PARTIAL REPLACEMENT OF COARSE AGGREGATES BY E-WASTE AND FINE AGGREGATES BY HDPE GRANULES SIMULTANEOUSLY

Submitted in partial fulfillment of the requirements of the award of the degree of

Master of Technology

In

Civil Engineering

by

AAKASH GARG

18032010362

Under the guidance of

DR.SUPRAKASH BISWAS

SCHOOL OF CIVIL ENGINEERING

GALGOTIAS UNIVERSITY

GREATER NOIDA

May, 2020

ACKNOWLEDGEMENT

I am highly grateful to**Prof. (Dr) Manju Dominic,**Dean of the School of Civil Engineering for giving me her advice and facilities for the successful completion of my project.

It gives me great pleasure to express my deep sense of gratitude and indebtedness to my guide **DR.SUPRAKASH BISWAS**. Professor, School of Civil Engineeringfor his proper guidance, valuable support and encouragement throughout the project. I am highly obliged to him/her for providing me with this opportunity to carry out my ideas and work during my project period and helping me to gain the successful completion of my Project.

I am also highly obliged to**. DR.SUSHIL KUMAR SINGH** project coordinator for providing me with all possible support and their valuable encouragement throughout my project.

My special thanks are going to all of the faculties and staff of the School of Civil Engineering, Galgotias University,for encouraging me constantly to work hard inthis project. I pay my respect and love to my parents and all other family members and friends for their help and encouragement throughout this course of project work.

CERTIFICATE

This is to certify that the project work entitled **" PARTIAL REPLACEMENT OF COARSE AGGREGATES BY E-WASTE AND FINE AGGREGATES BY HDPE GRANULES SIMULTANEOUSLY**" submitted by AAKASH GARG **(18SOCE2010020)**to the School of Civil Engineering, Galgotias University, Greater Noida, for the award of the degree of **Master of Technology in Civil Engineering** is a bonafide work carried out by him under my supervision and guidance. The present work, in my opinion, has reached the requisite standard, fulfilling the requirements for the said degree.

The results contained in this report have not been submitted, in part or full, to any other university or institute for the award of any degree or diploma.

(PROF.)DR.SUPRAKASH BISWAS

(Prof. (Dr) Manju Dominic)

Professor

Dean,

Guide
School of Civil Engineering

External Examiner

DECLARATION

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken whenneeded.

Date: **(AAKASH GARG)**
Place: **18SOCE2010020**

ABSTRACT

E-waste is the challenge every nation is currently grappling with. Since e-waste is not portable and the rise in electronic product use is expanding this issue. This problem is increasing. Deposits are the most efficient form of recycling, and this process requires a broad land area that is problematic to reach . But concept of selective replacement of aggregates using e-waste as an element of concrete. We cannot replace it completely as aggregate provides some key properties to concrete like strength, durability and workability. Using e-waste as building material seems right when we look at the amount of aggregate required for making concrete and if we are able to reduce that amount it will be very beneficiary as it reduces the load from the natural resources.

In this work we did the usage of E-waste for field add-ons in the concrete mix M20 separately and then we measured the level of stress, flexure intensity and tensile resistance at the percentage of E-waste with coarse aggregates from 0%, 3%, 7.5%, 12% and 15% respectively the results shows increase in compressive strength and thendecrees in flexure strength which gives light weight of concrete.

We use HDPE separately, including Fine aggregates in the M20 concrete mix, as opposed to the compression intensity, flexure resistance & Split tensile force measurements for HDPE percentage and fine aggregates. From 5%, 7.5%, 10%, 12.5% and 15% respectively the results shows increase in compressive strength and then decrease in flexure strength which gives light weight of concrete as well.But as per our topic it is clear that we have to use both e-waste and hdpe simultaneously. We make a mix of concrete M20 in which we use the same percentage of Ewaste in coarse aggregates and HDPE as a fine aggregates and same tests and results shows that use of both simultaneously increases the strength of M20 concrete up to 60%.

Mankind affects the world in which it resides from prehistoric times. Such effects are also undesirable. The generation of waste is one such harmful consequence. We are an animal which has often left a lot of garbage, food artifacts, different items, remains and much more to make such materials. Firstly, society utilized small energy and, unfortunately, became degradable. As a part of the company's growth, more resources and less decomposable or depreciable resources are correlated with the desire for new, more desirable goods, produced and hand in hand. The higher society the more pollution it creates, the greater the degree of growth.

This conduct, however, contrasts with environmental sustainability. Fortunately, further effort is being made to reduce waste, i.e. reuse of wastes.

Waste usage is an effective disposal since the utilization of waste content lowers the expense of concrete in residential construction. As per replacement, RCA amounted to 0%, 5%, 10% and 15%, respectively. Limited substitution of RCA by E waste relative to standard concrete to achieve mechanical characteristics and chemical properties (corrosion and alkaline attack) (compressed and bending resistance). Electronic waste is an increasing threat causing severe contamination and human issues. Removal of this is a challenging problem. E-waste is perceived to be the most feasible method for the processing of significant amounts of e-waste products in the concrete field. Owing to rising prices of ordinary rough aggregates, civil engineers were compelled to consider appropriate alternatives. For coarse aggregates, e-waste is used as one such substitute. Because of the scarcity of the rough compound for concrete preparation, a partial substitution of e-waste was attempted with the rough compound.The findings of the study have shown that in E-waste concrete major gains were made in compressive strength comparison with normal concrete. The recovery of E-pollution eliminates pollution and saves energy.The fresh concrete was tested for slump test, while the hardened concrete for compressive strength. The inclusion of concrete of new plastic granules contributed to the creation of low weight concrete. The findings were noticed. In this research, Virgin plastic granules have been used as a partial substitute of natural coarse concrete aggregates (NCA). The amounts planned for new plastic granules ranged from 0% to 15%. The compressive strength of each sample was determined and compared with conventional concrete mix. The use of Plastic in concrete mix for a given w/c ratio, reduces the tensile and Compressive strength and also lower the density.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1
INTRODUCTION

1.1 Introduction

Electronics waste could be understand as a destructionproduced by rejected or damage electronic devices. It is a new concern which can create severe environmental issues because electronic waste can hardly be easily disposed of without doing harm to the ecosystem. The traditional method of e-waste disposal is to dump waste in landfills, but this method has many serious problems because it requires a lot of rare lands in our country and also contains many different hazardous materials such as lead, cadmium, beryllium, etc. These substances can pollute the soil when mixed with the soil, and contaminate the soil when mixed with groundwater, which is also very harmful to anyone, and if one consumes this water, this may trigger severe health issues and can also reverse them in certain situations cause cancer. In India, we produced around 15 million tons of e-waste, and by 2018, this number will reach 30 million tons, 3% of the e-waste generated has been properly decomposed, and the rest is decomposed by waste. Young sellers who do not worry about the harmful effects of e-waste

1.2 Aggregates

It is a granular rocky material made up of a sequence of <0.10 mm to > 50.00 mm in thickness. Granular content such as sand, rubble, moved dirt, hydraulic concrete pellets or slag are aggregates that are used to manufacture concrete or slurry in hydraulic cemented media. Crude and fine aggregate forms are included. Increasing category type depends on its scale and is classified into many forms of classifications. When the aggregates are mixed with cement or bonding materials, it is called bonding material, and when cement or bonding materials are not used, it is called non-aggregate.

1.2.1 Aggregate Origin and Geology

Aggregates are typically produced by natural rocks splitting. Thecompound's composition depends on the molten, sedimentary or metamorphic source material. In order to assess the appropriateness for specific purposes, complete evaluations are analyzed. Metallurgy, particle size, texture, and rock features of rock samples can also be used to evaluate applicability.

Total rough, more economical confused. Larger blocks provide less space for particles than equal smaller blocks. Using the maximum permissible coarse aggregate size reduces the need for cement and water. Use aggregates greater than the maximum permitted measurements of ground aggregates can result in arches or obstructions in concrete forms being entangled with and shaped. This makes the area shown underneath invalid, or at best can only be filled with fine sand and cement particles, making the area thinner.

Figure 1. 1 Aggregate

For Coarse Aggregates in Roads following properties are desirable:

1. Strength
2. Hardness
3. Toughness
4. Durability
5. Shape of aggregates
6. Adhesion with bitumen

1.2.2 Fine Aggregate

Another form of conglomerate is one that passes through a 9.5mm (3/8 ") sieve, passes almost entirely through a 4.75mm sieve (No. 4), and remains mainly on a 75 ونm screen (No. 200) sum. In order to improve workability and achieve economy by reducing the amount of cement, good aggregate must have a circular form. The exact assembly is calculated by filling the vacuums in the ground community and using it as a process able device. Aggregate properties have an effect on the final concrete. For example, changes in size, grade, texture, shape, and assembly strength mean changes in the properties of the resulting concrete. See also: Impact of aggregate properties on concrete

1.2.3 Uses of Aggregates

Specifically, the application of aggregates to moderate cracks for economic reasons and, more specifically, giving framework energy.In roads and ferroviary it is used to spread loads and reduce groundwater losses on roads as the foundation or bottom layer and/or road surface in different shapes. Boost concrete quantity and thus rising prices. The Poole accounts for roughly 60%-75% of the concrete amount and the PCC accounts for 79%-85%. It affects strength, wear resistance, elastic frame and other concrete properties, rendering it longer-lasting, tougher and more accessible.

Filling, backfilling, sanitary and filtration systems are other technologies.

1.2.4 Properties of concrete aggregates

The aggregate forms the bulk of the amount (60-80%) of the concrete. More than 75 percent of the amount is obtained for most conventional concrete. Bilateral durability (the aggregate does not readily break or decline), strength resistance and degradation, and aggregates in concrete, are economically (since cement is expensive).

1.3 Classification of aggregates

Generally, the coarse aggregate size is greater than 4.75 mm, and the good aggregate size is smaller than 4.75 mm. In most structural applications, the maximum volume is a maximum of 40 mm for coarse aggregate, while for large amounts of concrete such as dams, the maximum size is 150 mm. On the other hand, the maximum particle size of the fine aggregate was 0.075 mm.Figure 1.2 shows a typical particle size analysis for coarse and thin aggregates.

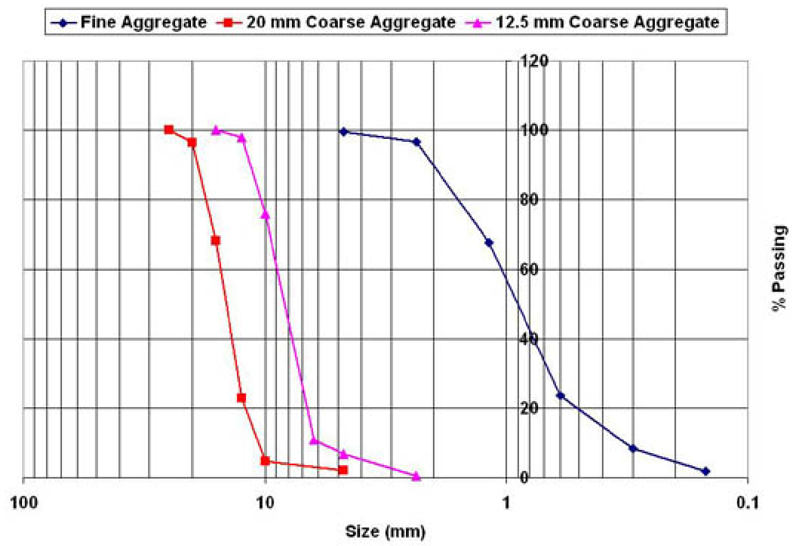


Figure 1. 2 Sieve analysis of Particle for size distribution of aggregates

Overall scores can be illustrious based on a screening investigation. Aggregates displaying fractional supply scopeof portions within a limited size range (such as 20mm and 10mm aggregates in Figure 1.2) are referred to as “standard” degrees, whereas aggregates displaying continuous size grades (sand in Figure 1.3 grains) are called “good”. Or continuous classification. When a summary of one or more volume scores appears within a well-defined and well-spaced range, the classification is called a "gap". The ultimate goal is to use a mixture of coarse and fine concrete aggregates to continuously define the proportions and establish the optimal loading of the aggregate. Later on in the Mix Architecture connection this question is tackled. The amounts may be divided into both natural and synthetic, depending on the source. Natural agglomerations can often be categorized into aggregates that can be used as they are (for example, river pebbles) and broken stone aggregates. Industrial aggregates, though, are chemically formed aggregates (see figure 1.3 for lightweight calcined fly ash aggregates) such as slag, glass and fly ash.

Figure 1.3 Pelletized and sintered fly ash makes a good lightweight aggregate

In terms of their number, the sum may also be categorized as small, regular and high. The density ranges between 800-1000 kg / m3, whereas natural weight aggregates, such as calestone or granite vary between 2500 to 2900 kg / m3 or hard aggregates like hematite and barite, with a density of 5400 kilogram / m3. The vary is from 800 and 1000 Kg / m4, for natural weights, like calestone or granite.

1.4 Complementary power, modulus and durability usually greater than concrete is the overall power individually evaluated. In concrete, though, the aggregate is higher than standard concrete, although the aggregate value of a very solid cement layer is weaker than the strength of the concrete. The ultimate intensity depends on how the parent rock is formed, textured and organized. The elasticity modulus is correlated with the power of the structure. For many reasons it is important.

• The value of E for the total differs from the value of the welding dough, which causes the interface to be incompatible, so this area is easy to break. Figure 1.5 illustrates a typical pattern for developing a crack under pressure loads. Interlayer cracks are formed first and then spread out toward the mortar.

• Total hardness can affect concrete deformation due to creep and shrinkage. The harder the kidney, the smaller the total deformation.

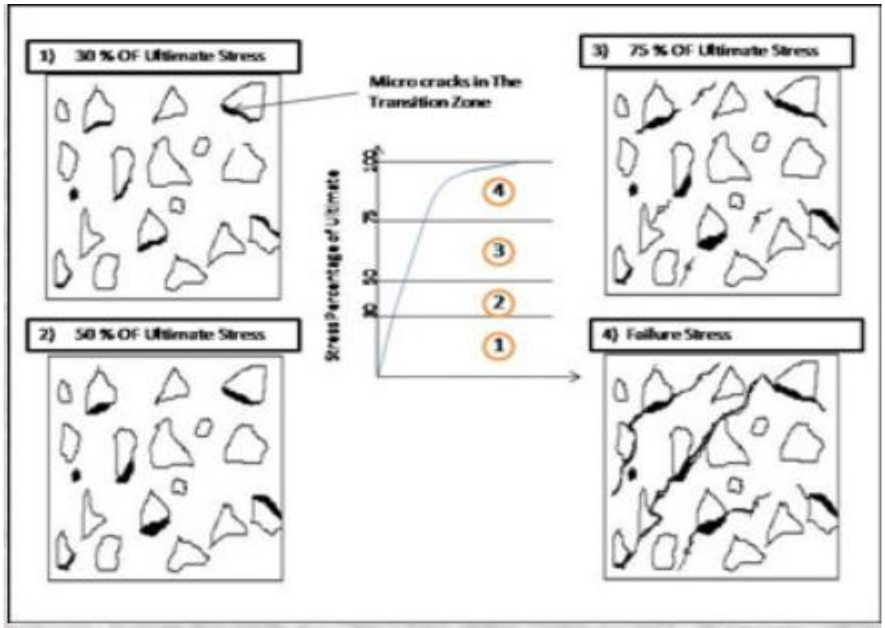


Figure 1. 4 Crack expansionshape of concrete in compression

1.5 Specific gravity and bulking

Totals are porous and have many voids, some are permeable and some are impermeable. This grouping feature makes it difficult to describe the specific gravity value. Depending of the measurement process used, the saturated and measurable surface drying cycle comprises of three forms of basic gravity that are measured in significant amounts. The true gravity of the sum (unless it is compressed to the smallest amount) cannot be calculated as the actual aggregate volume cannot be determined (because some holes are completely inaccessible). This phenomenon is called swelling. In the aggregate of the aggregate, bloating can cause problems, as well as difficulties in mixing and pressing.

