UTILIZING RECYCLED PLASTIC WASTE IN CONCRETE

E. Saradha[1] S. Manishankar[2]Dr. K. Vidhya[3]
[1]PG Student, Mahendra Engineering College, Namakkal.
[2]Assistant professor,Mahendra Engineering College,Namakkal.
[3]Associate professor, Mahendra Engineering College,Namakkal.

Abstract: Utilization of waste materials and byproducts is a partial solution for environmental and ecological problems. Here Plastics are the most important and toxic waste materials compare to other wastes. Use of these plastic materials are not only helps in getting them utilized in cement, concrete and other construction materials, it helps in reducing the cost of cement and concrete manufacturing, but also has numerous indirect benefits such as reduction in landfill cost, saving in energy, and protecting the environment from possible pollution effects. Plastic wastes consist of the waste of plastics bags, water bottles, drums, straws and some polythene sheets. An experimental study is made on the utilization of plastic waste particles as coarse aggregates in concrete with a percentage replacement ranging from 0 % to 20% on the strength criteria of M25 Concrete. This project gives the basic mechanical properties and strength of conventional concrete M25 grade.

CHAPTER 1

INTRODUCTION

1.1 GENERAL

The generation of plastic waste is one of the fastest growing areas.Because the usage of plastics are increasing day by day in domestic and industrial wise. In TamilNadu per day, 3,400 tons of plastics are generated in each city, 35 to 45 tons are plastic wastes and most of that is plastic bags. Each year 500 billion to trillion plastics are generated worldwide. It estimated that the rate of expansion is doubled every year. This wastes produced today will remain in the environment hundreds and perhaps thousands of years. It estimated that the rate of expansion is doubled every year. This wastes produced today will remain in the environment hundreds and perhaps thousands of years. As landfill areas are rapidly depleting the cost of solid waste disposal is rapidly increasing. One solution to this crisis lies in recycling wastes into useful processes. So these types of plastic wastes are used in the construction process.

Research into new and innovative use of waste materials being undertaken worldwide and innovative ideas that are expressed are worthy of this important subject. Many highway agencies, private organizations, and individuals have completed or are in the process of completing a wide variety of studies and research projects concerning the feasibility, environmental suitability, and performance of using waste plastics in highway construction. These studies try to match the societal need for safe and economic disposal of waste materials with the help of environmental friendly highway industries, which needs better and cost-effective construction materials.

1.2 NEED FOR PLASTICS RECYCLING

As the use of plastics has increased over the years, they have become a larger part of the municipal solid waste (MSW) stream growing from less than 1%in 1960 to approximately 12% in 2008. As an example of how and why plastic waste is increasing, the Beverage Marketing Corporation reports that the average American consumed 28.3 gallons of bottled water in 2006, up from 1.6 gallons in 1976. The United States is the world's leading consumer of bottled water: Americans buy 28 billion bottles of water annually, and 70 to 80 percent of those bottles end up in landfills.

1.3 RECYCLING PLASTICS CONSERVES ENERGY AND NATURAL RESOURCES

Recycling plastics reduces the amount of energy and natural resources (such as water, petroleum and natural) needed to create virgin plastic. According to the American Plastics Council, the production of plastics accounts for 4 percent of U.S. energy consumption, and 70 percent of plastics in the United States are made from domestic natural gas.

1.4 RECYCLING PLASTICS SAVES LANDFILL SPACE

Recycling plastic products also keeps them out of landfills and allows the plastics to be reused in manufacturing new products. Recycling one ton of plastic saves 7.4 cubic yards of landfill space.

1.5 RECYCLING PLASTIC IS RELATIVELY EASY

Recycling plastics has never been easier. Today, 80 percent of Americans have easy access to a plastics recycling program, whether they participate in a municipal curbside program or live near a drop-off site.According to the American Plastics Council, more than 1,800 U.S. businesses handle or reclaim post-consumer plastics. In addition, many grocery stores now serve as recycling collection sites for plastic bags and plastic wrap.

