrete is found by plunger needle test. This method of test is covered by IS 8142:1976. The apparatus consists of a container which should have minimum lateral dimension of 150 mm and minimum depth of 150 mm. Remove bleeding water from the surface of the mortar specimens just prior to making a penetration test by means of a pipette or a suitable instrument. To facilitate collection of bleeding water, tilt the specimen carefully to an angle of about 12° from the horizontal by placing a block under one side 2 minutes prior to removal of the bleeding water.

Insert a needle of acceptable size, relying upon the state of hardening of the mortar, within the penetration resistance equipment and produce the bearing surface of the needle into contact with the mortar surface. bit by bit and uniformly

apply a vertical force downward on the equipment till the needle penetrates the mortar to a depth of twenty-five millimeter as indicated by the scribe mark. The time needed to penetrate to the twenty-five-millimeter depth shall be close to ten seconds. Record the force required and therefore the time of application, measured as period once initial contact of cement and water. In future penetration tests lookout to avoid areas wherever the mortar has been disturbed by previous tests. The clear distance between two needle impressions shall be a minimum of 2 diameters of the needle being employed, but not but thirteen millimeters. The clear distance between any needle impression and therefore the side of the instrumentality shall be not but twenty-five millimeter.

Make penetration tests at hourly intervals for traditional mixtures and normal temperatures, the initial takes a look at being created when associate period of time of 3 to 4 h. For accelerated mixtures or high temperatures, it should be sensible to form the initial takes a look at when associate period of time of one or two h and ensuant tests at + h intervals. For low-temperature conditions or feeble-minded concrete mixtures, the initial penetration take a look at is also delayed for associate period of time of four to six h, and maybe longer. ensuant tests is also created at intervals of one h, unless the speed of increase in penetration resistance indicates that shorter intervals are fascinating. Not but six penetration resistance determinations Shah be created in every rate of hardening takes a look at and also the time intervals between penetration resistance determinations shall be like to administer a satisfactory rate of hardening curve, as indicated by equally spaced points. Continue the tests till one penetration resistance of a minimum of 26.97 N/mm²(275kgf/cm²) is reached.

4.8 TESTS ON HARDENED CONCRETE

The hardened concrete test consists of both the strength and durability properties of the concrete. The strength properties of concrete are carried out by compressive strength test, split tensile strength test, flexural strength test, cylindrical compression test.

4.8.1 Compressive Strength Test

This procedure is applicable for establishing testing technique for the compressive strength of concrete specimens. Specimens hold on in water shall be tested like a shot on removal from the water and whereas they're still within the wet condition. Wet condition is also maintained by covering the specimens with

wet gunny. The bearing surfaces of the testing machine shall be cleaned and dry loose sand or alternative material far away from the surfaces of the specimen that area unit to be in contact with the compression platens. just in case of the cubes, the specimen is placed in the machine in such a fashion that the load shall be applied to opposite sides of the cubes as forged that's, to not the highest and bottom. The axis of the specimen shall be carefully aligned with the middle of thrust of the spherically seated platen. No packing shall be use between the faces of the check specimen and therefore the steel platen of the testing machine. The loading rate shall be set to five.2 KN/sec for fifteen cm cube, to uniformly load the specimen as shown in fig 4.20. The load shall be applied while not shock, and raised incessantly till the resistance of the specimen to the increasing load breaks down and no bigger load will be sustained. the utmost load applied to the specimen shall then be recorded and therefore the appearance of the concrete and any uncommon options within the style of failure shall be noted.

Compressive strength (N/mm²) = $\frac{\text{Ultimate load in N}}{\text{Area of cross section (mm}^2\text{)}}$

Area of cross section (mm²)



Fig 4.18 compressive test

4.8.2 Split Tensile Test

This procedure is applicable for establishing testing methodology for the split durability of concrete specimens.

Specimen once received dry shall be unbroken in water for twenty-four hours before they're taken for testing. Unless different conditions square measure needed for specific laboratory investigation specimen shall be tested at once on removal from the water while they're still wet. Surface water and grit shall be wiped off the specimens and any sticking fins far from the surfaces that square measure to be involved with the packing strips. Marking - diametric lines shall be drawn on the 2 ends of the specimen victimisation any appropriate procedure and device which will make sure that they're within the same axial plane. putting of the specimen within the Testing Machine- The bearing surfaces of the testing machine and of the packing strips shall be cleaned as shown in fig four.21.