1.6 Deleterious substances in aggregate

• Water may be interfered with by impurities, including organic content

• Paste coating which affects the overall bond properties such as clay

• Solid and heavy materials, such as salt and pore aggregates, resulting in high degrees of water absorption and low intensity.

The reliability of the overall number is because it can tolerate unnecessary volume shifts from changes in physical conditions. Total absorption and porosity mainly determine its stability. The strength of the concrete aggregate was tested by moisturizing the weight loss was calculated by salts and associated cracks and the drying processes of sodium sulphate (as a liquid moisturizer) and the weight loss.

1.7 Purpose of Aggregates

Large, coarse solid bulk particles form the primary structural component of concrete. The voids between coarse macroscopic macromolecules are filled with smaller particles. Voids between smaller molecules are filled with smaller molecules. Finally, the space between the smallest coarse aggregate molecules is filled with the largest microscopic particles. In contrast, the distances between the largest of the micro particles are filled with the smaller microtomes of the aggregate, and the voids between the smaller microspheres are filled with the smaller particles. Finally, the voids between the finest grains are filled with cement. It can be seen that the better the classification of the aggregate (i.e. the better the particle size distribution), the stronger the voids will be filled, the higher the density and strength of the concrete.

Cement and water form a paste that holds solid particles firmly together as it hardens. In a rigorously graded, well-designed and well-mixed batch, each aggregate particle is thoroughly covered with cement-water slurry. When the cement-water paste hardens, each particle is firmly bonded to the adjacent particles.

Aggregate Sieves

The total screen size is determined by the number of grids that are linear in the screen. The higher the number, the more accurate the screen. Anything left in sieve 4 can be considered approximate or fine. Totals greater than all four; smaller ones are fines. The fourth aggregate is the dividing point. The finest rough aggregate screen is the same as the number 4 screen used in fine rough aggregate screen. With this exception, rough assembly screens are determined by the size of one of its slots. The sieves commonly used are 1 1/2 inch, 3/4 inch, 1/2 inch, 3/8 inch and 4 size. Any material that passed through sieve number 200 was very good for use in concrete. .

Particle Distribution

Experiences and experiments have shown that for ordinary concrete, certain distributions of particles always achieve the best results. For conventional totals, Table 1.1 shows the recommended particle size distributions from No. 4 to No. 100.

By extracting a representative sample from the material, sifting the sample through a series of sieve sizes ranging from coarse to fine, and determining the percentage of the sample trapped in each sieve, the distribution of particles in the total can be determined. This process is called performing a screening analysis. For example, suppose the total sample weighs 1 lb. Place it on sieve number 4 and shake the sieve so that no other sieve passes through. If the residual weight on the sieve is 0.05 lbs., then 5% of the total sample will remain on sieve # 4. A sieve place passed over sieve number 8 and shake. Suppose you find that the remaining weight in this sieve is 0.1 lbs. Since 0.1 lbs. equals 10% of one pound, 10% of the total sample is still on sieve # 8. The cumulative weight retained is 0.15 lbs. Divide 0.15 by 1.0 lbs. and you will find that the total weight retained is 15%. Rough aggregate sizes are usually defined as the range between smaller and larger sizes; for example, from 2 inches to 4 and 1 inches to 4

Table 1. 1 Recommended Distribution of Particle Sizes

SIEVE NUMBER	PERCENT RETAINED ON AQUARE MESH LABORATORY SIEVES
3/8”	0
No. 4	18
No. 8	27
No. 16	20
No. 30	20
No. 50	10
No. 100	4

1.8 E-Waste

It is the waste produced by the electronic disposal. It is an ongoing problem which causes serious environmental issues, as e-waste cannot be disposed efficiently without harming the environment. The conventional form of e-waste management is dumping waste into land fill but this method has so many serious problems as it needs a lot of landmass which is in scarcity in our country and it also contains so many different harmful materials like lead, cadmium, beryllium etc. these materials when mixes with soil they contaminate the soil and when mixes with ground water they contaminated it also makes it very harmful to consume by any anyone and if someone consume this water it with cause serious health issues and in some cases it even cause cancer. In India we generate about 15 million metric tons of e-waste and this number is going to 30 million metric tons by the year 2018 and still 3% of the e-waste generated in is decomposed properly and the rest of it is decomposed by the small peddlers who will not concern the harmful effects of the e-waste.

E-waste is a problem that is currently being addressed in every country. Since there is no way to dispose of electronic waste, and as consumption of electronic products grows, this problem gets worse. The most effective way to dispose of electronic waste is through landfills, which require a lot of land, and are difficult to find today. Therefore, it is a good idea to use electronic waste as a component in concrete by partially replacing aggregates. We cannot completely replace it because the assembly provides certainelementaryassets of concrete, such as strength, durability and operability. When we look at the amount of aggregate needed to make concrete, and if we can reduce this amount, the use of electronic waste as building material seems right because it reduces the burden on natural resources.

No building project without the usage of concrete can be pictured in the present scenario. Concrete is the construction material most commonly used in the building industry. Its strong strength and longevity are the primary explanation for its success. Today, the planet is moving quickly and our climate is evolving slowly. The focus is on the environment, natural resource conservation and waste recycling.

1.9 High-Density Polyethylene (HDPE)

High-density polyethylene (HDPE) is a thermoplastic polymer produced from ethylene monomer. When used in HDPE pipes, it is sometimes called "alkane" or "polyethylene". HDPE has high strength to density and can be used to produce plastic bottles, wear-resistant tubes, geomembrane and plastic wood. HDPE is usually recyclable and the resin identification number is "2".

Figure 1. 5HDPE sample size

HDPE's high density-to-density ratio is known. The density range is between 930 and 970 kg / m3. Although HDPE is significantly higher than HDPE, HDPE has no branching that enhances the power between particles and the tensile strength relative to LDPE. It is more complex, cleaner and immune to higher temperatures (120 degrees Celsius / 248 degrees F short-term). Unlike polypropylene, HDPE is not able to withstand the normally required autoclave conditions. By choosing the correct catalyst (for example, the Ziegler-Natta catalyst) and reaction conditions, it can be ensured that no bifurcation exists.

1.9.1 HDPE and Different Solvents.

Depending on the training procedure used to build a specific sample, the physical properties of HDPE can differ. In certain cases, a globally validated evaluation system is the deciding factor for evaluating such characteristics of a complex procedure. For instance, a static tensile test (NCTL) is used in the rotational modulation to evaluate the resistance of an environmentally stressing sample crack.

1.9.2 The Process of Making HDPE

HDPE is manufactured under controlled conditions through the use of a large amount of heat on petroleum. This process is also called "cracking" and helps produce ethylene gas. During the production process, the gas molecules will stick to form the polymers and then form the polyethylene. After this process, the polyethylene will have adhesive appearance, but after a series of mold processing, it will become granular. After the molding process is complete, you will get a strong polymer material that can be used for many purposes and applications in your home or factory.

1.9.3 HDPE Uses and Applications

Since HDPE is a universal material, it has many uses. Most notably, it is used to fill bottles. Because of its durable structure and recycling, it is one of the most popular materials for liquid containers. It is also used to contain hazardous materials and agricultural chemicals. HDPE can be made in durable furniture. HDPE also has important uses and applications in commercial building design. Because of its chemical properties, HDPE materials are resistant to heat, moisture, scratches and scratches. This makes it an ideal material for garden furniture, commercial lockers and commercial bathroom partitions.

No construction project can be pictured without utilizing concrete in the present scenario. The most widely used building material in the building industry is concrete. Its strong strength and longevity are the primary explanation for its success. Today the planet advances very fast, and our climate is slowly evolving. The emphasis is on natural resources management, the atmosphere and waste material recycling. E-waste is one of the latest pollutants found in the construction sector. In particular, recycling principles include awareness that e-waste is an evolving concern that raises significant contamination issues for humans and the ecosystem. E-Waste defines unused, redundant, damaged, electrical or mechanical equipment that are largely recycled. Rapid progress in technologies, low initial expense, have contributed to an increasingly growing surplus worldwide in technological waste. E-waste will be disposed of for many tons each year. E-waste includes several contaminants and chemicals that, if not adequately handled, cause significant safety and environmental problems. The easiest of all the industrial polymers it has a rather basic structure. The polyethylene molecule is a long chain of carbon atoms that is bound to each carbon atom by two hydrogen atoms. It's a little more complex occasionally. Often certain carbons have lengthy polyethylene chains connected to them, rather than hydrogen. This is referred to as polyethylene or LDPE branched or low density.

If no branch is usable it is referred to as linear polyethylene or HDPE, short for polyethylene of high density. Linear polyethylene is much stricter than polyethylene, but it is less expensive and much easier to produce polyethylene branched. The branch is connected to the main chain with side groups. Branching contributes to diminished crystallinity, decreased density and diminished rigidity. Branched polyethylene with low density is very robust and stable. It has excellent electrical properties, is acid and base resistant and has good tear tolerance. Branched polyethylene shall be used in shooting, mats, cloths, tubes with squeeze and foil coatings.

Regular polyethylene has a high density with moderate crystallinity and a high rate with melting. Linear polyethylene is stronger and more tensile than ramified polyethylene. It is used in tubes, house wares, games, pipes and separation of wire and cables. Properties the following explains the properties of HDPE since LDPE yarn or fibers are seldom requested:

Characteristic	UNIT	VALUE
Specific gravity	g/cm^2	0.960
Range of temp.	°C	-30 to +95
Melting temp.	°C	130
Tensile strength	cN/tex	50
Elongation at break	%	25
Shrink at 100°C	%	5
Seltextinguishing (acc. to UL 94-V2)		optional

Benefits HDPE's good UV resistance does not cause any problem in hot weather.

- HDPE has outstanding strength and does not impact damp or dry situations. HDPE has outstanding strength. It is suitable for fast drying compared to natural yarn and fibers.
- HDPE is both sexy and simple to care for.

- For horse, plant etc. HDPE is easier to use. No breaks, no strings torn, no jagged boundaries.

Colorful quick drying low Static thermal bonding, solid, dry hand (transportation moisture from the skin) very pleasant and lightweight thanks to Polyolefin Origin capable to provide good mass and paint, abrasion-resistant to chemical deteriorations, mildew, sugaring, rotting, stain, soil and weather conditions.

HDPE is also ideal for applications such as spinning and Rachel knives in specific ends: net and fabrics for agricultural purposes &geotextiles in all kinds in window breakers, window blinds, covers of shade and wind walls transparent wrapping, pool protective net shielding cords & lines of fishing nets Reinforcement for various lacquers, such as rubber, glass, etc.

.

CHAPTER 2
REVIEW OF LITERATURE

[3] Akram et al. (2015) published a paper "E-waste management by utilization of E-plastics in concrete mixture as coarse aggregate replacement" they focused mainly Coarse aggregate replacement, Durability, E-waste, management, Strength. A viable alternative to the environmental and economic issues is the usage of waste and chemical by-products. The usage of these products re-uses cement, concrete and other construction materials, as well as rising the expense of cement and concrete manufacturing. Substantially minimize production prices, conserve electricity and eliminate industrial waste are other secondary advantages. Electrical waste consists of refrigerators abandoned, clocks, TVs, air conditioners, cell phones, laptops, and a variety of other electronic hardware that is or has become outdated. In the building sector attempts are being made to allow the partial substitution of coarse or thin substances in the concrete by utilizing biodegradable components of e-waste. This research reflects on the usage of plastic e-waste in concrete and explores the possibility of the partial substitute of coarse aggregates using shredded e-plastic particles. When e-plastic was used alone, the intensity reduced, but tests comparable to control experiments were applied when 10 percent of fly ash were collected. The usage of this e-waste in concrete thereby reduces the need for standard gross aggregates, adding to environmental conservation.

The goal of this thesis was to find an effective means of reusing the hard plastic wastes as concrete aggregates. E-plastic waste may be disposed of by reusing it as construction materials. It was observed that, when e-plastic was used by itself, its intensity decreased, but when 10% of fly ash was applied, identical findings were obtained also for 15% of e-waste. Substitution of this concrete waste would thus reduce the need for standard coarse aggregates, contributing to natural resource conservation. If they are used in concrete, the particular severity of e-plastics will decrease the autonomous weight of the mixture. The injection of plastics into concrete often renders concrete ductile and therefore greatly deforms the strength of concrete until failure. In conditions when it is subjected to extreme weather such as extension, the concrete is useful.

[4] Ahirwar et al. (2016) also provided a report on "Electronic waste, natural aggregates, construction, slumping, and compressive power," "An experimental analysis on construction, utilizing e-waste." The usage of by-products from the construction sector is a viable alternative to environmental and ecological issues. The utilization of these surplus products lowers the costs of concrete manufacturing, as well as the reuse of cement concrete, RCC and other productive resources. Many related benefits include cuts in waste disposal rates, carbon efficiency and solid waste management. The e-waste involves outdated coolers, TV sets, cell phones, air conditioners, laptops and many other technological devices, which have become redundant or have completed a lifespan. In the building industry, steps are being made for the usage of non-biodegradable electrical waste materials as a replacement in part for fine or coarse concrete aggregates. The primary object of this research is to examine the improvement in mechanical properties of concrete by applying electronic waste to concrete. The usage of electrical waste aggregates contributes to low weight concrete construction. In this study report, the coarse compound is partly substituted for E-waste from 0 to 30%; 10 percent, 20 and 30 percent of fly ash are also applied to this mixture with the partial substitution of cement. The usage of this technological waste in concrete is thus recommended to reduce the need for standard coarse and fine aggregates and thereby to conserve the natural capital.

The key emphasis was on bitumen, additive, float, resilience, demand stability, VMA, VFB, air voids, and density [5] Singh and Malviya (2009) publish a paper called "Experimental Analysis of Part of Partial Replacement of Aggregate by electronic waste for flexible flooring." In India, the majority of the highways are bituminous surface pavements. Symptoms of distressed including splitting, rutting and so on are gradually attributed to the intense traffic, filling cars and major shifts in everyday and seasonal pavement temperature in earlier stages. Work has shown that modifications can be used to boost the rheological properties of bitumen and bituminous blends and render them more appropriate for road building.

Bituminous construction involves the combination of various sizes for the appropriate proportions of the aggregate and bitumen materials. Mechanical or e-waste electrical or mechanical waste that is collected is meant to be reused, resold, processed or disposed. Informal electronic / electric waste processing can contribute to serious health and environmental problems in developing countries, as these countries have little regulatory authority over e-waste production. The disposal of solid waste is today one of our country's biggest environmental concerns. The study includes the use or recycling of electric waste as the substitute for coarse bitumen aggregates. The research's purpose is to examine improvements in the mechanical properties of a bitumen blend with the introduction of e-wastes in bitumen concrete as a replacement.