1.6 PLASTICS RECYCLING: ROOM FOR IMPROVEMENT

Overall, plastics recycling is still relatively low. In 2008, only about 6.8 percent of plastics in the municipal solid waste stream was recycled—about 2.1 million tons of the 30 tons of plastic waste generated that year.

1.7 ADVANTAGES OF REUSE AND RECYCLE OF PLASTICS

It has been observed, to reduce the bad effects of waste plastics, it is better to recycle and reutilize wasteplastics in environment-friendly manners.As per statistics, about 80% of post-consumer plastic waste is sent to landfill, 8% is incinerated and only 7% is recycled. In addition to reducing the amount of plastic waste requiring disposal, recycling and reuse of plastic can have several other advantages, such as:

i. Conservation of non-renewable fossil fuels – plastic production uses 8% of the world's oil production, 4% as feedstock and 4% during manufacture,
ii. Reduced consumption of energy
iii. Reduced amounts of solid waste going to landfill
iv. Reduced emissions of Carbon dioxide (Co_2), Nitrogen oxides, (No_x) and Sulphurdioxide (So_2)

1.8 SIGNIFICANCE OF RESEARCH

Nowadays, the plastics usage is high so the quantity of plastic waste is high. This study to check the efficiency of concrete by using the plastic waste in it and to improve the strength of concrete using Portland Cement.

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL

Literature pertaining to similar studies conducted all over the world is collected from various sources to determine the feasibility and scope of the work.Similar studies undertaken are as follows:

2.2 Worksof Literature Reviewed

Khileshsarwe (M.E. Scholar, Department of Civil Engineering, Jabalpur Engineering College, Jabalpur, India) has investigated "Study of Strength Property of Concrete Using Waste Plastics and Steel Fiber"that the rapid Urbanization and Industrialization all over the world has resulted in the large deposition of Plastic waste. This waste can be utilized under a proper condition as content in Concrete. In this paper, we study the compressive strength of concrete using waste plastics and also add steel fiber with waste plastics. M-20 grade of concrete having a mix proportion 1:1.66:3.33 with water cement ratio 0.50 to study the compressive strength of concrete using waste plastics and waste plastic + steel fiber. Concrete cubes of size 150mm × 150mm × 150mm are prepared andtested for compressive strength after 7 and 28 days. A result of data obtained has been analyzed and compared with a control specimen. A relationship between compressive strength vs. days represented graphically. Result data clearly shows the percentage decrease in 7 and 28 days compressive strength. The use of waste plastics in concrete is relatively a new development in the world of concrete technology and a lot of research must go in this material is actively used in concrete construction. The use of plasticsin concrete lowered the strength of resultant concrete, therefore. The research must be oriented towards systems that help in overcoming this drawback of the use of plastics in concrete.

Lakshmi.R and Nagan.S did the Studies on Concrete containing E plastic waste in that**"Utilization of waste materials and by-products is a partial solution to environmental and ecological problems"**. Use of these materials not only helps in getting them utilized in cement, concrete and other construction materials, it helps in reducing the cost of cement and concrete manufacturing, but also has numerous indirect benefits such as reduction in land-fill cost, saving in energy, and protecting the environment from possible pollution effects. Electronic waste, abbreviated as e-waste, consists of discarded old computers, TVs, refrigerators, radios – basically any electrical or electronic appliance that has reached its end-of-life. Efforts have been made in the concrete industry to use non-biodegradable components of E-waste as a partial replacement of the coarse or fine aggregates. An experimental study is made on the utilization of E-waste particles as coarse aggregates in concrete with a percentage replacement ranging from 0% to 30% on the strength criteria of M20 Concrete. Compressive strength, Tensile strength and Flexural strength of Concrete with and without E-waste as aggregates were observed which exhibits a good strength gain. Ultrasonic tests on strength properties were executed and the feasibility of utilizing E-plastic particles as partial replacement of coarse aggregate has been presented.It is identified that e-waste can be disposed of by using them as construction materials. Since the e-waste is not suitable to replace fine aggregate, it is used to replace the coarse aggregate. The compressive strength and split tensile strength of concrete containing e-plastic aggregate are retained more or less in comparison with controlled concrete specimens. However, strength noticeably decreased when the e-plastic content was more than 20%. The addition of fly ash in the mix considerably improves the strength index of control mix as well as e-waste concrete. The strength development of fly ash based e plastic concrete in early days found to be less but 28 days compressive and split tensile strength has proven results in comparison with controlled concrete up to 25% e-plastic replacement. It has been concluded 20% ofE-waste aggregate can be incorporated as coarse aggregate replacement in concrete without any long term detrimental effects and with acceptable strengthdevelopment properties.