Positioning – one amongst the laminate strips shall be cantered on the middle of the lower platen. The specimen shall be placed on the laminate strip and aligned so the lines marked on the ends of the specimen square measure vertical and focused over the laminate strip. The second laminate strip shall be placed lengthwise on the cylinder, focused on the lines marked on the ends of the cylinder. The assembly shall be portioned to make sure the subsequent conditions:

- The lines marked on the ends of the specimen square measure vertical which the projection of the plane of the 2 lines marked on the ends of the specimen intersects the middle of the platens, and
- The supplementary bearing bar or plate, when used, and also the center of the specimen square measure directly at a lower place the middle of thrust of the spherical bearing block.

Rate of Loading – The load shall be applied while not shock and inflated unceasingly at a rate to supply around a ripping tensile stress of roughly fourteen to twenty one kg/cm²/min till the resistance of the specimen to the increasing load breaks down and no larger load will be sustained. This rate of loading for fifteen cm diameter and thirty cm length cylinder works out 1.62 kN/sec to 2.43 kN/sec.

the most load applied to the specimen shall then be recorded. the looks of concrete and any uncommon options within the sort of failure shall even be noted.

The measured splitting tensile strength (Tsp) of the specimen shall be calculated to the nearest 0.01N/mm² using the following formula

$$\text{Split tensile strength (N/mm}^2\text{)} = \frac{2P}{\pi L D}$$

Where,

P= maximum load in N applied to the specimen,

d= measured diameter is mm of the specimen, and

L = measured length in mm of the specimen.



Fig 4.19 Split Tensile Test



4.8.3 Flexural Strength test

This procedure is applicable for establishing checking technique for the flexural strength of test specimens. Specimens hold on in water at a temperature of 24o to 30o C for forty eight hours before testing shall be tested forthwith on removal from the water while they're still in a very wet condition. No preparation of the surfaces is needed.

The bearing surfaces of the supporting and loading rollers shall be cleaned, and any loose sand or different material far from the surfaces of the specimen wherever there to form contact with the rollers. The specimen shall then be placed within the machine in such a fashion that the load shall be applied to the upmost surface as solid within the Mould, on 2 lines spaced two hundred millimeter apart. The axis of the specimen shall be fastidiously aligned with the axis of the loading device. The bed of testing machine ought to be given 2 steel rollers 38mm in diameter on that the specimen is to be supported, and these rollers ought to be placed at distance 600mm c/c. No packing shall be used between the bearing surfaces of the specimen and also the rollers as shown in fig four.22.

The load shall be applied while not shock and increasing incessantly at a rate such the acute fiber will increase at roughly 0. 7 kg/sq cm/min, that is, at a rate of loading of 400kg/min for the hundred and fifty millimeter specimens. The load shall be enhanced till the specimen fails, and also the most load applied to the specimen throughout the check shall be recorded. the looks of the broken faces of concrete and any uncommon options within the variety of failure shall be noted.

The flexural strength of the specimen shall be expressed because the modulus of rupture shall be calculated to the closest zero.05 N/mm2 as follows:

$$\text{Flexural strength (N/mm}^2\text{)} = \frac{P L}{B D^2}$$

Where,

b= measured width in mm of the specimen,

h= measure depth in mm of the specimen at the point of failure,

l= length in mm of the span on which the specimen was supported,

P= maximum load in N applied to the specimen.



Fig 4.8 Flexural Strength Test

CHAPTER 5

RESULT AND DISCUSSION

5.1 EXPERIMENTAL TEST RESULTS

The following results have been discussed below with tabulations and figures.

5.1.1 Compressive strength test (*cube*)

- Incorporate of tannery sludge as a partial replacement of fine aggregate by 30% by weight gives good result in compressive strength 28days as well as 28 Days normal control mix. Further increase of tannery sludge percentage gradually decreases the compressive strength.

Table 5.1.1 Compressive Strength of Cubes

SI.NO	SAMPLES	Percentage (%) Tannery sludge	7 DAYS N/mm ²	14 DAYS N/mm ²	28 DAYS N/mm ²
1	Conventional mix	0%	14.63	18.11	23.15
2	Mix 1	10%	17.25	23.75	30
3	Mix 2	20%	19	26	35
4	Mix 3	30%	19.5	32	44.5

The cube compressive strength test has been discussed about the comparison of both conventional concrete and optimum percentage of partial replacement 30%in concrete is expressed in terms of graphs as shown in fig 5.1