The E-WASTE is blended with bitumen with specific percentage characteristics (4, 8, 10, and 12) of bitumen including penetration strength, ductility, flash and fire level, particular weight and shift in softening stage. The density, the ductility and the change point and basic gravity values are decreased as the E-WASTE level is raised, is as stated in Chapter 5. For the flash and fire stages, the value rises first (with 4, 8 and 10%) and falls to 12% of the E-WASTE volume. The properties of the DBM were drastically altered as stated below.

[6] Balaji et al. (2019) published an article "Experimental study on waste plastics disposal. In this investigation, the specifications of concrete composed of plastic HDPE granules and crushed river sand waste glass were examined separately. Including concrete plastic displayed a reduction in strength and concrete comprising glass demonstrates a rise in strength as the proportion of the components decreases. Then the optimum crushed glass combination was determined dependent on concrete intensity. Then, the new mixing amounts (S80G15P5, S75G15P10, S80G15P15 and S65G15P20) include both plastic and glass. The only finely substituted plastic derived results were higher than the only fine aggregate.

This paper presents the fresh and mechanical properties of concrete incorporated with HDPE plastic granules and crushed glass. Mixes of M30 were prepared by replacing the fine aggregate with 5%, _10%, _15% & _20% of plastic and glass in respective mixes. Based on the study, the following conclusions are stated below:

- The workability of concrete decreased consecutively by increasing the percentage of HDPE plastic granules in concrete.

- Out of the four mixes (S95P5, S90P10, S85P15 and S80P20) S95P5 and S90P10 performed better hardened properties.
- With an increasing percentage of crushed glass by an increment of 5% in each mix, workability and strength were increased by 23.33% and 8.14% respectively for S85G15 mix when compared to conventional concrete.
- Workability and hardened properties of concrete mixes were performed better up to S65G15P20.
- Strength of all four mixes up to S65G15P20 comparatively more than the only HDPE plastic granules replaced in concrete.
- It is observed that by replacement of 15% of waste glass and 20% of HDPE plastic granules are identified and concluded as an acceptable proportion by saving 35% of sand.

[7] In this article, India faces a big challenge to dispose of waste in sites all over the world, Zarbade et al. (2015). Deposits are disposed of at high expense and with significant issues for the community. If the pattern persists, waste production will rise by about 5% annually. This would potentially contribute to a drenched landfill cap by 2020. This research paper provides an overview of post-effects of the usage of reclaimed complete waste, e-waste, and cocoon shells as additional content in cement blends for use by host companies to maintain the highest mechanical consistency in the corresponding cement. Concrete blends comprising different surplus material and critical qualities were set, such as friction intensity and water preservation or water absorption, and a control mixture remained resolved and contrasted. In order to determine the changes in mechanical properties of the concrete, 16 mixes of M-40 concrete are prepared and include 10 percent, 20 per cent, 30 percent and 40 per cent of cocoon shells, recycling aggregate and e-waste as waste materials. Along with this concrete power blend, the average thickness of the aggregation was 20 mm.

[8] Proposed in this paper by Xavier, Parappattu (2016), the disposal of used plastics is a major challenge facing the world of our time. Plastics are seen more and more every day. It is very harmful to the atmosphere owing to the poor biodegradability of plastics. Partial replacement in the M30 grade of concrete comprising steel and polypropylene fasters by recycled plastic granules, 8% and 12%, is done in the study. The steel fibers were applied by concrete volume at 0.5 %, 1% and 1.5%. The research found different percentages of steel and

polypropylene, 70:30, 75:25 and 80:20. After 7 days and 28 days of water therapy, the compressive, broken tensile and bend intensity are calculated.

• Beton with 4% recycled plastic granules has demonstrated stronger properties than other two in process 3.

• For the 4 percent combination, 42,8MPa, 4,8MPa and 5,64MPa were obtained the compressive power, the tensile division and the bending force 28 day.

• The displacement of a fine aggregate by up to 8 percent was observed without loss of energy.

[9] Shinu&Needhidasan(2019) proposed in this paper, Electronic waste or E-waste is considered as the most dangerous among the wastes generated in the modern digital world. Due to the unending growth of these electronic wastes the drinking waters are getting polluted and our ecosystem is getting worstly affected all around the world. The present environmental problems can be minimized to a certain extent by utilizing these electronic waste materials in the construction industry

From the experimental investigation carried out, it is found that E-Waste is a viable alternative material for coarse aggregate in concrete that shall be used for non-structural applications. The self-weight of concrete was reduced when there is increase in E-Waste plastic percentage. Study shows that E-Waste shall be used in concrete when more strength is not required.

[10] Manjunath (2016) proposed for this e-waste paper demonstrates a specific solution to environmental and economic issues in the usage of e-plastic waste goods.By utilizing E plastic waste, the overall costs are high and infrastructure and roads have strong energy. It reduces waste management costs and saves electricity.

Based on experiments carried out by different investigators, the findings may be concluded:

(1) Plastic may be used in a concrete mix to substitute other aggregates. The unit weight of the concrete is thereby popular. For projects that need intolerable low-level concrete, such as concrete façade frames. This is useful.

2) The use of plastics in a combination decreases the stiffness, friction and tensile strength of the concrete for a given w / c.

(3) For plastic concrete, the influence of water-cement strength production ratio is not prominent. This is because plastic aggregates decrease concrete bond strength. Consequently, concrete failure occurs because the connection between the cement paste and the plastic aggregates is insufficient.

4) The use of plastics in concrete helps to create ductile concrete, thus increasing concrete's capacity to bend dramatically until failure. The concrete is effective in conditions where extreme environment, such as expansion and contraction, or freezes and thawing, happens.

5) The incorporation in the concrete of the buildings under analysis of recycled aggregates was demonstrated as energy advantages.

[11] This paper proposes Prashant& Kumar (2019) concrete, common building material, due to its plastic mouldability and its solidity being strong and highly compressible content. About 70% of the concrete volume consists of aggregates, which not only provide the concrete mix with weight, but also carry on substantial loads. Aggregate characteristics play a significant part in determining the attributes of the substance manufactured from it. It mentions an experimental test to research the effectiveness of e-waste to remove the coarse aggregates partly. The electrical or electronic disposals discarded are e-waste. M30 blend was formulated with 10, 15 and 20 percent of the substitute rates checked. Slump tests and compressive force tests shall be performed and recorded in this paper for each replacement stage. One efficient approach to reduce E-waste is by the usage of electrical waste in concrete, which will then rest on locations and cause environmental problems. • E-waste increases compressive strength during later ages thus enhances bending power • the optimum substitution amount of the coarse aggregate by E-waste is 10% • Concrete weight falls by 2.5% with every 5-percent application of E-waste. The findings are focused on this experimental study:

[12] As indicated in this article, wastes are used in concrete outputs such as fly ash and silicium, etc. from other factories, Rathore&Rawat (2019). Industrial and industrial waste is classified into two separate categories: favorable and hazardous waste. Volatile waste often has a history as industrial waste describes outdated, discarded or malfunctioning physical and mechanical items. E-waste is very difficult to remove.

The present thesis examines the impact of E-waste as a partial substitute for gross aggregates in a concrete mixture.

In fact it is not practical or desirable for the building industry to substitute any e-waste scale with more than 15%. Thus, this study indicates that the substance of E-waste may be used as a partial remedy for the variations of cough of up to 15%. The issue of waste management should be addressed and ultimately leads to environmental emissions from e-waste products.

The present research explores the effect of E-waste in concrete mixture as a partial replacement of gross aggregates. As found from above study

1) In contrasting findings with standard concrete of 28 days power, it is found that the stress resistance of concrete is 20.35 percent greater when field composites are substituted by 15 percent of two sizes of Ewaste content. This is the result of current experimental research.

2) Contrasting the findings with traditional 28-day beam intensity it is observes that, if the coarse aggregate is supplemented by 15% by two sizes of E-waste, the breathing power of the concrete beam is 15,69% greater.

3) It is not possible or useful for building work to replace any size of E-Waste in excess of 15%.

4) The flexural intensity provides acceptable results for the replacement by E-waste of the coarse aggregate. Thus it could be concluded from the present study that E-waste materials are a partial substitute for the ground aggregate of up to 15%. The waste disposal issue can be overcome and then contributes to the emissions from E-waste materials produced by the climate.

[12] The aim of this research is to analyze the durability testing of binary blended self-compacting (SCC) cement with electronic material waste replacement effect, namely high impact

polystyrene grain (HIPS) granules in partial sand, as suggested in this paper by Chunchu&Putta (2019). In this analysis the cement is replaced by pozzolanic fly ash material with a binder content of 497 kg / m3 and an agreed water / binder ratio of 0.36 for all SCC blends. For the 28 and 90 day curing cycles of SCC-produced HIPS specimens (0% – 40 percent of sand-replacement replacement) toughness characteristics such as porosity, water absorption and surprise are predicted. For HIPS SCC both the absorption rate of surface and internal water have been found to be minimal. In all study tests, substitution of HIPS in SCC up to 30% shows increased patterns. The toughness parameter values recorded in the SCC have been within permissible limits and indicate the excellent efficiency of HIPS. The thick SCC microstructure obtained with the combined impact of the HIPS and the fly ash can be related to the desired longevity values. Continuous incremental gradation in the matrix has decreased porosity owing to the HIPS 'circular form and even prevents fluid transfer in SCC. HIPS hydrophobicity. Further effects of fly ash, including pozzolanic activity and the fille impact in the ITZ, often add significantly to the long-term efficiency of longevity. Replacement of electrical plastic waste with fine concrete aggregates reduces the issue of recycling and retains existing resources.

[14] Sabău& Vargas (2019), suggested in this article, has greatly increased the amount of waste produced by human operation by the exponential rise in population growth levels in the world and the present consumer lifestyle. Especially because of its difficult degradation process, e-plastic waste causes significant environmental damage. This paper aims to identify the feasibility of partial replacement of gross mineral aggregates with e-plastic material from concrete. Tests on concrete mixes of 40, 50% and 60% of plastic e- waste were carried out for fresh and hardened properties in a control mix without e-plastic waste designed to achieve a pumping strength of 21 MPa. The compressive strength decrease was observing as the proportion of e-plastic waste rises, with the control mix decreasing to a maximum of 44 percent. In comparison, the density of cement mixes with e-plastic waste has been drastically decreased by as much as 22% which implies the manufacture of lighter components using this form of concrete is feasible. Two new equations were proposed, based on regression analysis of this study's experimental data. Such calculations predict a decrease of the compressive power of concrete mixtures to 14 and 28 days with e-plastic waste. There should also be a study of costs and a realistic way to sell this surplus material.

This research can lead to new uses of e-plastic waste materials, which means an improvement in the quality of the environment with respect to the treatment of composite materials such as ABS plastic. From the research carried out, it was possible to design a concrete mix with the use of ground e-plastic material, the waste of housings of electronic devices, replacing the traditional mineral aggregates. This concrete mix is to be used in the manufacture of concrete walls as dividing elements in social housing. The results from this study indicate the following:

•Most of the studies from the literature on concrete with e-plastic waste aggregate tend to overestimate the reduction in the compressive strength.

•All concrete mixes with e-plastic waste showed good workability in the fresh state, as indicated by the slump test values recorded.

•By replacing coarse mineral aggregate with e-plastic waste aggregate to make concrete a reduction in the compressive strength was recorded. The maximum reduction registered at 28 days that corresponds to 60% of e-plastic waste was 44%.

•The lack of adhesion between the cementitious matrix of concrete and the e-plastic waste aggregate was noted in the compression tests. To address this problem, before the grinding process, once the material is controlled and classified, it must be processed according to the texture required to increase the bond strength with the cementitious material.

•The two equations proposed show good correlation with the test results and can be used to estimate a 14 to 28 day drop in the crushing power of concrete blends aggregated in e-plastic waste.

•By using e-plastic waste to make concrete blocks a reduction in costs per m2of masonry wall as much as 15% can be obtained.

[15] The mechanical and chloride properties of fine, coarse-aggregate concrete substituted partially by high density polyethylene (HDPE) waste is examined by Shanmugapriya& Helen (2017). Totally six separate M25-grade concrete mixtures, with a partial fine aggregate replacement, is built by 5.0 %, 15.0 %, and coarse aggregates by 10%, 15%, 20% and HDP waste.

[16] Kibria et al (2017),this research reports on experimental investigations of polystyrene polymer. The use of polystyrene polymer is increasing day by day with economic growth. However, this polystyrene polymer is not decomposed and causes a serious environmental problem by increasing as a solid waste.

[17]Kumar et al. (2017), the work is the outcome of an experimental analysis on waste flex disposal in cement without jeopardizing its usual intensity. In the current context, the management of solid waste is extremely critical and will also be a major issue for the future. Flex is used for advertising and many other purposes in various types of hosting boards. As its applications grow rapidly each day, its disposal is often problematic because it is some sort of plastic and plastic disposal is a key problem in today's world sense, as it produces multiple forms of waste, culminating in the specific diseases between humans and other living beings. In this research work, waste flex is added to the concrete blend by producing very small parts about a certain proportion of cement in the mixture. This eliminates the issue of waste management and thus eliminates the expense of concrete more by utilizing waste materials. They took three% of the flex in the concrete blend, i.e. 0 .75%, 1% and 1.5% by cement weight. The concrete blend for the study is M-25. This research provides a comparative analysis of the compressive intensity of concrete cubes comprising standard concrete flex with a single construction combination between 7 and 28 days' treatment of the cubes. The analysis showed that the compression strength of the regular concrete measured after curing the Cubes was improved by 1 percent by the weight of the concrete and by the same amount at two percent by the other compression factor.

[18] Gibreil& Feng (2017), which investigates on HDPE (high-density polyethylene) as well crumb rubber powder (CRP). Unchanged and adjusted asphalt was used to calculate surface characteristics, density, softening points and ductility for a range of products of HDPE and CRP. Marshall Flow and steadiness were also conducted, including the Marshall Quotient, humidity response, and routing checking. The findings revealed that the physical properties of asphalt and Marshall Properties of HMA mixtures are enhanced with HDPE and CRP as additive. The resistance to humidity harm after introducing HDPE and CRP dramatically improved along with the resistance to permanent deformation.

[19]Ali et al. (2017) today's construction industry needs high building materials to grow rapidly. Bricks, which have good and simple handling properties which contribute to the variation of additional or substituted components in the mixture. Bricks High-density polyethylene (HDPE) has been selected for brick processing as the replacement for this analysis. The explanation for the usage of HDPE is the recyclability and the recycling cycle, which does not release any harmful gas in the atmosphere. Furthermore, utilizing HDPE aims to reduce emission causes by removing the millions of plastic waste generated at the landfill sites. In fact, the composite is extremely durable and temperature durable. In this research, the alternative materials were experimented in the combination of concrete bricks, a part of building materials. The bricks were checked, their compressive strength and the initial water absorption rate were analyzed. On the seventh and 28th days, the two experiments were done. On the basis of the results obtained, the use of 2.5% of HDPE showed values of 12.6 N / mm2, while the use of 3.5% of HDPE showed values of 12.5 N / mm2 for 28th day compressive strength test. 3.5% of HDPEs reported 12.5 N / mm2 in the next step.