YoucefGhernouti, Bahia Rabehi, Brahim Safi and RabahChaidhas studied "Use Of Recycled Plastic Bag Waste In The Concrete". The aim of this study is to explore the possibility of recycling a plastic bag waste material (BBW) that is now produced in large quantities in the formulation of concrete as a fine aggregate by substitution of a variable percentage of sand (10, 20, 30 and 40%). The influence of the PBW on the properties of the fresh and hardened state of the concrete: workability, bulk density, ultrasonic pulse velocity testing, the compressive and flexural strength of the different concretes, has been investigated and analyzed in comparison to the control concrete. The results showed that the use of PBW improves the workability and the density, reduces the compressive strength of concrete containing 10 and 20% of waste by 10 to 24% respectively, which have a mechanical strength acceptable for lightweight materials, remains always close to reference concrete (made without PBW). The results of this investigation consolidate the idea of the use of PBW in the field of construction, especially in the formulation of concrete. This study investigates the valorization of plastic bag waste as fine aggregate in the field of construction. The effects of incorporation of this waste on the physic-mechanical properties of the concrete have been analyzed. The following main conclusions can be drawn. The bulk density has decreased considerably for all concrete's with the content of replacement of sand by plastic waste that also becomes than lighter with 40% of plastic waste. Being given that the concrete must have good workability, fluidity is significantly improved by the presence of this waste. A reduction in the mechanical resistance according to the increase in the percentage of plastic bag waste, which remains always close to the reference concrete, when we recorded a fall of compressive strength at 28 days about 10 and 24% or the concrete's containing 10 and 20% of waste respectively.Finally, PBW aggregates can be used successfully to replace conventional aggregates in concrete without any long term detrimental effects and with acceptable strength development properties.

J.N.S. SuryanarayanaRaju, M. SenthilPandian has studied "Mechanical Study on Concrete with Waste Plastic". In the present scenario, the construction cost and scarcity of sand are increasing day by day. In order to counteract this problem, and is partially replaced by waste plastic material. Plastic waste is recycled for the production of new materials which can be used as an alternative component in concrete and is one of the best solutions for disposing of plastic waste. Also, this technique proves to be highly cost-effective than conventional methods. Plastic is one of the non-degradable materials in the world and the waste plastic can be recycled in many ways to produce new things. Partial replacement of sand by waste plastic material is done with M25 grade of concrete. Waste plastic was used to replace 5 to 20% of fine aggregates in the concrete mixes and tested after 28 days for compressive and tensile strength. The experiment revealed that the partial replacement of waste plastic material can be done to a limit of 15% of the weight of the fine aggregates used in concrete.M25 grade has a nominal strength of 25kN/mm^2. Replacement of sand by 5%, 10% and 15% with waste plastic increased the strength, whereas at 20% replacement the strength reduced. Hence, up to 15% replacement of plastic waste material in concrete is acceptable. The particle size of waste plastic is less than 3.36mm, therefore, the density of particles will be less compared to sand. Hence using plastic ingredients the overall weight of the concrete can be significantly reduced.