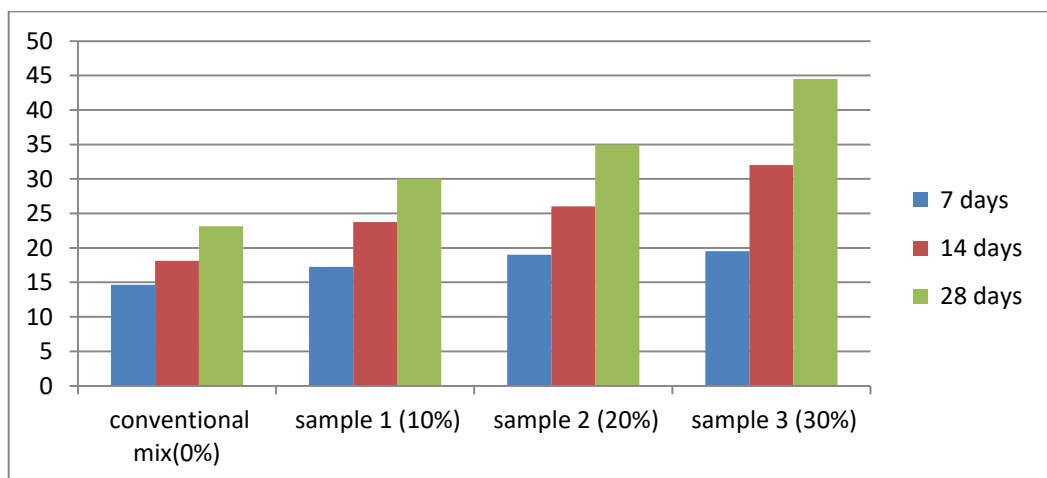


Fig 5.1.2 Optimum Replacement of Compressive Strength Test

Split Tensile Strength for (cylinders)

- Split tensile test in cylinder is most famous and important test which is carried out in total 8 numbers of trial mix.
- The result shows the substance material replacement of 30%(by weight)mixes were gives the higher value compare to normal control mix at age 28 days
- Based on above test results partial replacement of tannery sludge in fine aggregate along with tannery sludge has increased the split tensile value of 30% as compare to normal control mix were tabulated in table 5.1.2

table5.1.2 split tensile strength

SI.NO	Samples	28 th days (N/mm ²)
1	Conventional mix (0%)	2.09
2	Mix (10%)	3.47
3	Mix (20%)	3.69
4	Mix (30%)	4.35

The cylinder split tensile strength test has been discussed about the comparison of both conventional concrete and optimum percentage of partial replacement of 30% in concrete is expressed in terms of graphs as shown in fig.5.2

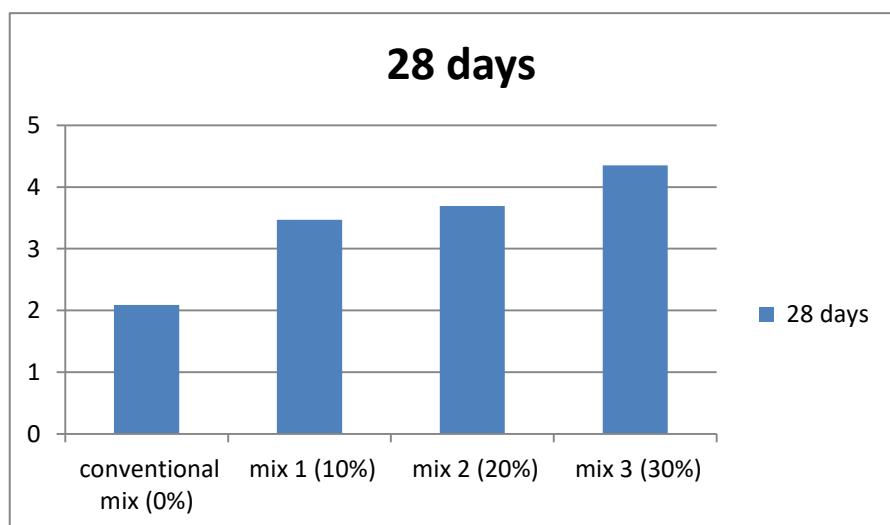


Fig 5.2 Optimum Replacement of Split Tensile Strength Test
Flexural strength test (prism)

- Flexural strength test as age 28 days were carried out in all the trial mix prism. The results of partial replacement tannery sludge by 30% (by weight) Shows comparatively good amount higher value compare to normal control mix.
- Apart from the flexural value of prism in optimum content show more than IS 456.2000 Code provision minimum recommended value of M25 grade were tabulated in table 5.1.3.