[20]In India flexible paves with bituminous surfaces are widely used in Reddy &Venkatasubbaiah (2017). As road traffic is raised, overloading of cars and increases in temperatures related to climate increases adds to a variety of distresses such as running, firing, bleeding, splitting and patholing in tar surfaces. Construction often takes place in developed countries like India, which needs wide demand of building materials which are both eco-friendly and economical. Seasonal variations in temperature and container composition greatly affect asphalt due to its visco elastic composition. Due to this asphalted binder action, rutting and fatigue cracks are typical in many kinds of flexible failure. Waste plastics, including high-density polyethylene, are disposed of via waste dump and have environmental pollution due to the difficulty of environmental factors in degrading polymer materials. The loss of tire-rubber is a big environmental issue in India, with various vehicles growing rapidly. Crumb rubber is recycled from cars or trucks. A safe construction approach is called the usage of crumb rubber in bituminous materials as an additive. Polyethylene is a widely used plastic in the world. Polyethylene can increase the rigidity of asphalt pavements as used in the alteration of asphalt, but deformation them at high temperatures under intense traffic loads. Rubber was also used as a surface concrete asphalt modification. High density polyethylene and crumb rubber material are used in this analysis in asphalt blend as alternatives to bitumen. For different high density

polyethylene, crumb-crown powder materials, the physical properties, penetration, durability and dynamics of unmodified and modified asphalt were calculated. This research demonstrates lower sensitivity to temperature and improved tolerance to damage to humidity, and irreversible deformations following application of HDPE and CRP.

CHAPTER 3
MATERIALS AND METHODS

3.1 Materials

3.1.1 Cement

Ordinary Portland limestone cement was used for casting the cubes and beams for all the concrete mixes. The cement was of uniform grey color, and bought from a local vendor. In this research we use Ordinary Portland Cement (OPC) of 43 grade of brand Ambuja Cements form single batch through the investigation was used.

Table 3. 1 Oxides composition of Portland limestone cement (Sam et al., 2013)

Concentration of oxides (% weight)			
OXIDS	CEM A	CEM B	CEM C
CaO	61.74 ± 0.4	62.19 ± 0.4	57.37 ± 0.3
SiO2	18.77 ± 0.6	21.90 ± 0.6	21.69 ± 0.2
Al203	5.41 ± 0.2	2.50 ± 0.9	6.40 ± 0.2
Fe2O3	3.01 ± 0.1	2.92 ± 0.3	3.10 ± 0.1
S03	3.89 ± 0.6	4.03 ± 0.1	4.0 5± 0.1

MgO	3.13 ± 0.4	2.23 ± 0.1	3.34 ± 0.1

3.1.2 Tests on Cement

Normal Consistency

This test determines the quantity of water required to produce a cement paste of standard consistency for the use in other test. The Vicat'sapparatus (IS: 5513-1976) is used for this purpose. The consistency of standard cement paste is defined as that consistency which will permit the Vicat's plunger 50mm long and having the bottom of the Vicat'smould.

Apparatus

Vicat's apparatus with mould, Plunger, Balance, Measuring cylinder, Non-porous plate.

Procedure

• Prepare a pastas of weighed cement consistency with a weighted quantity of drinking water (during not less than 3 minutes and no longer than 5 minutes)

• Remember time to calculate from the moment the water is applied to dry cement before the mold is full.

• Gently apply a paste to the Vicat's mold and bring it down to the tip of the container.

- Place the test block and the mould together with a non-porous resting plate under the plunger

- Lower the plunger gently to touch the surface of test block and quickly release, allowing it to sink into the paste.

- Prepare trial pastes with various % of water and carry out tests as above until the amount of water necessary for penetration of the Vicat's plunger to 5mm to 7mm from the bottom is determined.

Results

Express the amount of water as % by weight of dry cement.

3.1.3 Initial and Final Setting Time

Vicat's apparatus will be used to estimate initial and final setting time of cement at normal consistency.

Apparatus

Vicat's apparatus with mould and non-porous plate, Initial setting time 1 sq. mm Needle, Final setting time 1 sq. mm Needle with enlarged base**,** Balance, Measuring cylinder**,** Stopwatch, Thermometer.

Samples:

Cement**,** Potable water.

Procedure

- Weigh about 400 gm. of neat cement
- Prepare neat cement paste by gauging the cement with 0.85 times the water required to give a paste of standard consistency.
- Time will be recorded with stopwatch from the time the water is added.
- Standard needle will be placed on the test block and time will be observed when the needle fails to pierce the block beyond 5.0 +/- 0.5 mm (measured from the bottom of the mould)
- The time difference between the starting time when water is added to cement to the time mentioned in above will be noted.
- The difference of time from starting time when water is added to cement to the time mentioned in above will considered as final setting time.

Figure 3. 1 Vicat'sApparatus

3.1.4 Fineness Test of Cement

This test will be performed according to IS: 4031-15.

Apparatus

Balance capacity 500 gm., I.S. Test sieve 90 micron.

Samples

Cement

Procedure

- Measure 300 gm. with accuracy. Built on a regular IS sieves of cement (W1) of 90 microns.
- Down the finger in the sample to break any air set lumps. Don't smooth the sieve, though.
- Sieve the sample continuously with a sieve in both hands and a gentle wrist movement.
- The sieving should be continuous for 15 minutes.
- Weigh the residue left (W2) after 15 minutes sieving and calculate percentage of residue retrained on 90 micron sieve.

Results

Fineness of cement (%) = W2/W1 x100.

Figure 3. 2 Sieve Shake

Table 3. 2 The physical properties of OPC as determined given in the table

S. No	Properties	Experimental Value
1	Normal Consistency%	33%
2	Initial setting time	41min
3	Final setting time	225min
4	Soundness of Cement (Le chatelier expansion)	2.75mm
5	Fineness of Cement (%age retained on 90 micron IS sieve)	3.77%
6	Specific gravity of Cement	3.1
7	Compressive strength at 3 days 7 days 28 days	25.6 MPa 31.3 MPa 46.7 MPa

3.2 Fine Aggregates

Ordinary pit sand used for the experimental program was procured locally .The sand was first dried, passed through a 5mm sieve to eliminateconstituent portionbigger than 5mm including roots and debris. Sieve analysis was conducted to determine the particle size distribution using Malest Auto sieve shaker.

3.2.1 Properties of Fine Aggregates

Aggregate is prime constituent of concrete as it provides volume to the concrete. It a chemically inert material, it provides strength and durability to the concrete. For fine aggregate we use locally available sand which pass through 4.75mm sieve.

3.3 Coarse Aggregates

Locally available coarse aggregates having maximum size of 19mm were used in this work. Particle size distribution of the coarse aggregate was also obtained using Malest Auto sieve shaker.

3.4Inspections on Aggregates

3.4.1 Sieve Investigation of Fine Aggregates

To determine the gradation of fine aggregates

Apparatus

Sieves of the sieve 10mm, 4.75mm, 2.36mm, 1.18mm, and 600micron 300 micron 150 micron and 75 micron, Balance and standard weights, Oven.

Sample

Fine aggregate

Procedure

- Take about 500 gm. of sand.
- Air-dry the sample either at room temperature or by heating it in an oven at temperature of 100 degree C to 110deg C.
- Each sieve shall be shaken separately over a clean tray for not less than 2 minutes Light brushing may be used on the 150 & 75 micron sieves to prevent blinding of apertures.
- On completion of sieving the material retained on each shall be weighed.
- Fineness Modulus is calculated by Sum of cumulative % retained divided by 100.

Results

Fineness Modulus = (Sum of cumulative % retained)/100.

3.4.2 Coarse Aggregates - Sieve Analysis

To determine the gradation of coarse aggregates

Apparatus

Sieves of sizes 25mm, 20mm, 10mm, 4.75mm & 2.36mm, Balance, Oven

Samples

Coarse Aggregates

Procedure

- The total weight of sample coarse aggregate and trays before quartering / dividing shall be 25 kg. The sample for sieving shall be prepared from the larger sample either by quartering or by means of a sample divider. Minimum weight of sample for each sieve analysis on 20 mm grade aggregate is 2.0 Kg.

- Air-dry samples must be measured and ultimately picked from the highest on the matching sieves. Be patient, before using, to make sure the sieves are clear.

- Until no more than one residue, but in either case for a duration not less than two minutes, each string shall be shook individually over a clean tray.

- Rocking is performed by means of various movements, back and forth, left and right, rotating and anti-clockwise, and regular flipping, to maintain the substance moving in constantly varying directions over the sieving sheet.

- The substance is not pressured by hand pressure through the sieve, however the placement of particles on sieves that are coarser than 20 mm is allowed.

- Small lumps, if present, may be separated with a gentle finger pressure on the surface of the sieve.

Results

The percentage by weight of the total sample passing through one sieve and retained on the next smaller sieve, to the nearest 0.1 percent .The results of the sieve analysis may be recorded graphically on the chart.

3.4.3 Specific Gravity

This test was performed according to IS 2386-Part (iii) 1963.To determine the specific gravity and water absorption of fine aggregates.

Apparatus

Pycnometer-500 ml, Oven

Samples

Fine Aggregate, Potable Water

Procedure

- Make and record all weight determination to 0.1g accuracy and take weight (SSD).
- Partially fill the pycnometer with water. Introduce into the pycnometer 500 gms of SSD fine aggregate and fill approximately 90% of capacity. .
- Determine the total weight of pycnometer, dry to constant weight at a temperature of 1100 C, cool in air at room temperature and weigh.
- Determine the weight of the pycnometer filled to its calibration capacity with water.

Calculation

Sp. Gr. = D/A-(B-C)

Water Absorption = 100(A-D)/D

Where,

A= Weight of saturated surface dry sample

B= Weight of Pycnometer containing a sample filled with water

C=Weight of Pycnometer filled with Distilled water only

D=Weight of Oven dried sample

Results

The individual and mean results shall be reported.

Figure 3. 3 Specific Gravity Apparatus

The physical properties of aggregate are given in table (2).

Table 3. 3 Properties of Aggregate

S.No	Properties	Experimental Values	
		Coarse Aggregate	Fine Aggregate
1	Water Absorption	0.30%	0.50%
2	Specific gravity	2.71	2.64
3	Crushing Value	18.22%	-
4	Impact Value	12.90%	-
5	Fineness Modulus	6.56	2.67
6	Bulking Of Sand	-	30.21%

Electronic waste: This research consider PCB board along withaggregate is between 1.18mm to 2.36mm. All the metals attached on the PCB were removed by hand.

Table 3. 4physical properties of Electronic waste

Properties	Suchithra et al.2015	Damal et al. 2015	Panneer et al.2016	Laksluni et al. 2010
Specific Gravity	1.9	1.2	1.44	1.01
Water absorption (%)	0.2	<0.2	Nil	<0.2
Color	Dark and Ivory	Brown and Dark	Dark 8c Brown	White and Dark
Shape	Angular	Round and cylindrical	Angular	Angular
Crushing Value (%)	-	<2%		<2%
Impact Value (%)	-	<2%	-	<2%

Table 3. 5 Properties of E-waste

S.NO	Properties	Experimental Values of E-waste
1	Water Absorption	0.04%
2	Specific gravity	1.20
3	Crushing Value	2.35%
4	Impact Value	1.95%
5	Fineness Modulus	2.50

3.4.4 Polymeric Material

The thermoplastic polymer formed from the monomer ethylene (PEHD), is high-density polyethylene (HDPE) or high-density polyethylene (PEHD). Or used for HDPE tubing, this is often referred to as "alkathen" or "polythene.' The high density bottles described by their recycled code of Polyethylene (HDPE) were obtained from and used in the work environment of KNUST. The labels on the bottles have been taken away and the bottles have been cleaned, dried, cut and shredded manually, using table knives and scissors, into smaller sizes. Cloud waste for the preparation of the concrete samples is supplemented by recycled plastic wastes. The specific gravity test on the plastic aggregates was performed, and the Malest Auto 7 shaker was also used for the distribution of the particles of the plastic aggregates.

Figure 3. 4 Mixture of collected virgin plastics

3.5 Advantages of HPDE

- Low cost
- Impact resistant from -40 C to 90 C
- Moisture resistance
- Good chemical resistance
- Food grades available
- Readily processed by all thermoplastic methods

3.6 Disadvantages and limitations of HPDE

- High thermal expansion
- Poor weathering resistance
- Subject to stress cracking
- Difficult to bond
- Flammable
- Poor temperature capability

Table 3. 6 Thermo physical properties of High Density Polyethylene (HDPE)

Thermo physical properties of High Density Polyethylene (HDPE)	
Density	940 kg/m3
Melting Point	130.8 °C.
Temperature of crystallization	111.9 °C.
Latent heat of fusion	178.6 kJ/kg.
Thermal conductivity	0.44 W/m.° C. At °C.
Specific Heat Capacity	1330 to 2400 J/kg-K
Specific heat (solid)	1.9 kJ/kg. °C.
Crystallinity	60%

Figure 3. 5HDPE aggregate

3.7 Water

Generally water that is satisfactory for drinking is also suitable for use in concrete. In this work portable water suitable for human consumption was employed in the experimental procedures. Potable water mentioned in IS: 456-2000 for mixing and curing of concrete specimens was used throughout the research.

Concrete: Concrete of grade M20 was used in the research and W/C ratio of 0.5 was used. The mix proportion of 1:1.8:3.08 (where 1is for cement 1.8 for fine aggregate and 3.08 for coarse aggregate of size 10mm to 20mm).

3.8 Slump Test

The workability of all concrete mixture was determined through slump test. The slump tests were performed according to IS 1199-1959.

Apparatus

Frustum of a cone, tamping rod.

Procedure

• Until processing starts, the interior surface of the mold must be polished and clear of dust and other embedded concrete.

• The mold shall be mounted on a flat, horizontal, stable and non-absorbent surface, such as a carefully levelled metal sheet which will stay tightly during filling.

• Four layers of the mold must be packed, each around a quarter of the mold height.

• The rounded end of a tamping rod shall be tamped on each layer with 25 strokes.

• The strokes will be evenly spread around the mold cross-section and pass through the underlying material for the second or corresponding levels.

• Anymortar that might have spilled between the mound and the base plate shall be washed off.

- By moving it gradually and deliberately in a vertical direction, the mold is automatically separated from the concrete.

• The concrete will then subside and the slump is subsequently determined by measuring the gap between the height of the mold and the height of the specimen that has been inspected from the highest level.

Figure 3. 6 Slump Cone

Table 3. 7 Workability, Slump of Concrete with 20mm or 40 mm maximum size of aggregates& Using Ewaste& HDPE as well

Degree of Workability	Slump (mm)
Very Low	-
Low	20-85
Medium	55-105
High	110-160

Sulphuric Acid, H2SO4

A Philip Harris laboratory acid (AnalaR grade) with the following properties was used Assay 98%.

Wt. per ml 1.84g

Maximum limit of impurity Chloride 0.007%

Arsenic 0.0002%

Lead 0.001%

Non – volatile 0.01%

Nitric Acid, HNO3

A Philip Harris laboratory (AnalaR grade) acid 70% W/W was also employed Purity % 69 – 70

Wt. per ml 1.42g Arsenic 0.0001%

Lead 0.0002%

Equipment

Resources and devices used in this procedure are: a) backing mixer to blend water and aggregates homogenously (b) Mechanical balance to calculate aggregate's mass and specimenc) water volume flask (d) Cube and brace moulds for casting b) Tamping rope for cast molds (b) Curing tan (e).

3.9 Preparation of Samples

3.9.1 Mix Proportion

The control mix has a mix ratio of 1:1.5:3i.e. M20 (cement: fine aggregate: coarse aggregate) which was adapted for this work with a constant water- cement ratio of 0.55. For making mixes containing e-waste and HDPE, the amount of plastic were calculated as 2%, 4%, 6% and 8% by weight of the coarse aggregate in the control concrete. The mix proportion for the control and the other mixes for the cube and beam specimens.