Pramod S. Patil, J.R.Mali, Ganesh V.Tapkire, H. R. Kumavat has studied "Innovative Techniques Of Waste Plastic Used In Concrete Mixture". Disposal of plastic waste in an environment is considered to be a big problem due to its very low biodegradability and presence in large quantities. In recent time use of such, Industrial wastes from Polypropylene (PP) and Polyethylene Terephthalate (PET) were studied as alternative replacements of a part of the conventional aggregates of concrete. Plastic recycling was taking place on a significant scale in India. As much as 60 % of both industrial and urban plastic waste is recycled which obtained from various sources. People in India have released plastic wastes on a large scale have huge economic value, as a result of this, recycling of waste plastics plays a major role in providing employment. The test conducted on material like Cement, Sand, Conventional aggregate having all the results within the permissible limit as per IS codes. The modified concrete mix, with an addition of plastic aggregate replacing conventional aggregate up to a certain 20% gives strength within permissible limit.Modified concrete cast using plastic aggregate as a partial replacement to coarse aggregate shows 10% it could be satisfying as per IS codes. The density of concrete is reducing after 20% replacement of coarse aggregates in concrete.

Ganesh Tapkire, Satishparihar, PramodPatil, Hemraj R Kumavat investigated "Recycled Plastic Used In Concrete Paver Block". In this paper Recycled plastic aggregate used in various proportions in the concrete mix and check there suitability. The amount of waste plastic being accumulated in the 21st century has created big challenges for their disposal, thus obliging the authorities to invest in felicitating the use of waste plastic coarse aggregate in concrete is fundamental to the booming construction industry. Disposal of plastic waste in an environment is considered to be a big problem due to its very low biodegradability and presence in large quantities. In recent time use of such, Industrial wastes from plastic bottles, pallets, carry bags; Polypropylene (PP) and Polyethylene Terephthalate (PET) were studied as alternative replacements of a part of the conventional aggregates of concrete. If plastic wastes can be mixed with the concrete mass in some quantity or in some form, without affecting the fundamental and other properties or slight negotiation in strength the strength of concrete. Industrial wastes from Polypropylene (PP) and Polyethylene Terephthalate (PET) were studied as alternative replacements of a part of the conventional aggregates of concrete. Three replacement levels 10%, 20 %, 30% by Weight of aggregates were used for the preparation of the concrete. The concrete consist of cement, sand, Aggregate, and water. Out of which the aggregate percentage is 60 to 70 % in concrete and from the above observation, it is computed to use the 20% Recycled plastic aggregate in concrete which does not affect the properties of concrete. From the above observation, it is possible to use the plastic in the concrete mix up to 20% weight of the coarse aggregate. Looking into above aspect we come to the conclusion that plastic can be in cement concrete mix increase the % in plastic to decrease the strength of concrete. By using the plastic in concrete mix to reduces the weight of cube up 15%. From the above observation, it is possible to use the plastic in concrete and bonding admixture in concrete and also increase the % of plastic in concrete. Lastly, we strongly conclude the use of Recycled plastic aggregate in concrete which is the best option for the disposal of plastic & ultimately reduces the plastic pollution in the Environment.

R. Kandasamy and R. Murugesan studied "Fibre Reinforced Concrete Using Domestic Waste Plastics AsFibres". Fiber Reinforced Concrete (FRC) is a composite material consisting of cement based matrix with an ordered or random distribution of fiber which can be steel, nylon, polythene etc. The addition of steel fiber increases the properties of concrete, viz., flexural strength, impact strength and shrinkage properties to name a few. A number of papers have already been published on the use of steel fibers in concrete and a considerable amount of research has been directed towards studying the various properties of concrete as well as reinforced concrete due to the addition of steel fibers. Hence, an attempt has been made in the present investigations to study the influence of the addition of polythene fibers (domestic waste plastics) at a dosage of 0.5% by weight of cement. The properties studied include compressive strength and flexural strength. The studies were conducted on an M20 mix and tests have been carried out as per the recommended procedures ofrelevant codes. The results are compared and conclusions are made. The following conclusions are presented based on experimental results from the present investigation. Addition of 0.5% of polythene (domestic waste polythene bags) fiber to concrete Increases the cube compressive strength of concrete in 7 days to an extent of 0.68%; Increases the cube compressive strength of concrete in 28 days to an extent of 5.12%;

Increases the cylinder compressive strength of concrete in 28 days to an extent of 3.84%; Increases the split tensile strength to an extent of 1.63%; and The increase in the various mechanical properties of the concrete mixes with polythene fibers is not in the same league as that of the steel fibers.

