



Experimental Study on Eco-Friendly Concrete with Fly Ash and Waste Glass

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Abstract:

With the rapid growth in the infrastructure development, the procurement of cement for construction activities is certain to increase. Due to various environmental problems concerned with the cement industry, there arises a great need to make use of an alternate technology which can be sustainable and economical. An effort is made to develop Eco-friendly Concrete and to study its Strength, Water Absorption and other parameters. The materials used here are Cement, Fine aggregate, Coarse aggregate, Fly Ash (Class F) and waste glass powder. It involves Casting of green concrete cubes and cylinders and testing them for its compressive and split tensile strength. Cubes and Cylinders were casted for varying proportions of Fly Ash and Waste glass powder to determine the mix properties.

Keywords: Green concrete, Fly Ash, waste glass powder, Environmental Pollution, Ambient Curing.

I.INTRODUCTION

Concrete is most commonly used construction material, which is used in all the structures for their construction. Ordinary Portland Cement (OPC) is the most commonly used binder material in construction practices. Manufacture of One Ton of OPC releases approximately One Ton of Carbon Dioxide into the atmosphere and which requires high energy for its production which causes environmental pollution by contributing to the production of greenhouse gases. 7% of greenhouse gases are emitted by the cement industry to the atmosphere. The severe problem faced by the world nowadays is environmental pollution. This increased environmental pollution has thus resulted in global warming. Today the whole world is impacted by global warming. Atmospheric Carbon di-oxide level have increased by about 30% over the past 200 years. There are many alternatives which can be used to reduce the emission. They are rice husk, fly ash, egg shell, glass powder etc. If we are going for any alternatives for the construction then it should be easily available and economical. For sustainable construction all the construction companies are very much interested in using recyclable materials. In recent years the incentives to reduce the environmental pollution has increased. Fly ash is an industrial waste and it has pozzolonic characteristic occurring due to the burning of pulverized coal in the power plants. In the construction sector instead of cement or instead of fine aggregates, as a base and sub base material in highway construction, as a filling materials in dam ,in retaining walls, and for the light construction material. Fly ash when used with Portland cement, it contributes to high strength and improved durability. The production of fly ash is high across our country. If fly ash is segregated, collected and used properly then it can resolve the problem of disposal of waste and it can reduce the use of cement which uses high amount of energy and natural resources. The interest of construction community is increasing

in using the waste materials for sustainable construction. The glass from the surroundings is disposed as a landfill. Waste glass do not cause environmental pollution but it is harmful to humans and animals if proper care is not taken and it is less friendly to environment because of its non bio-degradable nature. So the development of new technology is very essential. Alkali content in the cement can be increased by introducing waste glass in it. Waste glass contains approximately 72% of silica, when it is ground to very fine powder, it reacts with alkalis in cement and cementitious material which contributes to the increase in the strength of cement.

OJECTIVES OF THE STUDY

- ✓ Our main objective is to develop an ecofriendly concrete by partially replacing cement by fly ash and waste glass powder to control global warming.
- ✓ To the variation in strength for the eco-friendly concrete by varying the proportions of fly ash and waste glass powder.
- ✓ To achieve high compressive strength and spilt tensile strength for ecofriendly concrete.
- ✓ To reduce environmental pollution which is caused due to the manufacture of cement.
- ✓ To effectively use the wastes such as fly ash and glass powder.

SCOPE OF THE STUDY

This study is based on the development of eco-friendly concrete. There are many studies which mainly focus on the environmental friendliness. But they are mainly based on the strength properties of concrete. The waste from the coal industries (fly ash) is used as the resource for the development of ecofriendly concrete. The non-biodegradable waste like glass, which is easily available is used in this project. By using these

two wastes the cost for the production of concrete can be reduced.

II.LITERATURE REVIEW

Vijeta Verma et.al.(2018)^[1]: In this paper they have partially replaced cement by using fly ash and glass powder at 10%,20%,30%,40%. In this they have obtained maximum compressive and flexural strength at 10%. They came to the conclusion that concrete becomes more workable as fly ash and glass powder content increases . The main objective of this journal is energy consumption and effective disposal of waste. Large amount of energy is required in manufacturing of cement which will result in the production of CO₂, to reduce this during manufacturing some amount of cement can be replaced by fly ash and glass powder. Fly ash is an industrial waste with pozzolonic properties, which should be properly disposed to avoid its harmful effect on environment. Glass Therefore this journal can be an effective solution for disposal of fly ash and waste glass.