Mix Amounts- To design M20 grade concrete

Characteristic strength = 20.0 N/mm2

Qualitycontrol degree= good

Aggregate‘s maximum size= 20.0 mm

Coarse aggregate's Specific gravity = 2.709

fine aggregate‘s specific gravity = 2.379

cement‘s specific gravity of = 3.455

Type of **e**xposure = Moderate

Weight of water = 179.9 kg/m3

3.9.2 Mixing, Casting, Curing

For study, cement concrete mix M20 was chosen. In a defined 1:1.5:3 proportion, the raw material was blended with water with a changing water cement ratio of 0, 50 (1 cement, 1.5 ground-level sand: 3 stone aggregates 20 mm nominal size). The fine, coarse and plastic aggregates were initially weighted and blended evenly in the concrete blender for around two minutes. The cement was applied and one third of the overall water was combined. The residual water was eventually applied following 2 minutes of mixing. If a homogenous blend was obtained, the mixing was halted after five minutes with all the blends.

Both cubic and beam moulds were thoroughly cleansed and oiled before casting. Prior to casting. The molds have been closely sealed to insure that no lacuna exists on the mold that might contribute to a slurry leakage. For each class the washed and oiled mold was filled in three layers of concrete and tamped with the tamped rod 25 times. Using the vibrator Kango Hammer Type F, the moulds were then tamped from side to side. When the cement slurry on top of moulds emerged, the shaking was halted.

The samples were held 24 hours in the damp sack-covered steel moulds. After 24 hours the specimens had been collected and placed in a safe water tank before the day the mechanical and other products had been checked.

Figure 3. 7 Concrete Mixer

Figure 3. 8 Hammer Vibrator

CHAPTER 4

TESTS &METHODOLOGY

The e-waste was shredded and put on the main sieve of the Auto Sieves Shaker's set-up sequence and the unit turned on. With some aggregates going into several sieves, some stayed, the shaker shook the plastically aggregates. The shaker ceases automatically after 10 minutes and plastic aggregates stored in the accompanying sieves have been weighted to their masses. With 378 g sand and 296 g coarse aggregates respectively, the same cycle has been replicated.

Figure 4. 1 Auto Sieve Shaker

4.1 Specific Gravity

An empty relative density bottle was weighed and then filled with HDPE aggregates and then weighed again. Since HDPE is less dense than water and floats in water, kerosene was used as the liquid for this experiment. The bottle containing the plastics was then filled with kerosene and reweighed. The kerosene was poured away and the specific gravity bottle then filled with water and reweighed. The same procedure was repeated with a different bottle and the average specific gravity obtained from the results.

The specific gravity (SG) is obtained using the formula

$$SG = \frac{density\ of\ HDPE\ aggregates}{Density\ of\ water}$$

4.2 Workability, Slump Test, ASTM C143 (2005)

Fresh concrete is defined as concrete at the state when its components are fully mixed but its strength has not yet developed. The properties of fresh concrete directly influence the handling, placing and consolidation, as well as the properties of hardened concrete. Workableness of a newly mixed amount of concrete is specified in ASTM C 125 as the property which defines the amount of effort needed to handle minimal homogeneity.

Consistency (or fluidity) and stability are the core attributes of workability. Consistency is used to calculate the simple flow of fresh concrete and the capacity of fresh concrete to hold all the materials together without separating and excessive bleeding is defined as cohesive.

The slump was covered with three layers of freshly manufactured concrete with a trombone. For each stage of loading, the cone was tamped 25 times with a rod during which the cones were separated vertically and a rod and a guideline were used to calculate the slump. The slowdown between the top and the original center of the top surface of the specimen was measured.

Figure 4. 2 Measuring slump using the Slump Cone

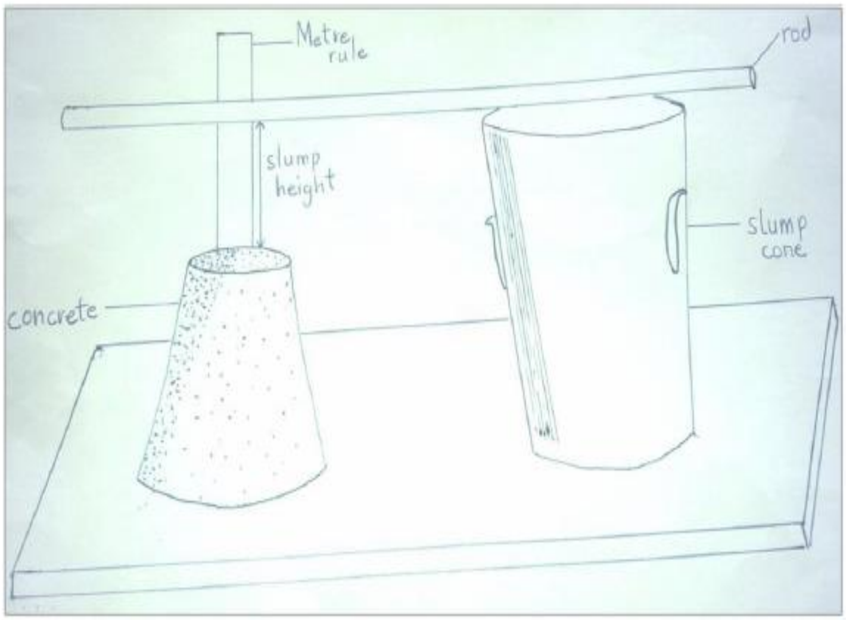


Figure 4. 3 Schematic diagram for measuring Slump height

4.3 Compressive Strength, ASTM C39

When stress is applied on a hardened concrete the response of the concrete depends on the stress type and on various factors which include, properties and proportions of materials that are used for concrete mixture design, degree of compaction, and conditions of curing (Janković*et al.*, 2011).The compressive strength of concrete is the most common measure for judging not only the ability of the concrete to withstand load, but also the quality of the hardened concrete. This test method consists of applying a compressive axial load to moulded cylinders or core at a rate which is within a prescribed range until failure occurs.

Three samples were taken from each percentage replacement of HDPE waste plastic content and their compressive strength determined after 7, 14 and 28 days of curing in clean water. The compressive strength was calculated from the formula;

$$Compressive\ dtrength = \frac{Load\ in\ (n)}{Area\ in\ (mm^2)}$$

$$Compressive\ dtrength = \frac{W}{L1 \times L2}$$

Figure 4. 4 Determining Compressive strength of Cube Sample

The average of the two most consistent compressive strength values for each curing day was used for the analysis.

4.4 Flexural Strength, ASTM C78 (2002)

A lubricated 100mm×100mm×500mm was filled with the fresh concrete using a trowel and then the specimen was covered with wet sack cloth and left for 24 hours. After 24 hours the specimens were removed from the mould and put into a curing tank containing clean water and left for 28 days before determining the modulus of rupture or flexural strength of the concrete. Ten beams were cast for this test with two samples for each percentage replacement. The average value for the two samples for each percentage replacement was taken for the analysis.

Figure 4.4 above shows Ele Blackhawk flexural strength testing machine use for testing a sample. This shows the results obtained for the flexural strength for the beam specimens.

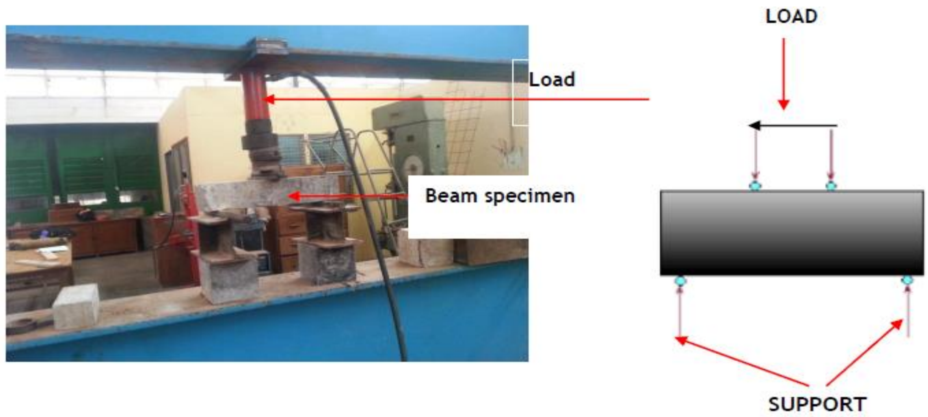


Figure 4. 5 Set up for a 3 point Flexural strength testing

The modulus of Rupture or flexural strength of a concrete using the 3 point loading is calculated using the formulae: $R = \frac{PI}{bd^2}$

Where R (flexural strength), P (applied capacity), L (span length), b (beam's width) and d (beam's thickness).

Figure 4. 6 Fractured Beam Specimen after flex

4.5 Effects of HNO3 and H2SO4 on Hardened Cubes

Concrete is highly vulnerable to acid media, this is because none of its hydration products (calcium silicate hydrates with different C/S ratios) is stable. Cement and concrete products can be subjected to attack by various inorganic and organic acids including sulfuric, nitric, hydrochloric, and phosphoric. However, sulfuric acid can be considered as the most common cause of deterioration of these products (Allah Verdi*et al.*, 2005). The source of sulphate attack on concrete may either be due to external or internal sources. External sources are natural occurring sulphates in the environment or those that are the product of industrial processes or various human activities.

After 28 days of curing cube specimens in clean and portable water, the specimens were removed from the curing tank. The cube specimens were then left to dry in air for 24 hours in laboratory conditions. Then the unit mass of the dried cubes were taken after which two solutions one containing 5% of HNO3 and the other containing 5% H2SO4 by volume or weight of water were prepared. The dried specimens were then totally immersed in the respective solutions for 28 days. After 28 days of immersing the cube specimens in acidic solutions they were then removed and their new mass, new compressive strength, color changes and the percentage loss in mass was determined.

The loss in mass is determine using the formula

$$\%\ loss\ in\ mass\ = \frac{M1 - M2}{M1} \times 100\%$$

Where M1= specimen's mass before immersion M2 = specimen's mass after immersion.

Figure 4. 7 Cube Specimens after 28 days in HNO3

Figure 4. 8 Fractured Cube Specimen after 28 days in H2SO4

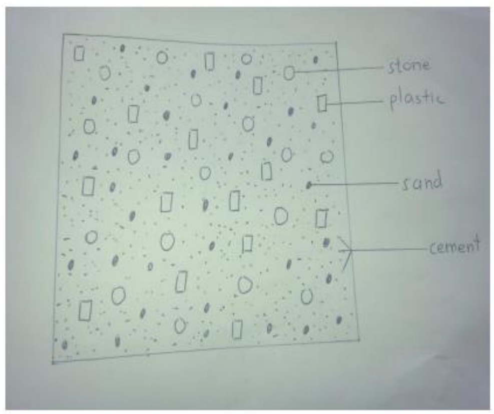


Figure 4.9 Schematic diagram of the composition of the fractured surface of Polymer modified concrete

4.6 Water Absorption of Hardened Specimen

The formulations and physical properties of the cement elements and those of the aggregates, including the mixture size, the production of chemical and other cement admixtures. The moisture state of the concrete during the processing is often greatly influenced by the waters absorption.

Specimens of air-dried cubes were weighted for density, and dry samples were then processed in an oven at a continuous temperature of 107oC for 24 hours to insure that the samples were completely dried at a constant weight. The cube specimens were extracted after 24 hours and their masses were stored and registered. The samples should be cooled in the lab, then soaked 24 hours in warm water.

Figure 4. 10 Cube Samples in the oven

Figure 4. 11 The Oven

The water absorption rate was then determined with the formula

$$\% \, Water\ absorption \ = \frac{W1 - W2}{W1} \times 100\%$$

Where W1 = test specimen's oven dry mass

W2 = test specimen’s wet mass

4.7 Spilt tensile test and procedure

One of the important properties of concrete is “tensile strength” as structural loads make concrete vulnerable to tensile cracking. Tensile strength of concrete is much lower than its compressive strength (that’s why steel is used to carry the tension forces). It has been estimated that tensile strength of concrete equals roughly about 10% of compressive strength. To determine the tensile strength, indirect methods are applied due to the difficulty of the direct method. Noting that the values obtained of these methods are higher than those got from the uniaxial tensile test. These indirect techniques are: 1- split cylinder test and 2- flexural test. In this section, the Splitting Tensile Strength test is discussed.

4.7.1 Splitting Tensile Strength Test

Equipment

Compression testing machine, two packing strips of plywood 30 cm long and 12 mm wide, moulds, tamping bar (steel bar of 16 mm diameter, 60 cm long), trowel, glass or metal plate

Preparation of Samples

The sample size is cylinder of diameter 15 cm and height of 30 cm. The mould used is metal with mean internal diameter of the mould is 15 cm ± 0.2 mm and the height is 30 +/- 0.1 cm. The mould should be coated with a thin film of mould oil before use to prevent adhesion of concrete.

Concrete is placed into the mould in layers of approximately 5 cm thickness. Each layer is compacted either by hand or by vibration. When compacting by hand, the tamping bar is utilized and the stroke of the bar shall be distributed in a uniform way. The number of strokes for each layer should not at least 30. The stroke should penetrate in to the underlying layer and the bottom layer should be rodded throughout its depth.

After compacting the top layer, the surface of the concrete should be finished level with the top of the mould, using a trowel and covered with a glass or metal plate to prevent evaporation of water.

Curing: The test specimen should be stored in a place at a temperature of 27° +/- 2°C for 24 hrs. After this period, specimens are removed from the moulds to be submerged in clean fresh water or saturated lime solution for the specified curing period (such as 7 or 28 days). The water or solution should be renewed every 7 days.

4.7.2 Procedure of Splitting Tensile Test

After curing, wipe out water from the surface of specimenusing a marker, draw diametrical lines on the two ends of the specimen to verify that they are on the same axial place. Measure the dimensions of the specimen.Keep the plywood strip on the lower plate and place the specimen.

Align the specimen so that the lines marked on the ends are vertical and centered over the bottom plate.Place the other plywood strip above the specimen and bring down the upper plate to touch the plywood strip.Apply the load continuously without shock at a rate of approximately 14-21 kg/cm2/minute (Which corresponds to a total load of 9.9 ton/minute to 14.85 ton/minute).

Write the breaking load (P)

Calculation of Tensile Strength

Range Calculation for testing machine

According to IS456, split tensile strength of concrete = 0.7 * Fck

The splitting tensile strength, $T_{sp} = 2P / \pi DL$

Where P is the applied load, D is the diameter of the specimen and L is length of the specimen

Accordingly $P = 0.7 \, F_{ck} \times \pi DL / 2$

Expected load = P x factor of safety

Range to be selected for loading = (— to —)

Splitting Tensile Strength

Tsp = 2P/ pi DL where P here is the actual failure load

Thus, Splitting tensile strength of given concrete =……………….N/mm²

NOTE

The strength should be the average of three tested specimens.

Figure 4. 12 Spilt tensile test

CHAPTER 5

RESULTS AND DISCUSSION

The concrete mixes with a characteristic compressive force of 20 Map were prepared in conjunction with IS 10262. Concert mixtures have been designed to substitute the thin sum (5%, 7.5%, 10%, 12.5% & 15%) and the field (0%, 3%, 7.5%, 12%&15%) with a hard disk (HDPE, 3%). e-waste. In Table 5.1, a traditional concrete mixing technique was developed and the water cement ratio was constant to 0:42,a detailed mix proportion of the mix is given by M20 Mix.

Table 5. 1 Details of mix proportion.