2.3 SUMMARY OF LITERATURE REVIEW

1) 0%,4%,8%,12%,16%, 20%,25%up to 20% replacement plastic in concrete is giving improvement in compressive & Tensile strength.

2) Splitting tensile strength increased after the addition of plastic pieces in concrete.

3) Polyethylene fibers in different proportions from 0.3%, 0.6%, and 0.9% to 1.2% of the volume of concrete.

CHAPTER – 3

SCOPE AND OBJECTIVE

3.1SCOPE

The scope of this research is to reduce the usage of coarse aggregate in concrete. In this manner, it can satisfy the conditions of green buildings. It is also carried out to make a comparative study of compressive strength, split tensile strength and modulus of elasticity of concrete using ordinary Portland cement.

3.2 OBJECTIVE

1) To introduce the plastic waste as a replacement such as coarse aggregate in concrete.
2) To Study the mechanical properties of recycled waste plastic concrete and conventional concrete
3) To study the compressive strength of recycled waste plastic concrete and conventional concrete
4) To study the split tensile strength of recycled waste plastic concrete and conventional concrete
5) To study modulus of elasticity of recycled waste plastic concrete and conventional concrete

CHAPTER 4

METHODS AND MATERIALS

4.1 MATERIALS

The materials used for this study include cement, fine aggregate, coarse aggregate, waste plastics.

4.1.1 Cement

The most common cement used is Ordinary Portland Cement. The type I is preferred according to IS 269-1976, which is used for general concrete structures. 53 Grade ordinary Portland cement is confirming to 12269. Out of the total production, Ordinary Portland Cement accounts for about 80-90 percent.

Fineness of cement = 8%
Standard consistency of cement = 31%
Initial setting time of cement = 36 min
Specific gravity of cement = 3.46

4.1.2 Aggregate

Aggregates shall comply with the requirements of IS 383. As far as a possible reference shall be given to natural aggregate.Aggregates are the important constituents in concrete. They give body to the concrete, reduce shrinkage and effect the economy. One of the most important factors for producing workable concrete is a good gradation of aggregates. Good grading implies that a sample fraction of aggregates in a required proportion such that the sample contains minimum voids. Samples of the well-graded aggregates containing minimum voids require minimum paste to fill up the voids in the aggregates. The minimum paste will mean less quantity of cement and Minimum paste will mean less quantity of cement and less water, which will further mean increased economy, higher strength, lower shrinkage, and greater durability. Aggregate comprises about 55% of the volume of mortar and about 85% volume of mass concrete. Mortar consists size of 4.75mm and concrete contains aggregates up to a maximum size of 150mm. The fractions from 80 mm to 4.75 mm are termed as coarse aggregates. Those fractions from 4.75 mm to 150 microns are termed as fine aggregates. For most work, 20 mm aggregates are suitable.

Specific gravity of fine aggregate = 2.38
Specific gravity of coarse aggregate= 2.71

4.1.3 Water

Water is an important ingredient of concrete as it actually participates in the chemical reaction with cement. Since it helps to form the strength-giving cement gel, the quantity and quality of water are required to be looked into very carefully.Water used for mixing and curing shall be clean and free from materials like oils, acids, alkalis, salts, sugar, organic materials or other materials that may be harmful to concrete or steel. The pH value of the water used in concreting shall not be less than 6.

4.1.4 Plastic

Nowadays the plastics usage is high so the quantity of plastic waste is high. This study to check the efficiency of concrete by using the plastic waste in it and to improve the strength of concrete using Portland cement.A material that contains one or more organic polymers of large molecular weight, solid in its finished state and it some state while manufacturing or processing into finished articles, can be shaped by its flow, is termed as PLASTIC.