Vinod Goud et.al.(2016)^[2]: In this paper they have explained about their experimental procedure for the partial replacement of cement by fly ash for different water-cement ratios and for 10 to 30 % replacement of cement by fly ash. In this they have obtained maximum strength for 10 and 20 %. Fly ash is a waste generated in thermal power plant, which causes harmful effect on environment when it is not disposed properly. This can be a solution for proper management and dumping of fly ash by using it in construction processes. Proper management of industrial waste can avoid the harmful effect on environment and reduces the stress on earth.

Prof. Jayeshkumar Pitroda et.al.(2012)^[3]: In this paper they have designed mix M25 and M40 according to IS:10262.By this they came to the conclusion that the strength reduces when the cement is replaced by fly ash. The results that fly ash can be a better supplementary construction material and also economy of construction can be effectively increased. The pollution on environment can be reduced by reducing the consumption of energy resources. Fly ash which is produced as a waste in thermal power plant is causing large amount of negative impact on environment. Properties of fresh and hardened concrete can be effectively increased by using partially cementitious materials. this journal states the feasibility of using fly ash as partial replacement for cement in concrete.

Dhanaraj Mohan Patil et.al.(2013)^[4]: In this study the have prepared four groups of concrete mixes .First mix was prepared by replacing cement by the glass powder of particle size 90 microns from 10 to 30%.Second mix was prepared by replacing cement by waste glass powder of particle sizes 90 to 150 microns from10 to 30 %.And the other two mixes were prepared by using only 90 to 70 % of cement as that of design. By this they came to the conclusion that glass powder does not contributes to the early strength gain of concrete.

Rakesh Sakale et.al.(2016)^[5]: In this study an effort is been made to study the properties of concrete by partially replacing cement by waste glass powder, and feasibility of using glass powder in concrete is studied. Here cement is replaced by glass

powder in the rate of 10-40% in increments of 10% respectively. The results indicates, at 20% , the compressive, tensile and flexural strength attain its maximum and decreases by the further addition of glass powder. As the amount of glass powder increases, slump of concrete decreases subsequently. The compressive strength remains unchanged up to 20% addition of glass powder. This journal states that disposal of waste glass is a major problem in these days. One of the effective way to overcome these limitation is to use glass powder in the construction practice.

Shri Ananda Sai et.al.(2017)^[6]: This journal mainly concentrates on the reduction of pollution caused by production of cement, and to control the over use of river sand in the construction technology. Crushed glass powder is used as the partial replacement for cement to reduce the use of cement and M-sand which is a byproduct obtained during the process of manufacturing of coarse aggregate is used instead of river sand. The results indicates the 15% replacement of cement by glass powder is optimum. 12 and 15% of strength is increased by replacing 10 and 20% of M-sand by river sand. Thus the author concludes that by using glass powder and M-sand emission of carbon di oxide and depletion of river bed can be reduced along with the production of high strength concrete.

III.EXPERIMENTAL INVESTIGATION

Experimental study is done on concrete prepared by partialreplacement of cement by fly ash and waste glass powder.The cement is partially replaced by the waste glass powder by 5% ,which is kept samein all the four mixes whichwe have prepared and the flyash content is increased by 5% in each mix upto 20%.Concrete mixtures are produced,tested and compared in terms of compressive strength and spilt tensile strength with conventional concrete for 7and 28days curing period.

IV.MATERIALS USED

CEMENT

Here in this study we have used Ordinary Portland Cement of grade 43. Cement is the one of the major ingredients which is used in a concrete mix and it act as a binder material. Here in this study we are use the cement for the preparation of cubes and cylinders. The cement was tested for specific gravity and fineness before the preparation of cubes and cylinders.

FLY ASH

Fly ash is a pozzolonic material which produces energy using coal. It is produced by the thermal power plant. Mixture of fly ash and cement gives the more strength, durable, workability, compaction strength. Fly ash avoids the land fill products. The chemical composition present in fly ash is determined by incombustible material in the coal. The chemical composition of fly ash are Oxide of Silica (SiO₂), Alluminium (Al₂O₂), Calcium (CaO) ,which are present in large amount and Magnesium, Potassium, Sodium and Titanium are present in small amount. The different chemical composition in fly ash depend on the use of variety of coal. ASTM broadly classifies fly ash into two classes.