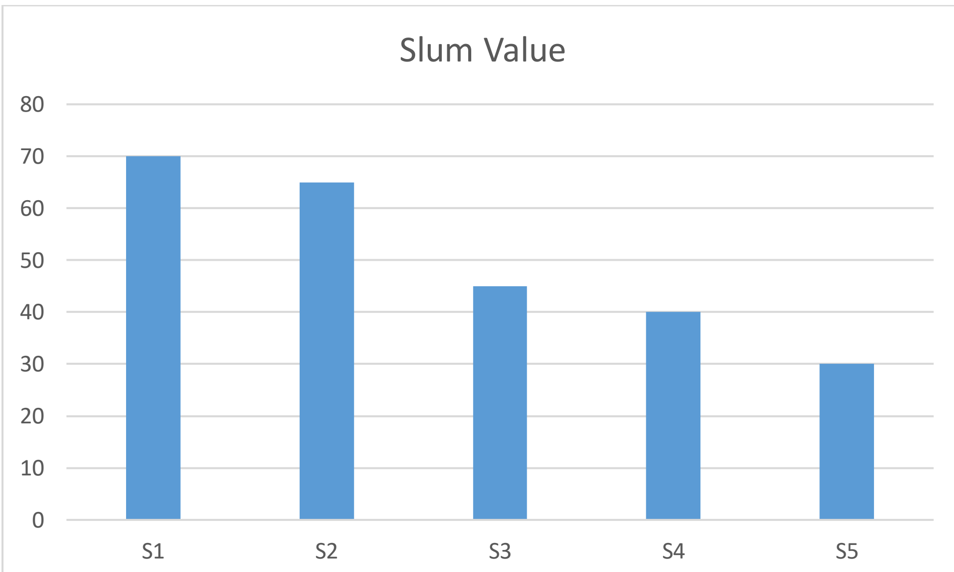
Mix Designation	**Quantity in kg/m3**				
	Cement Fine Aggregate		**Coarse Aggregate**	**% of HDPE**	**% of E-waste**
1	315	847.6	1285.5	5	0
2	315	805.2	1285.5	7.5	3
3	315	762.8	1285.5	10	7.5
4	315	722.3	1285.5	12.5	12
5	315	847.6	1156.86	15	15

5.1 Fresh Slump Test

The slum test was carried on fresh concrete which contains mixture of both E-waste and HDPE. The results are as following.

Table 5. 2 Slum result of fresh concrete using E-waste and HDPE.

Sr. No	Slum cone Designation	% of E-waste	% of HDPE	Slum Value Slum Value
1	S1	0	5	70
2	S2	3	7.5	65
3	S3	7.5	10	45
4	S4	12	12.5	40
5	S5	15	15	30



With the growing waste-plastic ratio, slumps are likely to decrease sharply due to added waste-plastic fibers which block flow and decrease the workability of concrete.

5.2 Compressive strength using HDPE as fine aggregates

The compressive intensity results in a transition in the concrete mix with a disparity in the HDPE weight. The test results revealed that for 7 days compressive intensity in mixes of 5 percent, 7.5 per cent, 12.5 per cent, and 15 percent HDPE sand substitution respectively were observed of 71.2 per cent, 69.6 and 67.5 per cent of its 28 days intensity. With the rise in sand replacement rate, the values were reduced. Whereas, in the case of coarse aggregate substitution 78, 3% of mixes, 72, 8% for mixes, 73, 0% for 0 percent, 3%, 7, 5%, 12 and 15% for e-waste substitution have been observed. Related observations were produced on 14 days, which revealed tests of compressive intensity levels between 80.1 percent and 85.7 percent in the 28 days. The compressive power of 28 days of mixtures of 112.5% sand replacement and 15% coarse aggregate substitution indicates similar results to the traditional product cement mixture. Since the lack of crushing power is increased for the HDPE, the unit weight of the cement blends can be decreased as the amount of HDPE is limited.The reduced force between the paste and the plastic surface and the hydrophobic nature of the plastic can also be ascribed to the low hydration of the cement, where the movement of water can be restricted.

Table 5. 3 Compressive strength of concrete using HPDE.

S. No	Cube Designation	Compressive Strength (N/mm2)			% Age of HDPE
		7 Days	14 Days	28 Days	
1	CC	23	27.8	35.00	5
2	F1	21	25.00	31.00	7.5
3	F2	24.2	26.8	35.01	10
4	F3	18.9	24.00	28.25	12.5
5	C1	22.9	25.00	30.25	15

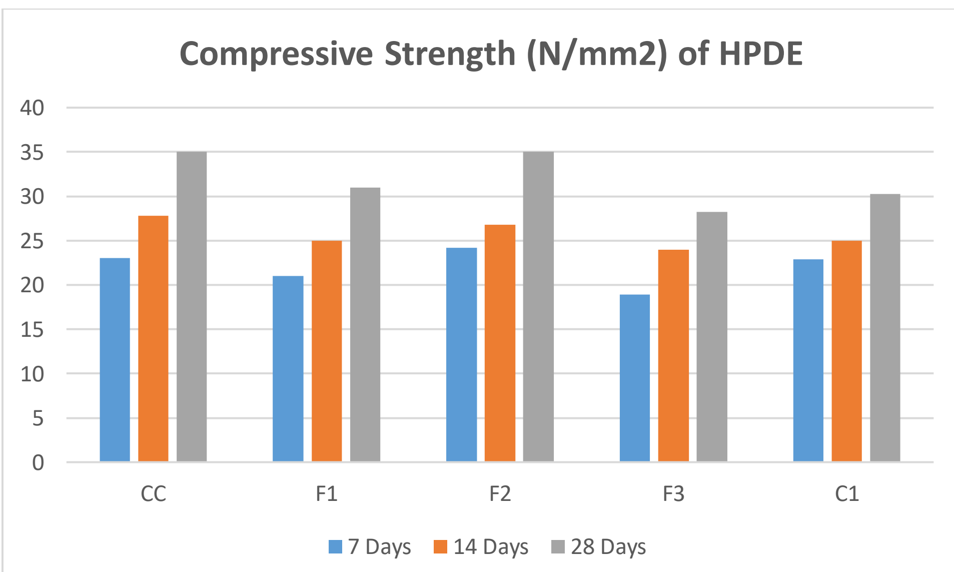


Figure 5. 1 Compressive strength results HPDE of the concrete mixes.

5.3 Compressive strength using e-waste as coarse aggregates

The compressive power of standard concrete as well as concrete with electronic-waste at 7 days, 14 days and 28days are given in table below. It can be clearly seen that the strength of the concrete will increase up to 17.8% when 7.5% aggregate is replaced by e-waste after 28 days. But when we further increase the percentage of e-waste the strength of concrete starts decreasing.

Table 5. 4 Result of Compressive Strength

S. No	Cube Designation	Compressive Strength (N/mm2)			% Age of E-waste
		7 Days	14 Days	28 Days	
1	A1	17.77	23.09	28.80	0
2	A2	19.11	26.06	33.33	3
3	A3	20.44	28.09	35.11	7.5
4	A4	18.66	23.09	28.08	12
5	A5	16.35	20.89	24.24	15

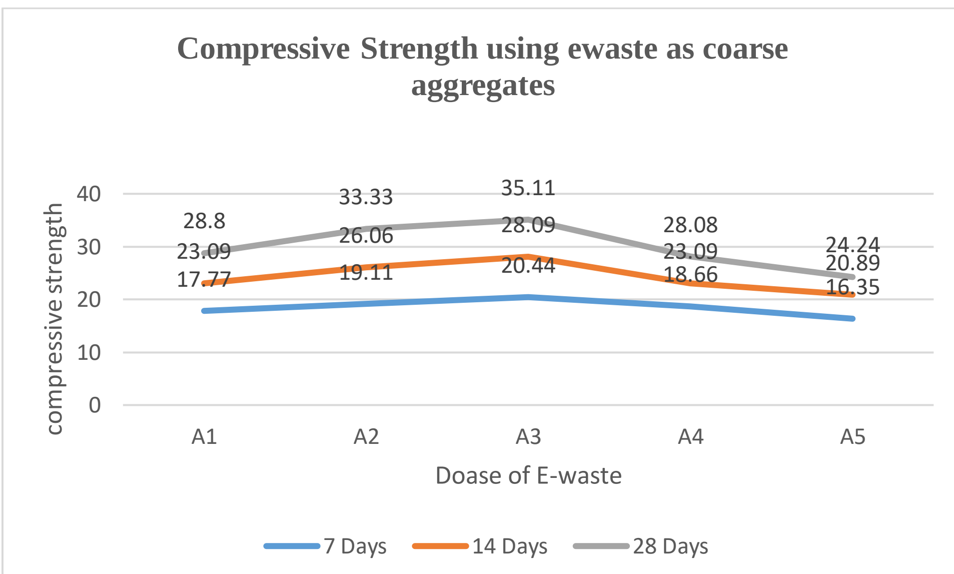


Figure 5. 2 Graph showing Compressive Strength using e-waste as coarse aggregates

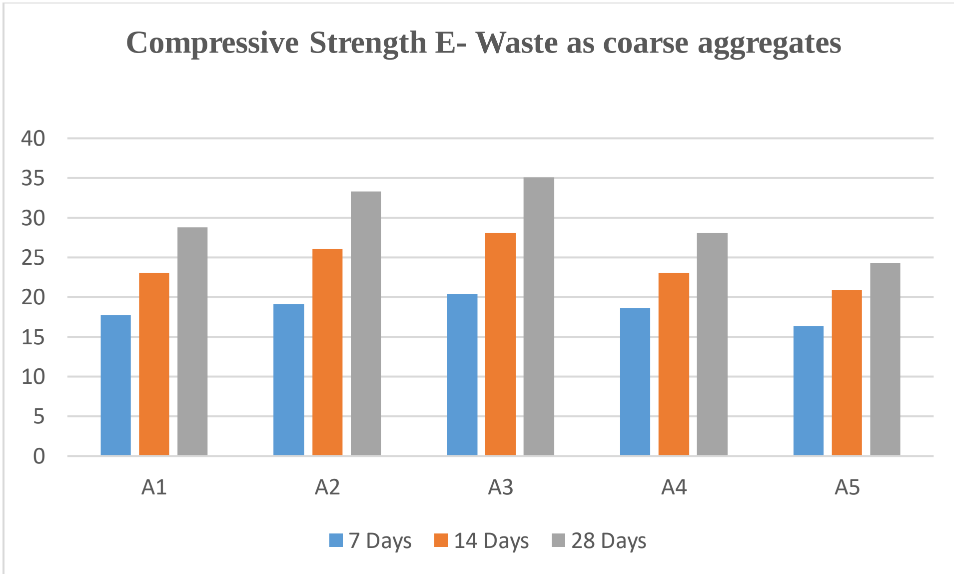


Figure 5. 3 Compressive Strength using e-waste as coarse aggregates

As find from above graph and table the compressive strength adding an E-waste as coarse aggregate found at highest compressive strength of 35.11 N/m2 at the e-waste mixing of 7.5. This is the optimized value when the Compressive Strength find high.

Table 5. 5 Compressive Strength (N/MM2) of concrete using E-waste as coarse aggregate and HDPE as fine aggregate

S. No	Cube Designation	% Of e-WASTE	% OF hdpe	Compressive_Strength (N/mm2)		
				7 Days	14 Days	28 Days
1	M1	0	5	18.9	19.98	21.08
2	M2	3	7.5	19.9	22.5	23.9
3	M3	7.5	10	21.5	23.0	26.3
4	**M4**	**12**	**12.5**	**22.3**	**24.0**	**26.7**
5	M5	15	15	17.0	19.99	23.8

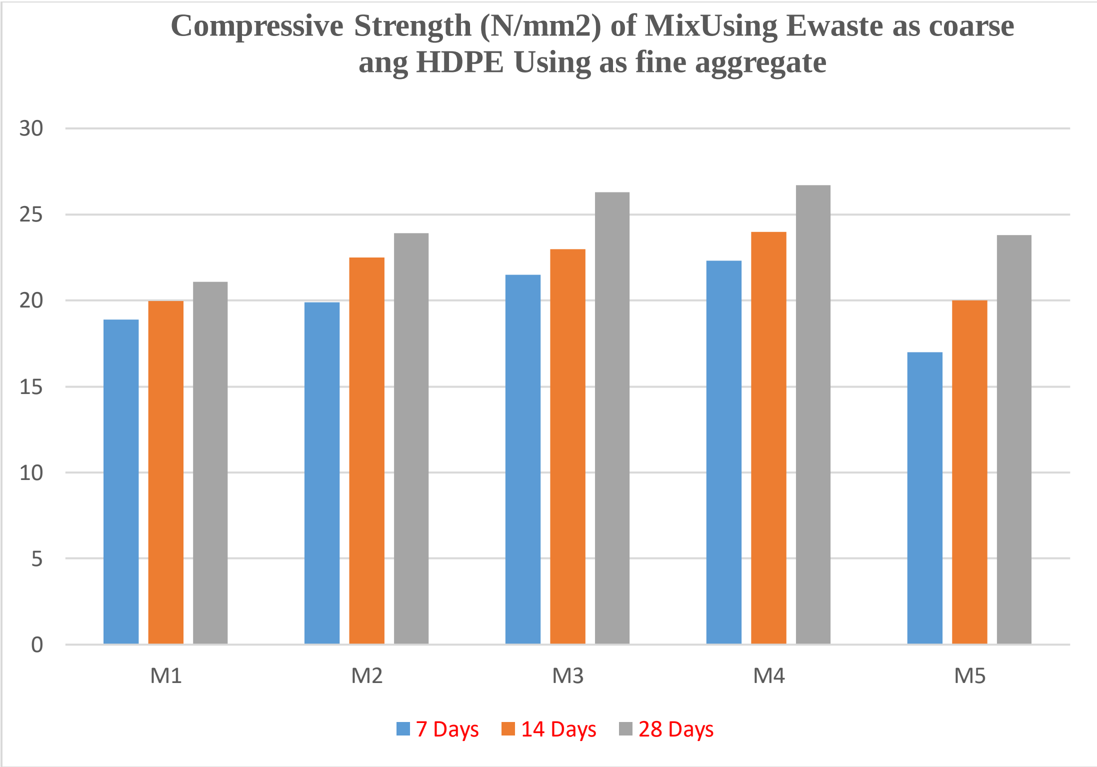


Figure 5. 4 Compressive Strength (N/mm2) of Mix Using Ewaste as coarse and HDPE Using as fine aggregate

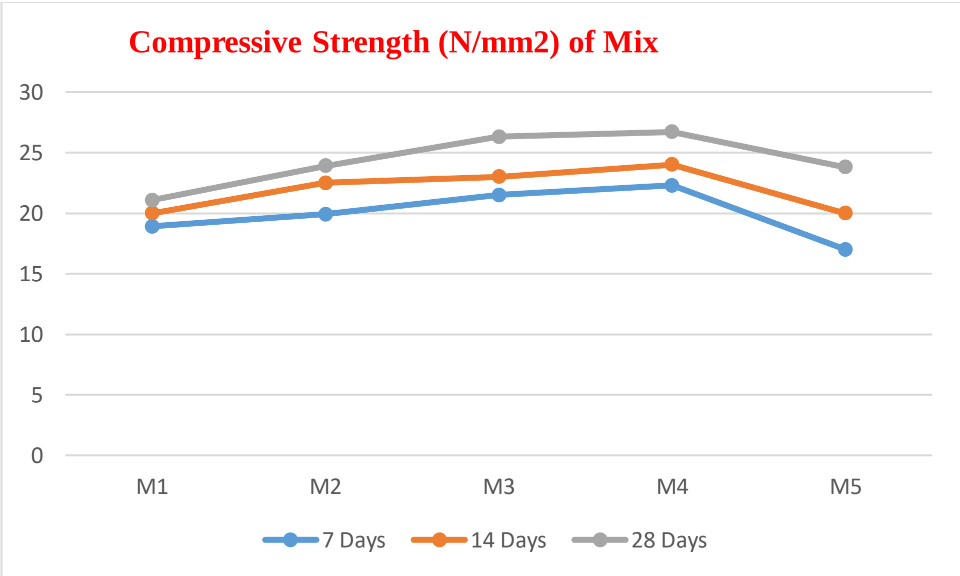


Figure 5. 5 Graph Compressive Strength (N/mm2) of Mix Using Ewaste as course and HDPE Using as fine aggregate

As find from above graph and table the compressive strength adding an E-waste and HPDE found at highest compressive strength of **26.7** N/m2 at the e-waste mixing of 12 of E-Waste and 12.5 of HDPE. This is the optimized value when the Compressive Strength find high.