4.1.4.1 Types of Plastics

- Thermosets
- Elastomers
- Thermoplastics

4.1.4.2 RESINS

Resins are solid or semi-solid materials, light yellow to dark brown in color, composed of carbon, hydrogen, and oxygen. Resins occur, naturally in plants and are common in pines and fire, often appearing as globules on the bark. Synthetic resins such as polystyrene, polyesters, and acrylics are derived primarily from petroleum. Resins are widely used in the manufacture of lacquers, varnishes, plastics,adhesives, and rubber.

4.1.4.3 VARIOUS RESINS OF PLASTICS

- Low-density polyethylene (LDPE)- bags, sacks, bin lining, and Squeezable detergent bottles etc.
- High-density polyethylene (HDPE) - bottles of pharmaceuticals,Disinfectants, milk, fruit juices,bottle Caps etc.
- Polypropylene (PP) - bottle cap and closures, filmwrapping for biscuits, microwave trays for Ready-made meals etc.
- Polystyrene (PS) - yogurt pots, clear egg packs,bottle caps.
- Foamed Polystyrene - food trays, egg boxes, disposable cups, Protective packaging etc.
- Polyvinyl Chloride (PVC) - mineral water bottles, credit cards, toys, Pipes and gutters; electrical fittings, Furniture, folders, and pens; medical Disposables etc.

Table.4.1 Properties of plastics

Properties	Values
Specific gravity	1.04
Density (g/cc)	0.945 - 0.962
Melting point	75 - 100
Fineness	<2.36

Figure 4.1 High-density plastic (Polypropylene)

4.2 METHODOLOGY

1) Literature review

2) Collecting the waste plastics to be used
3) Testing the properties of materials
4) Designing the mix
5) Casting the cubes, cylinders, and beams
6) Testing of the specimens
7) Comparing the results
8) Conclusion

CHAPTER 5

EXPERIMENTAL INVESTIGATIONS

5.1 TEST PROGRAMME

The project deals with the behavior of recycled waste plastic concrete in partial replacement of coarse aggregate. To find out the strength parameters such as compressive strength,split tensile strength and modulus of elasticity of concrete with partial replacement of coarse aggregate is the prime concern of this study.

Seventy-two cubes, hundred and eight cylinders, are tested under compression, split tensile and deflection test respectively. The M25 grade of concrete is used for this study

The investigated parameters under this study were concrete strength and the percentage of replacement plastics for the coarse aggregate. Further details of concrete specimens are as follows:

5.2 DETAILS OF SPECIMENS

5.2.1 Cube Specimens

A mold of internal dimensions of 150 × 150 × 150 mm is used for casting of cubes for compression strength for both conventional concrete and waste plastic concrete Specimens. Fig 5.1 shows the cubes molds.

5.2.2 Cylinder Specimens

A mould of internal dimensions of 150 mm diameter and 300mm height are used for casting of a cylinder for split tensile strength for both conventional concrete and waste plastic concrete Specimens are yet to be cast.

Fig. 5.1 Cube moulds

CHAPTER 6

RESULTS AND DISCUSSIONS

6.1 COMPRESSIVE STRENGTH

Compressive strengths were measured using a compression testing machine with a maximum capacity of 2000kN. For all tests, each value was taken as the average of three samples. Test results for conventional concrete for both 14 and 28 days curing were tabulated in Table 6.1. The dimensions for the concrete cube should be in 150×150×150mm respectively. The testing arrangements are shown in Fig 6.1 and Fig 6.2

Fig. 6.1 Compressive Strength Testing for Cube

The ultimate compressive load and compressive strength of the conventional and plastic concrete cubes for 14 days and 28 days curing results are tabulated in Table 6.1

Fig 6.2 Concrete cube specimen in after testing

Fig 6.2 shows the failure mode of the conventional concrete cube at the ultimate load point. The ultimate load of this concrete cube is 585 kN for 14 days and 685 kN for 28 days curing

Table 6.1 Compressive strength results for concrete cubes

% of	Compressive strength(N/mm^2)

