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Experimental investigation on the partial replacement of sand with plastic in concrete

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ABSTRACT

In this Project, experimental studies have been devoted to investigating the "Experimental investigation on the partial replacement of sand with plastic in concrete". One of the main environmental problems today is the disposal of the waste plastics. On the other side, the Indian Construction Industry is facing problems due to insufficient and unavailability of Construction Materials. To find a solution to the above problems, one of them can be used to solve the other. In this experimental study, an attempt has been made to use the waste plastics in concrete. The use of plastics in various places as packing materials and the products such as bottles, polythene sheets, containers, packing strips etc., are increasing day by day. This results in production of plastic wastes from all sorts of livings from industrial manufacturers to domestic users. To circumvent this pollution crisis, many products are being produced from reusable waste plastics. On the other side, the Indian construction industry is facing problems due to insufficient and unavailability of construction materials. So, we need to search for new construction materials as well as a method to dispose the plastic waste. To find a solution to the above problems, one of them can be used to solve the other. In this experimental study, an attempt has been made to use the waste plastics in concrete and studies have been conducted to focus particularly on the behaviour of compression members with various proportions of plastic wastes. The plastics used in this investigation were polythene sheets, raw plastics (raw material used for straw manufacturing), road wastes (waste plastics collected from road sides and shredded) and plastic straw. The above plastic wastes were mixed with cement concrete in various proportions and test specimens were cast (cubes) to study the behaviour of plastic mixed concrete in axial compression.

Keywords— *Thermoset, Thermo Plastic Polymers, Crystalline Materials, Amorphous Solids, Granulated Plastic, Specimen, Cubes, Cylinder, Beam*

1. INTRODUCTION

Concrete is the world's most versatile, durable and reliable construction material. It is one of the most widely used construction material, which is associated with Portland Cement. It is one of the leading components for making concrete. Concrete is the most widely used man made construction material in the world and its second only to water as the most utilized substance in the planet. Seeking aggregates for concrete and to dispose of the waste from various commodities is the present concern. Today sustainability has got top priority in construction industry. In the present study the recycled plastics were used to prepare the fine aggregates thereby providing a sustainable option to deal with the plastic waste. There are many recycling plants across the world, but as plastics are recycled, they lose their strength with the number of recycling. So, these plastics will end up as earth fill. In this circumstance instead of recycling it repeatedly, if it is utilized to prepare aggregates for concrete, it will be a boon to the construction industry.

Disposal of waste has become a major problem to the agencies in the town and cities. The waste plastic available in the domestic waste mainly consists of Low-Density Polyethylene (LDPE). Plastic bags dumped in the dustbins find their way into the drainage system and clog them. Often, these are burnt along the roadside, which produces fumes causing air pollution. Industrial wastes from Polypropylene (PP) and Polyethylene Terephthalate (PET) were studied as alternative replacements of a part of the conventional aggregates of concrete. Four replacement levels.15%, 25%, 55% and 75% by volume of aggregates were used for the preparation of the concretes.

The productive use of waste material represents a means of alleviating some of the problems of solid waste management (Davis and Cornwell, 1998). The reuse of wastes is important from different points of view. It helps to save and sustain natural resources that

are not replenished, it decreases the pollution of the environment and it also helps to save and recycle energy production processes. Wastes and industrial by-products should be considered as potentially valuable resources merely awaiting appropriate treatment and application. Plastic wastes are among these wastes; their disposal has harmful effects on the environment due to their long biodegradation period, and therefore one of the logical methods for reduction of their negative effects is the application of these materials in other industries Concrete plays an important role in the beneficial use of these materials in construction.

Although some of these materials can be beneficially incorporated in concrete, both as part of the cement binder phase or as aggregates, it is important to realize that not all waste materials are suitable for such use.

Concrete is a crucial building material utilized all over the world. Aggregates are the vital constituents of the concrete. The mining of aggregates in rivers has led to deterioration of river basins, also increase in pollution and changes in pH level. The process of extraction of sediments causes the river to cut its channel through the bottom of the valley floor in both upstream and downstream of the removal site. The sand mining in rivers had gone up to such an extent that in many countries, there is a legal prohibition on sand mining. Even In places where there is no debar, nowadays satisfactory sand is not promptly available which is required to transport sand over a long distance.

The search for an alternate source is of high priority. Artificially manufactured sands are used as a substitute to the natural sands but are uneconomical. If an appropriate industrial or agricultural by-product, which is a waste material, is used to replace sand partially it will diminish the problems and complications due to the inadequacy of sand. On the other hand, it will also be an environment friendly technique of disposal of huge quantities of materials that would otherwise contaminate land, air and water. If this waste can be used as a partial sand replacement material in concrete, it will be an extremely valuable resource. Lightweight concrete has been universally used in several structural applications and its utilization increments every year on a global basis. The explanation for this is that using lightweight concrete has countless benefits.