Table 5.1.3 Flexural Strength Test

Sl.No	samples	28 th days
1	Conventional mix (0%)	6
2	Mix 1 (10%)	5.86
3	Mix 2 (20%)	7.15
4	Mix 3 (30%)	9

The prism flexural strength test has been discussed about the comparison of both conventional concrete and optimum percentage of partial replacement of 30% in concrete is expressed in terms of graphs as shown in fig 5.3

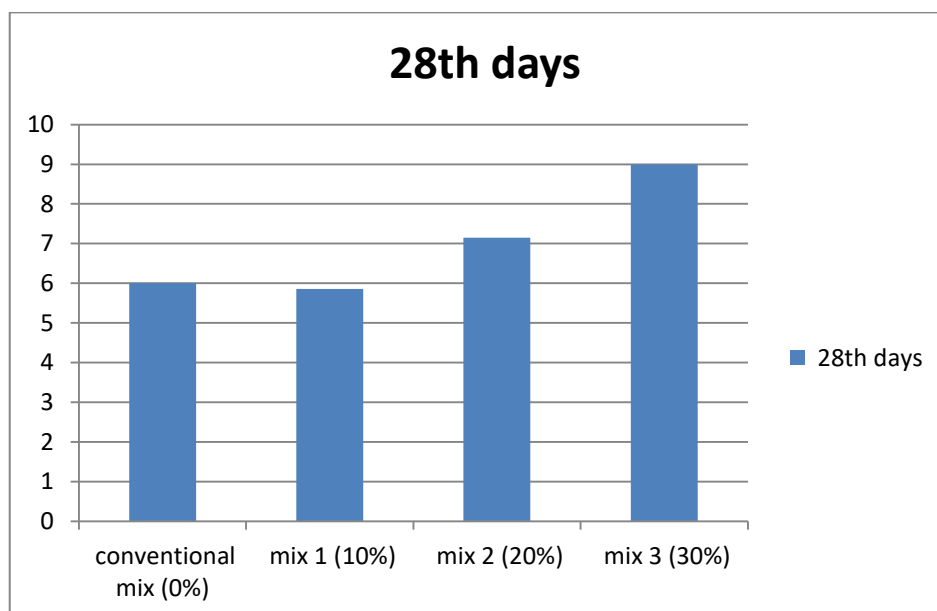


Fig.5.3 Optimum Replacement of Flexural Strength Test

CHAPTER 6

CONCLUSION

6.1 GENERAL

The following conclusions are given below:

- Incorporation of tannery sludge as a partial replacement of fine aggregate in concrete gives good result in both fresh and hardens state. In high volume of replacement is gives good strength and workability then low volume of replacement.
- Mechanical behavior of conventional and tannery sludge concrete cube, cylinder , prism were studied for compressive, split tensile strength and flexural strength with curing time of 7 ,14,and 28 days.
- Compressive, split tensile strength and flexural strength of tannery sludge concrete increases and becomes maximum at about 30% and then decreases.
- At the level of 30% replacement of fine aggregate by tannery sludge meets maximum strength us compare to that of conventional concrete and other replacement of concrete.

It can be concluded from the above result that 30% replacement of tannery sludge waste with fine aggregate is the best proportion. The tannery sludge wastes loaded in to concrete which makes its useful. The partial replacement of tannery sludge as fine aggregate concrete makes concrete strengthen. Thus our project states the tannery sludge concrete can be strengthen by tannery sludge waste replacement .

REFERENCE:

1. M.Angeline Swarna & R.Venkatakrishnaiyh, A paper on "Manufacturing bricks using Tannery effluent sludge". IJRDET, volume 1, issue 1, oct-2013
2. M. Angeline Swarna and R. Venkatakrishnaiyah (2014), A paper on "Manufacturing bricks using Tannery effluent sludge". IJRDET, volume 3, issue 4, oct-2014
3. P. C. Sabumona (2010), A paper on "Textile and tannery ETP sludge as cement replacement". IJRDET, volume 1, issue 1, June – 2010.
4. Anoop.S, A paper on "Optimum mix parameters of concrete using recycled plastics" IJRDET, volume 2, issue 3, april – 2008.
5. MahhiHaroun (2008), A paper on "characterization of tannery sludge and development as composting material"
6. Oladoja (2011), A paper on "proper disposal of tannery sludge using anaerobic digestion method".
7. Baskar.R and Meera Sheriffa Begum.K.M (2006), "Characterization and reuse of textile effluent treatment plant", Journal of the University of Chemical Technology and Metallurgy, 41, 4, 2006, 473-478.
8. Angeline Swarnal.M & Venkatakrishnaiah.R,"Manufacturing of bricks using tannery effluent sludge"International Journal of Recent Development in Engineering and Technology (ISSN 2347-6435) Volume 3, Issue 4, October 2014.
9. Raghunathan .T , Gopalsamy .P , Elangovan.R , "Studyon Strength of Concrete with ETP Sludge from DyeingIndustry", International Journal of Civil and Structural Engineering ,ISSN 0976 – 4399, Volume 1, No 3, 2010.
10. Amiya Akram , C. Sasidhar , K. Mehraj Pasha ,"E-Waste Management by Utilization of E-Plastics in Concrete Mixture as Coarse Aggregate Replacement", International Journal of Innovative Research in Science,Engineering and Technology, ISSN(Online) : 2319-8753, Vol. 4, Issue 7, July 2015 pp1-8.