Plastics	7 days	14 days	28days
0	17.5	22.65	27.92
2	16.12	25.82	30.26
4	23.053	27.92	32.21
6	23.446	28.12	31.98
8	25.802	27.92	33.01
10	24.262	35.33	38.25
12	14.668	27.55	28.21
14	16.347	21.31	22.12
16	14.633	20.16	19.24
18	10.974	14.30	15.21
20	10.11	11.97	13.33

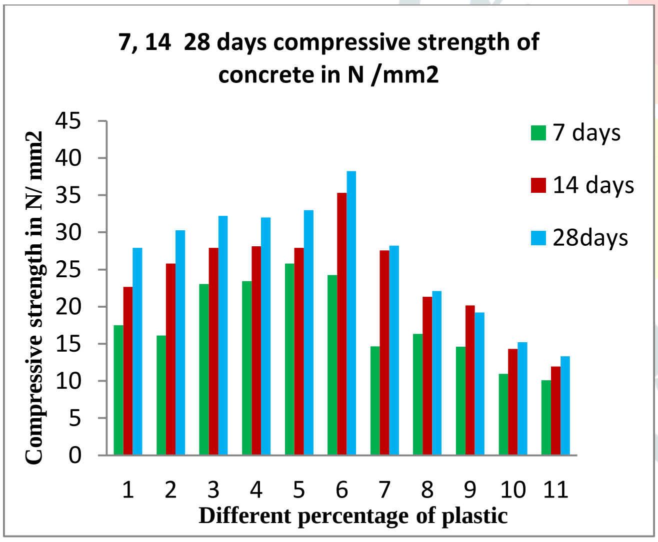

Fig. 6.3 Compressive strength for cubes

The compressive strength for plastic concrete cubes for 14 and 28 days results are shown at Fig 6.3.

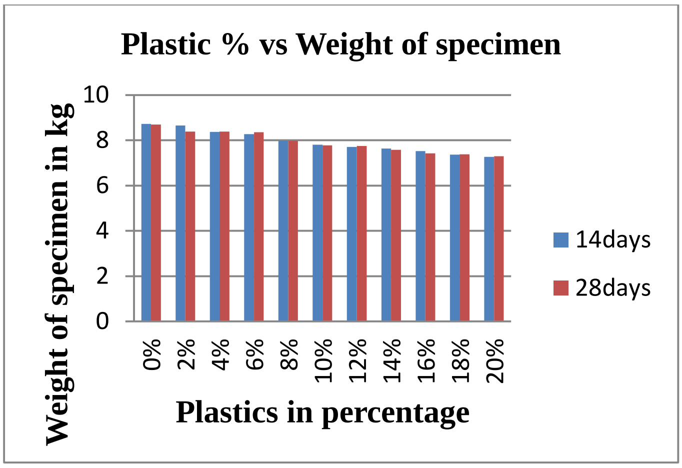

Fig. 6.4 Self-weight comparison for cubes

The self-weight variations for plastic concrete cubes for 14 and 28 days results are shown at Fig 6.4.

CHAPTER 7

APPENDIX

MIX DESIGN FOR CONVENTIONAL CONCRETE(M25)

GENERAL

In the present study, the physical properties of cement, fine aggregate, coarse aggregate.

AIM

To design M25 grade concrete

GIVEN DATA

Characteristic strength = 25N/mm^2

The degree of quality control = good

The maximum size of aggregate = 10mm

The specific gravity of coarse aggregate = 2.71

The specific gravity of fine aggregate = 2.38

The specific gravity of cement = 3.46

Type of exposure = Moderate

Type of usage PCC structure

Grading of the sand zone is II as per sieve analysis results

SOLUTION

(a) Target mean strength:

From table 1 of IS 10262-2009,the value of standard deviation is 5 MPa

$F'_{ck} = f_{ck} + 1.65\ s$

Where,

F'_{ck} = target average compressive strength at 28 days,

F_{ck} = characteristic compressive strength at 28 days,

S = standard deviation.