- ✓ **Class F:** Fly ash normally produced by burning anthracite or bituminous coal, usually has less than 5% CaO. Class F fly ash has pozzolanic properties only.
- ✓ **Class C:** Fly ash normally produced by burning lignite or sub-bituminous coal. Some class C fly ash may have CaO content in excess of 10%. In addition to pozzolanic properties, class C fly ash also possesses cementitious properties

FINE AGGREGATE

Fine Aggregate is a filler material to the concrete mix. It is used to fill the voids in the concrete. The specific gravity of fine aggregate is found before preparing the mix design. The obtained values of specific gravity is used for the mix design of our project. The natural sand with 4.75mm of maximum size was used in our project.

COARSE AGGREGATE

Coarse aggregate is one of the main ingredient of the concrete mix, which makes the concrete to resist the impact load and crushing load. In our project we have used 20mm size aggregate. The specific gravity of coarse aggregate is found before preparing the mix design. The value obtained from the specific gravity is used for the procedure of mix design.

WATER

We have used portable water which is available in the college premises in our project. It helps to form the strength by forming the cement paste.

V.RESULT AND DICUSSIONS

1.Compressive strength test

The compressive strength of the cube was determined by testing them in Compression Testing Machine (CTM) after 7 days and 28 days of curing. The compressive strength has also been studied by plotting graph of different mixes v/s their curing period

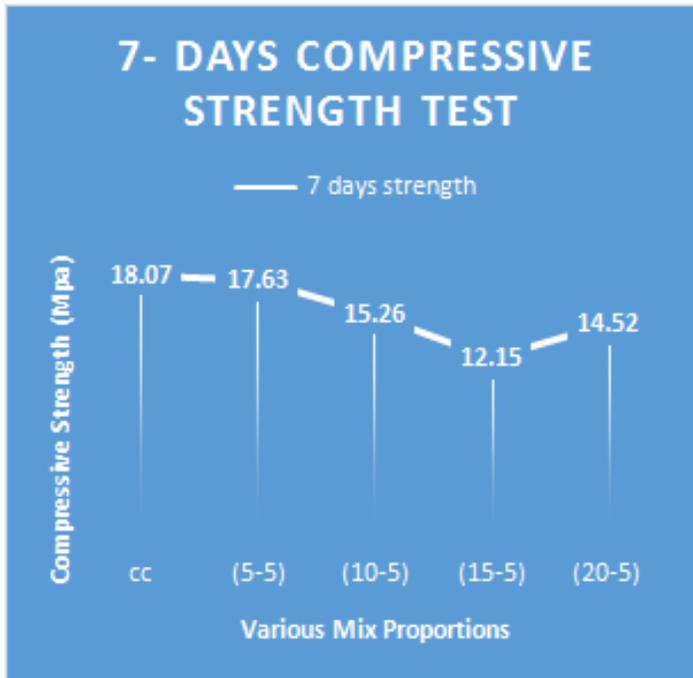


Figure.1. 7-days compressive strength v/s various mix proportions

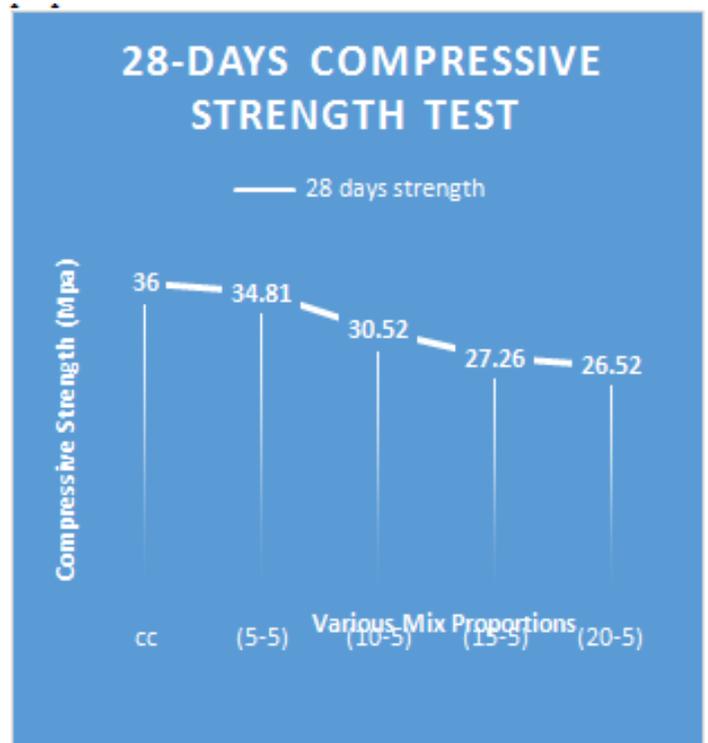


Figure.2. 28-days Compressive Strength v/s Various Mix Proportions

2.Split Tensile Strength Test

The split tensile strength is determined by testing it in compression testing machine for 7 days and 28 days. The split tensile strength is also have been studied by plotting graph of split tensile strength v/s various mix proportions.