11. Balasubramanian.j ,Sabumon. P.C, John U. Lazar,Ilangoan. R (2005)-
'Reuse of textile effluent treatment plant sludge in building materials',
article in Waste Management 26 (2006) 22–28.
12. Dhiraj Agrawal ,Pawan Hinge , Waghe. U. P, Raut. S.P (2014), "Utilization
of industrial waste in constructionmaterial – A review", International
Journal of Innovative Research in Science, Engineering and Technology
ISSN: 2319-8753.
13. Nirmal kumar.K and Siva kumar. V (2008), "A study on the durability
impact of concrete byusing recycled waste water", Journal of industrial
pollution control 24 (2008) pp 1-8.
14. Pande. A.M, Makarande. S.G (2013)," Effect of RiceHusk Ash on Mortar",
International Journal of Engineering Research and Applications (IJERA)
ISSN: 2248-9622 Vol. 3, Issue 1, January -February 2013, pp.1710-1717.
15. Senthol kumar K., Shiva kumar V. and Akilamudhan P. (2008)-
'Experimental studies on disposal of various industrial solid wastes',
Journal of modern applied science, Vol-2, No-6, pp128-132.
16. ACI (2002), Building Code Requirement for Structural Concrete (318-02)
and Commentary (318R-02), American concrete institute, Farmington hills,
MI, USA, 2002.
- 17.Al-Tabbaa, A., and Perera, A. (2006), "State of Practice Report
UK Stabilizaton/Solidification Treatmentand Remediation: Binders &
Technologies- Part II Research", Cambridge University Engineering
Department, Cambridge, UK.
- 18.Ali, A., Ahsanuzzaman, A. N. M., Badruzzaman, A. B. M. and Rahman, M.
M. (1998), Lead Pollution in Dhanmondi Lake in Dhaka, Aqua, volume 7,
no. 6, December 1998.
- 19.Asavapisit, S., Naksrichum, S., and Harnwajanawong, N. (2004),
"Strength, leachability and microstructure characteristics of cement-based
solidified plating sludge", Environmental Technology Division, School of
Energy and Materials, King Mongkut's University of Technology Thonburi,
Thailand.
- 20.Ashfaque, K.N. (1999), Analysis of Heavy Metals in Bed Sediments of
Dhanmondi Lake, M.Sc. Thesis, Department of Civil Engineering,

Bangladesh University of Engineering and Technology, Dhaka, Bangladesh.

21. Azom, M. R., Mahmud, K., Yahya, S. M., Sontu, A., and Himon, S. B. (2012), "Environmental Impact Assessment of Tanneries: A Case Study of Hazaribag in Bangladesh", International Journal of Environmental Science and Development, Vol.3, No. 2, April 2012.
22. Sathish Kumar V and Vijayaravind S, "Utilization of Tannery Shredded Waste as Fine Aggregate in Concrete" International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 IJERTV4IS040777 www.ijert.org Vol. 4 Issue 04, April-2015.
23. J. Rajaram, B. Rajnikanth, A. Gnanamani, "Preparation, Characterization and Application of Leather Particulate-Polymer Composites (LPPCs)" Journal of Polymers and the Environment September 2009.
24. Nitish Puri, Brijesh Kumar, Himanshu Tyagi "Utilization of Recycled Wastes as Ingredients in Concrete Mix "International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-2, Issue-2, January 2013.
25. A. Venkatachalam, P. Devadas Manoharan "Design of High Performance Bituminous Mix Using Tannery Waste" Proceedings of 27th IRF International Conference, 14th June 2015, Chennai, India, ISBN: 978-93-85465-35-2.