From table 1, (IS 10262 : 2009) Standard Deviation, SD= 5 N/mm^2

Target strength = 25+ 1.65 × 5

= 33.25 N/mm^2

(b) Calculation of water content:

From Table 2 (IS 10262 : 2009) ,
Maximum water content for 20mm aggregate =186 *l* (25-50mm slump)
For any 25mm slump a 3% increase in water content should be done
For 100 m slump, water content = 186+0.06x186 = 197 *l*

(c) Calculation of cement content:

w/c ratio = 0.4
Cement content = 197/0.4 = 492.5 kg/m^3
320 kg/m^3 <492.5 kg/m^3 > 450 kg/m^3
Hence assume maximum cement content as 450 kg/m^3 (IS 456: 2000)
Water content = 450 x 0.4 = 180 *l*

(d) Proportioning of volume of CA and FA content:

From Table 3, of IS 10262: 2009,
Volume of CA for 20mm aggregate and FA of zone I = 0.6
Since w/c ratio is 0.4, 0.01 should be increased for every ±0.05 change.
Therefore, % corrected volume of CA for 0.4 w/c ratio = 0.62
% volume of FA for 0.4 w/c ratio = 1-0.62 = 0.38

(e) Mix calculation:

Volume of concrete = $1m^3$

Volume of cement = $\frac{mass\ of\ cement}{sp.gravity of cement} x \frac{1}{1000}$

$= \frac{450}{3.15} x \frac{1}{1000} = 0.143m^3$

Volume of water = $\frac{mass of water}{sp.gravity of water} x \frac{1}{1000}$

$= \frac{180}{1} x \frac{1}{1000} = 0.180m^3$

Volume of total aggregate (e) = 1- (0.143+0.180)
e = 0.677 m^3

Mass of FA = e × volume of FA × specific gravity of FA × 1000
= 0.677 × 0.38 × 2.74 × 1000
= 704.89 kg

Mass of CA = e × volume of CA× specific gravity of CA ×1000
= 0.677 × 0.62 × 2.74 × 1000 = 1150.1 kg

RESULTS

Weight of water = 180 kg/m^3

Weight of cement = 450 kg/m^3

Weight of fine aggregate = 704.89 kg/m^3

Weight of coarse aggregate = 1150.1 kg/m^3

Mix proportion 1 : 1.56 : 2.56

REFERENCES

- Indian Standard plain and reinforced concrete code method (Fourth Revision) – IS 456: 2000
- Indian Standard Concrete Mix Proportioning – 10262 2009
- Indian Standard Methods of test for Strength of concrete – 516 1959
- YoucefGhernouti, Bahia Rabehi, Brahim Safi and RabahChaid, Use Of Recycled Plastic Bag Waste In The Concrete, Volume 8, ISSN 1314-7269
- Pramod S. Patil, J.R.Mali, Ganesh V.Tapkire, H. R. Kumavat, Innovative Techniques Of Waste Plastic Used In Concrete Mixture PP: 2321-7308
- Ganesh Tapkire, Satishparihar, PramodPatil, Hemraj R Kumavat, Recycled Plastic Used In Concrete Paver Block PP: 2321-7308

- Lakshmi.R and Nagan.S, Studies on Concrete containing E - plastic waste, International Journal of Environmental Sciences Volume 1, No 3, 2010, ISSN 0976 – 4402.
- R. Kandasamy and R. Murugesan, Fibre Reinforced Concrete Using Domestic Waste Plastics As Fibres, ARPN Journal of Engineering & Applied SciencesVol 6, No 3, March 2011, ISSN 1819-6608.
- J.N.S. SuryanarayanaRaju, M. SenthilPandian, Mechanical Study on Concrete with Waste Plastic, International Journal of Research in Civil Engineering, Architecture & Design, Volume 1, Issue 1, July-September 2013, pp 62-67.
- Khileshsarwe, Study of Strength Property of Concrete Using Waste Plastics and Steel Fiber PP: 2319 – 1805 (2014).