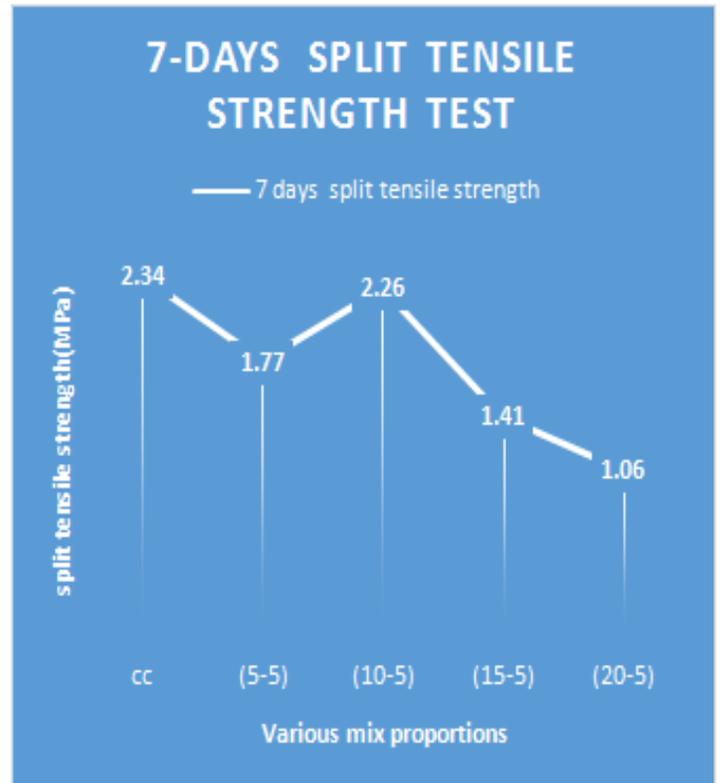


Figure. 3. 7-Days Split Tensile Strength V/S Various Mix Proportions

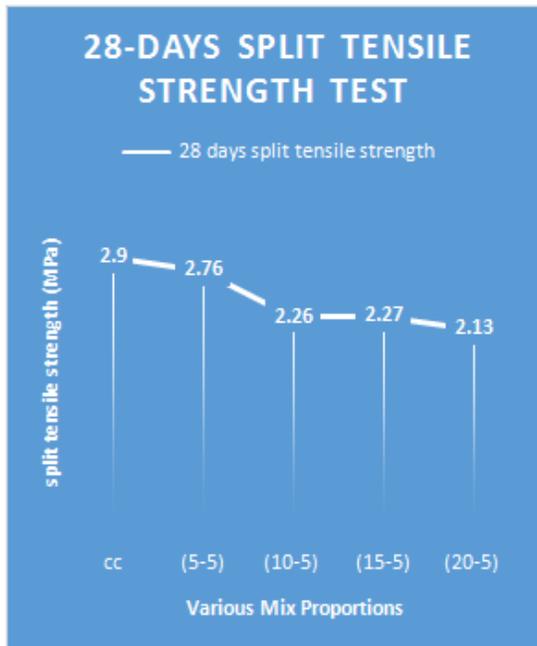


Figure.4. 28-Days Split Tensile Strength V/S Various Mix Proportions

VI.CONCLUSIONS

- Eco-friendly concrete helps in reducing the environmental pollution as there is less use of cement in the manufacture of eco-friendly concrete.
- It reduces the Carbon Dioxide emissions into the environment and thus helps in controlling global warming effectively.
- It ensures effective use of the industrial waste products such as fly-ash, waste glass powder.
- Effective utilization fly ash and waste glass powder in concrete reduces the use of cement in concrete.
- In this study we have found that the strength of concrete decreases as the fly ash and glass powder content increases.
- In this study, the mix with 5 % of fly ash and 5% of waste glass powder exhibits high compressive strength compared to all the other mixes.
- In this study the mix with 5% fly ash and 5% of waste glass powder exhibits high split tensile strength compared to all the other mixes.
- As per the cost analysis the cost increases as the fly ash and waste glass powder increases the cost reduces.

VII.REFERENCES

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