5.4 Split tensile strengthusing HDPE

The change of tensile strength at 28 days of curing is shown below in the concrete mixes' division of strength. Tests show 7-14-day findings higher than normal cement mixtures, growing with the ductile property of HDPE wastes.

Due to the free water accessible on plastically surfaces, the decrease in the divided tensile strength of the cement mix with an improvement in HDPE waste volume is primarily due to a weaker relation between the flatter plastic surfaces and cement paste.

Therise in the quality of the HDPE product. Increased performance can be linked to

Table 5. 6 Split tensile strength of concrete using HDPE and fine aggregate

S. No	Cube Designation	% OF hdpe	Split Tensile (N/mm2)		
			7 Days	14 Days	28 Days
1	CC	5	1.28	2.75	3.33
2	F1	7.5	1.28	1.80	2.40
3	F2	10	2.02	2.65	3.28
4	F3	12.5	1.88	2.38	2.90
5	C1	15	1.35	2.01	2.50

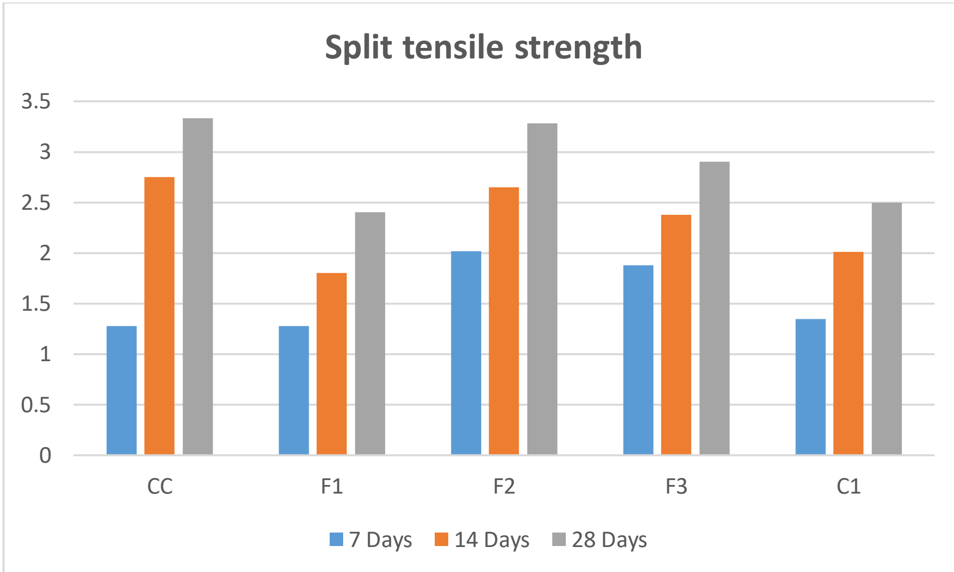


Figure 5. 6 Split tensile strength of HDPE

5.5 Split tensile strength using E-Waste

Table above showed the results of the split tensile strength. The study was done with a 7, 14 and 28 day age compressive concrete power. The cubes have been checked with a 2000KN compression check unit. From the figure above, 10% of the substitution of gross aggregate by E-waste in concrete shows the highest split tensile power.

Table 5. 7 Split tensile strength using e-Waste AS course Aggregate

S. No	Cube Designation	% OD e-WASTE	Split Tensile (N/mm2)		
			7 Days	14 Days	28 Days
1	EW0	0	2.10	2.72	3.65
2	EW5	3	2.62	3.28	3.69
3	EW10	7.5	3.10	3.52	3.99
4	EW15	12	2.78	3.28	3.61
5	EW20	15	2.65	2.82	3.05

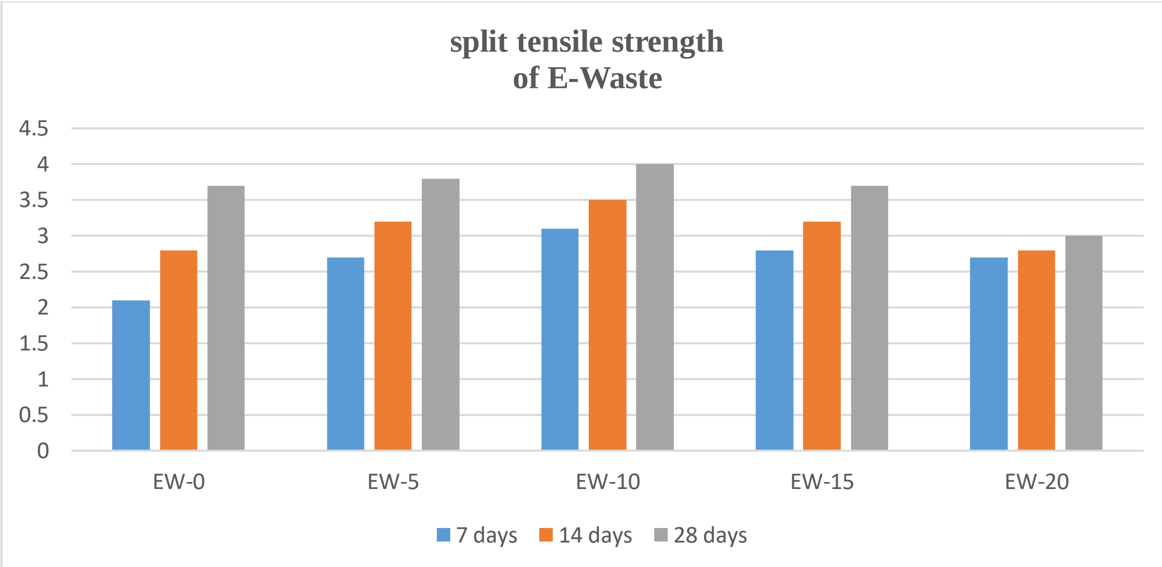


Figure 5. 7 Effect of E-waste on split tensile strengthusing E-waste as coarse aggregate

Table 5. 8 Split Tensile strength of concrete using E-waste as course aggregate and HDPE as fine aggregate

S. No	Cube Designation	% OD e-WASTE	% OF hdpe	Split Tensile (N/mm2)		
				7 Days	14 Days	28 Days
1	M1	0	5	2.2	2.3	2.4
2	M2	3	7.5	2.4	2.6	2.7
3	M3	7.5	10	2.8	2.7	2.8
4	M4	12	12.5	3.1	3.2	3.4
5	M5	15	15	3.5	3.6	3.7

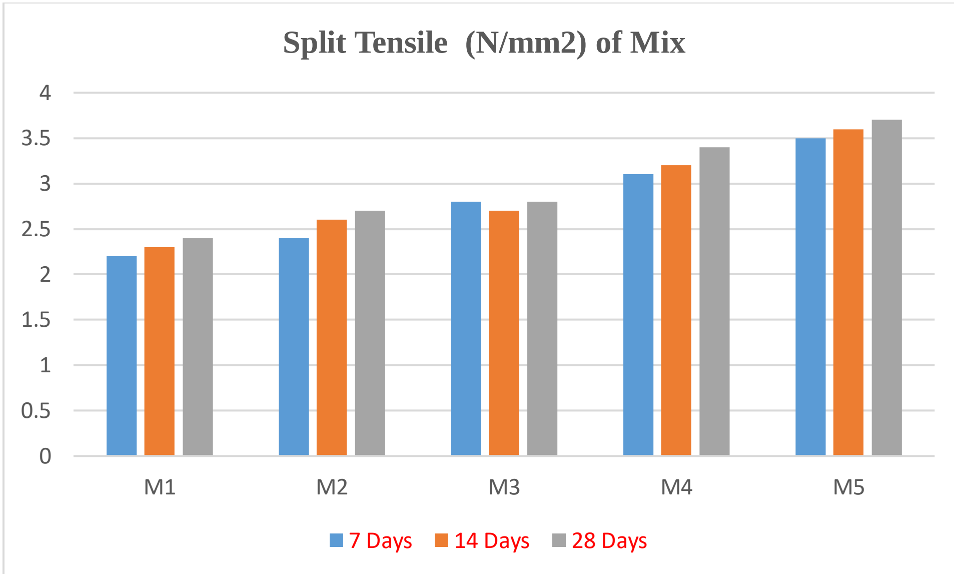
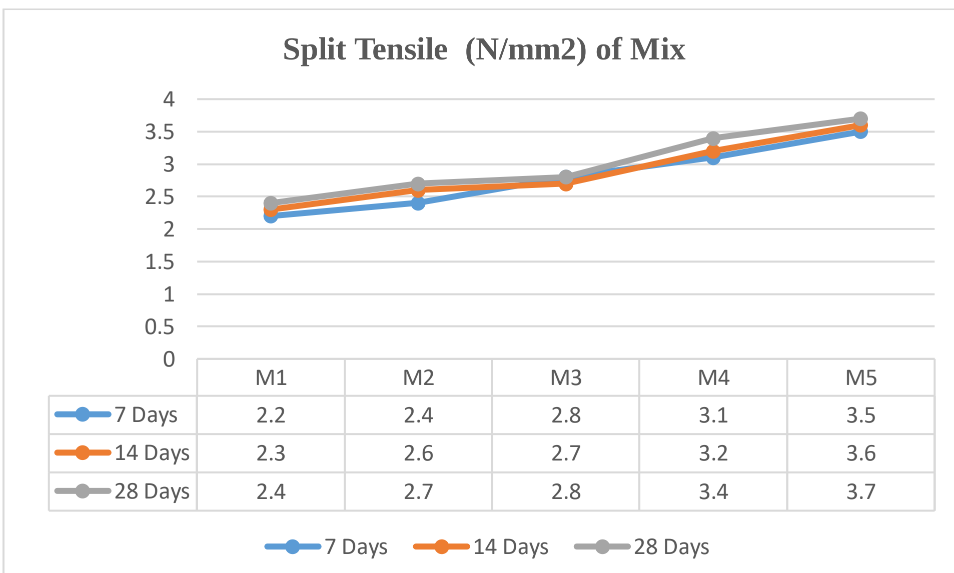


Figure 5. 8showing Split Tensile strength of concrete using E-waste as course aggregate and HDPE as fine aggregate



	M1	M2	M3	M4	M5
7 Days	2.2	2.4	2.8	3.1	3.5
14 Days	2.3	2.6	2.7	3.2	3.6
28 Days	2.4	2.7	2.8	3.4	3.7

Figure 5. 9 Graph: Split Tensile strength of concrete using E-waste as coerce aggregate and HDPE as fine aggregate

As find from above graph and table the Split Tensile strength adding an E-waste and HPDE found at highest compressive strength of **3.7**N/m2 at the e-waste mixing of 15 of E-Waste and 15 of HDPE. This is the optimized value when the Compressive Strength find high.

5.6 Flexural Strength Using HDPE

The variation of concrete bending strength at the age of 7, 14 and 28 days. From the test results, it was found that mixtures of partial aggregate replacement by HDPE waste had a higher bending power than standard concrete mixtures, regardless of volume and age of replacement. For mixtures of 10% sand replacement (6.14 MPa) and 15% coarse aggregate substitution (6.34 MPa) relative to the traditional concrete mix (3.86 MPa), the average flexural intensity has been found to be 28 days.

Table 5. 9 Flexural Strength of concrete using HDPE and fine aggregate

S. No	Cube Designation	% OF hdpe	**Flexural** Tensile (N/mm2)		
			7 Days	14 Days	28 Days
1	CC	5	2.15	3.10	3.88
2	F1	7.5	2.18	2.26	4.92
3	F2	10	3.20	3.20	5.98
4	F3	12.5	2.28	2.27	4.82
5	C1	15	3.27	3.15	4.25

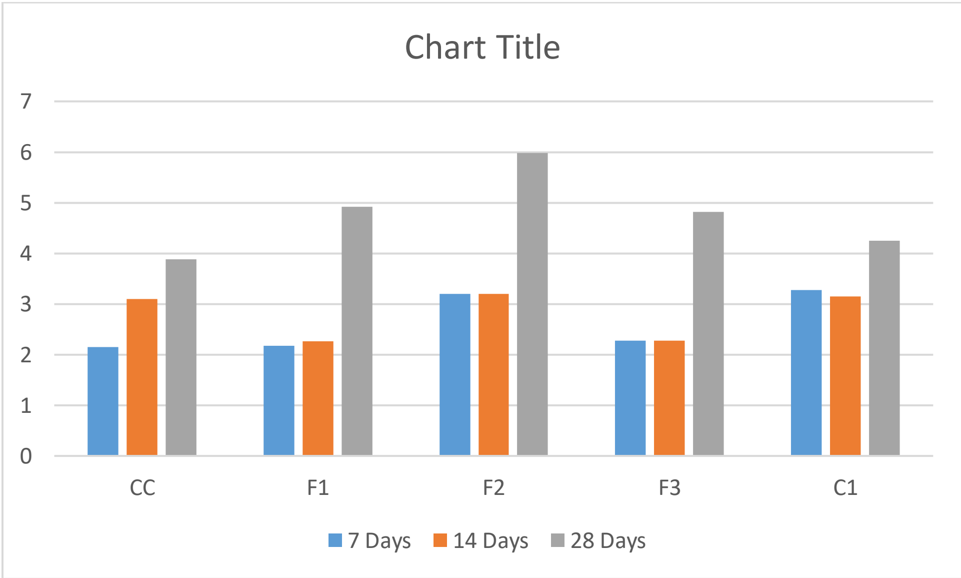


Figure 5. 10 Flexural strength results of concrete using HDPE and fine aggregate

5.7 Flexural Strength Using E-waste

Flexural strength results of normal concrete and replaced concrete were presented. The test results show the maximum flexural strength when 15 percent replace the coarse aggregate with E-waste in concrete.

Table 5. 10 Flexural Strength Using E-waste as a course aggregate

S. No	Cube Designation	% OF E-Waste	**Flexural** Tensile (N/mm2)		
			7 Days	14 Days	28 Days
1	ES-0	0	2.92	3.28	3.88
2	ES-5	3	4.95	4.92	4.95
3	ES-10	7.5	5.25	5.22	6.02
4	ES-15	12	5.72	5.98	6.25
5	ES-20	15	4.02	4.75	5.25

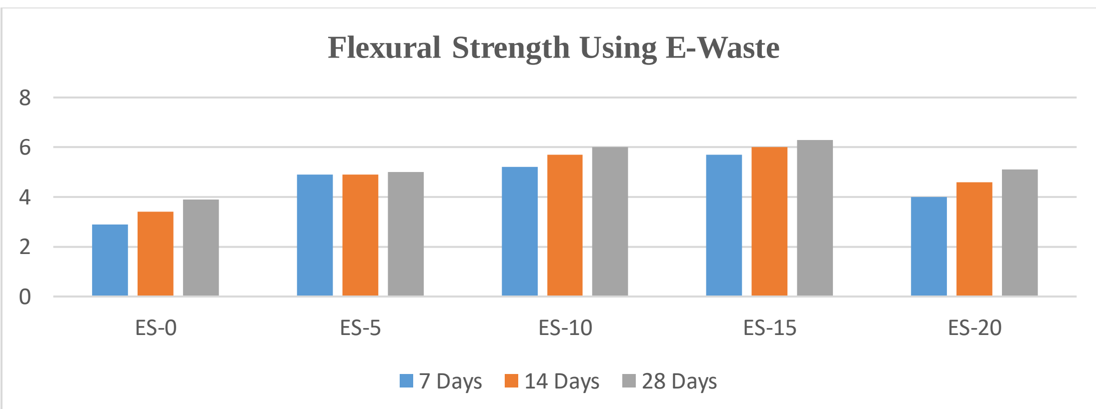


Figure 5. 11 Flexural Strength Using E-Waste

Table 5. 11 Flexural Strength of concrete using E-waste as coarse aggregate and HDPE as fine aggregate

S. No	Cube Designation	% OD e-WASTE	% OF hdpe	**Flexural** Tensile (N/mm2)		
				7 Days	14 Days	28 Days
1	M1	0	5	5.1	5.3	5.6
2	M2	3	7.5	5.2	5.4	5.8

3	M3	7.5	10	5.5	5.8	6
4	M4	12	12.5	5.7	6.3	6.5
5	M5	15	15	6	6.5	6.8

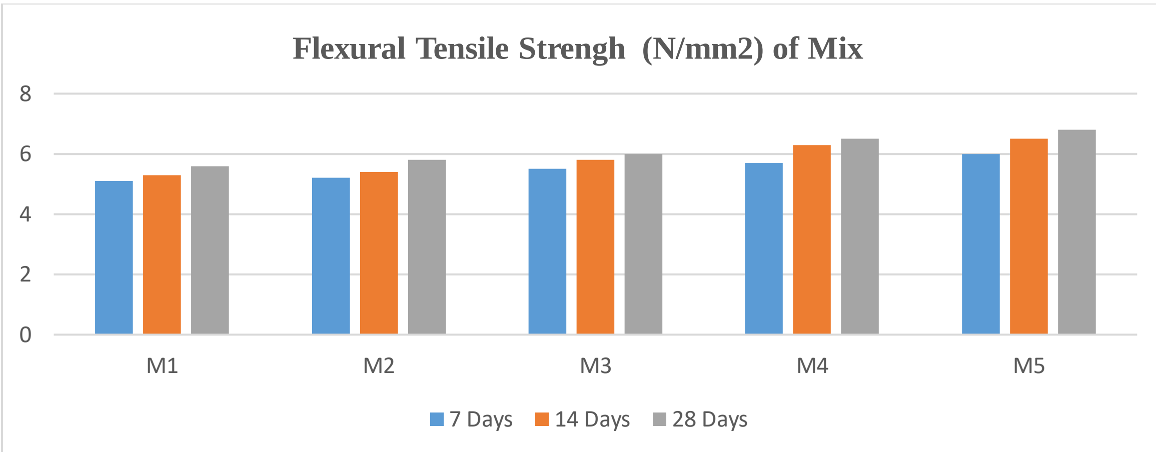


Figure 5. 12showing Flexural Strength of concrete using E-waste as coerce aggregate and HDPE as fine aggregate

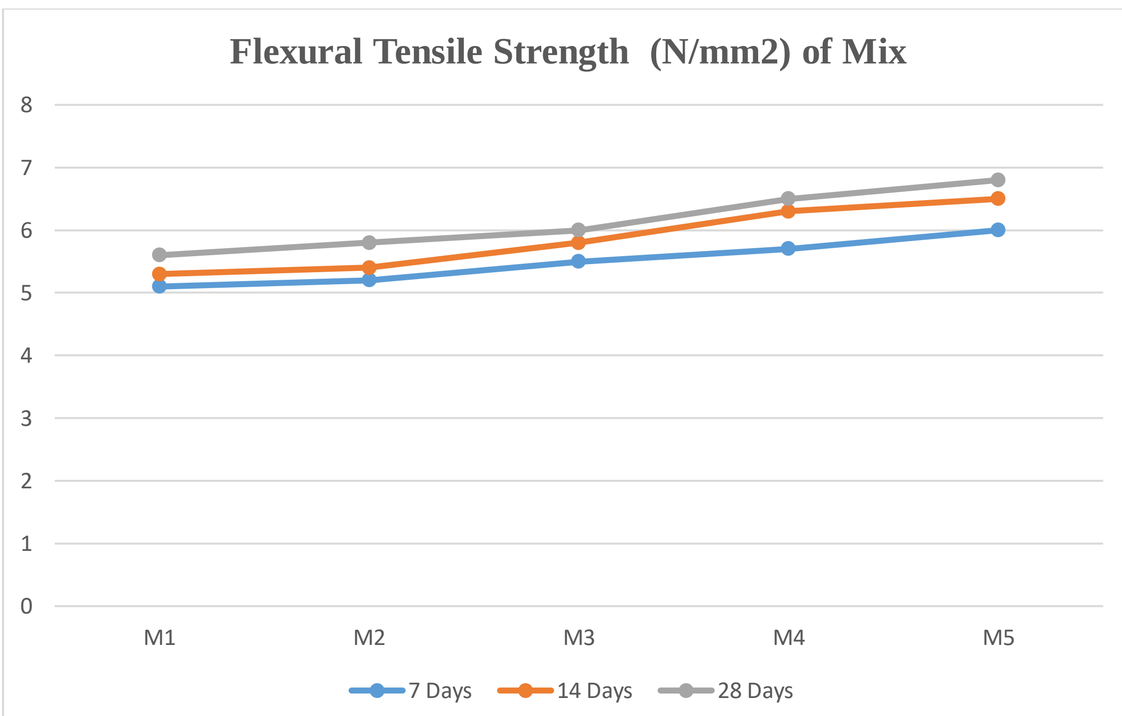


Figure 5. 13 Graph showing Flexural Strength of concrete using E-waste as coarce aggregate and HDPE as fine aggregate

As find from above graph and table the **Flexural Strength** adding an E-waste and HPDE found at highest compressive strength of **6.8** N/m2 at the e-waste mixing of 15 of E-Waste and 15 of HDPE. This is the optimized value when the Compressive Strength find high.

CHAPTER 6

CONCLUSION & FUTURE SCOPE

6.1 Use of E-waste as a course aggregate

- E-waste inclusion reveals a compressive intensity improvement of up to 15 % replacement.
- Increased strength of split pulleys was almost insignificant whereas up to 15 percent replacements were achieved with flexural tensile strength. The results of e-waste on bending power are more severe than the split tensile energy.
- The sulfate attack and chloride attack, which do not affect concrete strength and the optimal mixture, are more durable than the control mix from the durability study. It is ideal for maritime application.
- The e-waste can be disposed of effectively.
- Makes the concrete light weight and therefore reduces the weight of the structure.
- Allows it robust so that seismic loads can comfortably carry.
- The burden on natural capital is raising.
- It makes concrete more workable.
- Saves the land used for e-waste disposal.
- It reduces the risk of damaging e-waste materials.

6.2 Use of HDPEas a fine aggregate

Compressive and break tensile strength in concrete mixtures of different natural aggregate substitution rates of HDPE waste is identical in behavior. Whereas the bending strength properties of the mixtures are comparable to the conventional cement concrete mixture by adding HDPE waste. The strong chloride permeability findings indicate that ion chloride entry decreases with HDPE and the mixes were categorized into low permeability relative to high-permeability cement concrete.

REFERENCES

1. Raut, S. R., Dhapudkar, R. S., &Mandaokar, M. G. (2018). Experimental study on utilization of E-waste in cement concrete. *The International Journal of Engineering and Science (IJES)*.
2. Balaji, K. V. G. D., Kumar, T. S., & Gupta, K. N. Adoption of Recycled HDPE Plastic Granules and waste Crushed Glass as a Partial Substitute of fine Sand in Concrete.
3. Akram, A., Sasidhar, C., & Pasha, K. M. (2015). 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*, *4*(7).
4. Ahirwar, S., Malviya, P., Patidar, V., & Singh, V. K. (2016). An experimental study on concrete by using E-waste as partial replacement for course aggregate. *IJSTE-International Journal of Science Technology & Engineering*, *3*(04).
5. Singh, M. K., &Malviya, P. (2019). An Experimental Study on Partial Replacement of Aggregate by E-Waste for Flexible Pavement.
6. Balaji, K. V. G. D., Kumar, T. S., & Gupta, K. N. Adoption of Recycled HDPE Plastic Granules and waste Crushed Glass as a Partial Substitute of fine Sand in Concrete.
7. Zarbade, P., Joshi, R., & Jain, D. Evolution of Concrete using Recycled Aggregate, Coconut Shells and E-Waste as a Coarse Aggregate
8. Xavier R. C, Parappattu, N. B. (2016). Study on Partial Replacement of Fine Aggregate with Recycled Plastic Granules in Hybrid Fiber Reinforced Concrete. *International Research Journal of Engineering and Technology (IRJET), 3(8), 2166-21-69.*
9. Shinu, N. M. T., &Needhidasan, S. (2019). An experimental study of replacing conventional coarse aggregate with E-waste plastic for M40 grade concrete using river sand. *Materials Today: Proceedings*.
10. Bt, A. M. (2016). Partial replacement of e-plastic waste as coarse-aggregate in concrete. *Procedia Environmental Sciences*, *35*, 731-739.
11. Prashant, S., & Kumar, M. (2019). Effect of partial replacement of coarse aggregates with e-waste on strength properties of concrete. In *Sustainable Construction and Building Materials* (pp. 555-560). Springer, Singapore.

12. Rathore, V., &Rawat, A. (2019, September). Effective utilization of electronic waste in concrete mixture as a partial replacement to coarse aggregates. In *AIP Conference Proceedings* (Vol. 2158, No. 1, p. 020037). AIP Publishing LLC.

13. Chunchu, B. R. K., &Putta, J. (2019). Effect of Recycled Plastic Granules as a Partial Substitute for Natural Resource Sand on the Durability of SCC. *Resources*, *8*(3), 133.

14. Sabău, M., & Vargas, J. R. (2018). Use of e-plastic waste in concrete as a partial replacement of coarse mineral aggregate. *Computers and Concrete*, *21*(4), 377-384.

15. Mathur, A., Choudhary, A., Yadav, P. S., Murari, K., & Student, U. G. (2017). Experimental study of concrete using E-waste as coarse aggregate. *International Journal of Engineering Science*, *11244*.

16. Kumar, A. A., &Selvan, R. S. (2017). Performance of recycled E-waste as aggregates in green concrete. *Nature Environment and Pollution Technology*, *16*(4), 1135-1140.

17. Shamili, S. R., Natarajan, C., &Karthikeyan, J. (2017). An overview of electronic waste as aggregate in concrete. *World Academy of Science, Engineering and Technology International Journal of Structural and Construction Engineering*, *11*(10).

18. Rahman, S. K., Akshay, A., Kharlukhi, M. W., Vignesh, K. J., & Thomas, N. R. (2018). An Experimental Study on Use of E-Waste Glass as Aggregate in Concrete Blocks. *Technology*, *9*(4), 248-253.

19. Needhidasan, S., &Sai, P. (2020). Demonstration on the limited substitution of coarse aggregate with the E-waste plastics in high strength concrete. *Materials Today: Proceedings*, *22*, 1004-1009.

20. NAG, S., &Chandrakar, G. (2020). A Study on Partial Replacement of Fine Aggregate with E-Waste (NMPCB) In Eco-Friendly PCC Concrete. *IJRAR-International Journal of Research and Analytical Reviews (IJRAR)*, *7*(1), 256-263.

21. Hamsavathi, K., Prakash, K. S., &Kavimani, V. (2020). Green high strength concrete containing recycled Cathode Ray Tube Panel Plastics (E-waste) as coarse aggregate in concrete beams for structural applications. *Journal of Building Engineering*, 101192.

22. Rajesh, A., Leveil, J. L. M., Sasikumar, R., &Karthikeyan, V. Partial replacement of coarse aggregate using E-waste. *SSRG International Journal of Civil Engineering (SSRG-IJCE*), 7(4), 1-4.

23. Needhidasan, S., Ramesh, B., &Prabu, S. J. R. (2020). Experimental study on use of E-waste plastics as coarse aggregate in concrete with manufactured sand. *Materials Today: Proceedings*, *22*, 715-721.
24. Lopez, N., Collado, E., Diacos, L. A., &Morente, H. D. (2019). Evaluation of Pervious Concrete Utilizing Recycled HDPE as Partial Replacement of Coarse Aggregate with Acrylic as Additive. In *MATEC Web of Conferences* (Vol. 258). EDP Sciences.
25. Lokeshwari, M., Ostwal, N., Nipun, K. H., Saxena, P., &Pranay, P. (2019). Utilization of Waste Plastic as Partial Replacement of Fine and Coarse Aggregates in Concrete Blocks.
26. Philomina, S., &D'Mello, M. (2017). An Experimental Investigation to Produce a Cost Effective Concrete By Partial Replacement Of Coarse Aggregate With High Density Polyethylene (HDPE) Waste And Cement With Alccofine.
27. R.Lakshmi, S. Nagan, "Utilization of Waste E –plastic Particles in Cementitious Mixtures" Journal of Structural Engineering, Vol.38, No.1, April- May 2011,pp.26-35.
28. S.P.Kale, H.I.Pathan "Recycling of Demolished Concrete and E-waste" International Journal of Science and Research, 2013.
29. R. Lakshmi, S. Nagan, "Investigation on Durability Characteristics of E-plastic Waste Incorporated Concrete" Asian Journal of Civil Engineering (Builing and Housing) Vol.12, No.6, April 2011.
30. Shanmugapriya, M., & Helen Santhi, M. (2017). Strength and chloride permeable properties of concrete with high density polyethylene wastes. *International Journal of Chemical Sciences*, *15*(1), 108-116.
31. Kibria, M. G., Rahaman, O., Wahid, M. F., & Salam, A. (2017). Effect of Recycled Polystyrene Polymer in Concrete as a Coarse Aggregate. *Proceedings of Civil and Water Resources Engineering Conference*
32. Kumar, A., Tomar, A. K., & Srivastava, V. (2017). Utilization of Waste Flex in Concrete. *J. Environ. Nanotechnol*, *6*(2), 105-109.
33. Gibreil, H. A., & Feng, C. P. (2017). Effects of high-density polyethylene and crumb rubber powder as modifiers on properties of hot mix asphalt. *Construction and Building Materials*, *142*, 101-108.

34. Ali, N., Din, N., Sheikh Khalid, F., &Shahidan, S. (2017). Compressive strength and initial water absorption rate for cement brick containing high-density polyethylene (HDPE) as a substitutional material for sand.

35. Reddy, N. M., &Venkatasubbaiah, M. C. (2017). Effects of high density polyethylene and crumb rubber powder on properties of asphalt mix. *International Research Journal of Engineering and Technology (IRJET). 04 (6), 2572, 2578.*