Plastic is a common material which finds its application in day-to-day life. Lack of proper disposal methods for plastic waste is one of the main hazards faced by the world today. It affects the ecological system very badly as plastic is not a biodegradable material. In present day research on concrete technology by using waste materials is growing at a faster rate. The new innovations are undertaken worldwide, many organizations had started a large number of research projects on replacement of sand by waste plastic material in concrete. So, on account of these facts, the replacement of sand by waste plastic material in concrete and similar construction materials has to be promoted in the upcoming days. Plastic is of manmade material and is a stable polymer which is light weight, resistant to any type of external attacks like fire etc. There are two types of plastics they are thermoset and thermo plastic polymers. Thermoset plastic this plastic becomes rigid once subjected to heat and cannot be melted on heating as the molecular chains are strongly bonded with meshed cross link. Epoxy resin, phenol, silicone and melamine are some of the examples for thermo setters. Now a day's this type of plastic is decomposed by conceal. The pollution caused by heating of plastic is increased and in order to reduce this issue waste plastic is used in concrete and in the construction of walls in buildings.

Thermo plastic is a material which is soft in nature on heating and hardens on cooling to lower temperatures. This process can be done several times and it is reusable material. Polyamide, polyethylene terephthalate and polyethylene are some of the examples of thermo plastic. Thermoplastics are mostly rubbery due to alternating rigid crystalline and elastic amorphous regions. Plastic waste is one of the dangerous waste pollutions on earth. For the reduction of this, so much research is going in the field of recycling process. Among them plastic replacement in concrete is one of the effective methods. Mostly plastic materials are amorphous solids, in those some of them are crystalline materials. Long chain mixtures of polymers are usually called as plastics. Plastics in their fresh forms have a distinct order.

2. LITERATURE REVIEW

Lakshmipathy et.al (2003) has done experimental investigations to study the suitability of the use of Re-engineered plastics as fibers for road pavements. The properties studied include compressive strength, tensile strength, flexural strength under reversed cyclic loading, impact resistance, plastic shrinkage and abrasion resistance etc., Efforts have been made to compare it steel fibers. The results have shown that the improvement of concrete properties at lower cost is obtained with Re-engineered plastic shred reinforced concrete.

Prabhir Das (2004) has suggested that plastics can be used in construction industry at various places. Proper selection of material/grade and suitable design considerations can help to replace many more applications. Lighter weight, design flexibility, part integration, low system cost, very high productivity and improved product appearance are the main features for use of engineering plastics. The engineering thermoplastics and introduction of application specific grades has thrown challenges to conventional materials in the industries. This paper provides all the supports in selecting suitable engineering plastics, process and design for conversion of conventional material to engineering plastics for performance and system cost benefits.

Chandrasekaran (2004) has explained a laboratory experimental study carried out to utilize waste plastics (in the form of strips) obtained from milk pouches in the pavement construction. Results of the study indicate that by adding plastic strips in the soil, shear strength, tensile strength and CBR values of the soil increases. In this study, plastic or polythene sheets having thickness of 0.5mm and which are made up of high density are used.

Three types of plastic strips were used in this study to act as a reinforcing material. The first one was cut into 20mm x 40mm size, second one was 25mm x 50mm size and the third one was of 30mm x 60mm size. These plastic strips have innumerable advantageous properties like high tensile strength, low permeability etc., These plastic strips act as a good barrier to gases and

liquids and are unaffected by cycles of wetting and drying. For all the strips used in this experimental work, an aspect ratio of two is maintained.

Vasudevan (2004), in his report has given most useful ways of disposing waste plastics and laying roads have come to light in research carried out by the Chemistry Department of Thiyagarajar College of Engineering. They have reported that the waste plastics may be used in block making modified light roofing, mastic flooring and polymer reinforced concrete. The novel composition of waste polymer-aggregate blend has been patented. They have suggested that utilization of waste plastics to enhance the binding property is better option than disposing or enforcing a blanket ban on the use of plastics. It has been reported that the per capita use of plastics in India is 3.5 kg, with virgin plastics accounting for 3.1 million tonnes and recycled plastics, one million. The use in Tamilnadu, with over 7000 units manufacturing material is put at 2.4 lakh tonnes per year. The 'Garbage Culture' has made disposal of waste plastic a major problem for civic bodies.

Agarwal (2004) has conducted pilot level studies using industrial PVC scrap to develop PVC board. Efforts have been made in developing innovative number of such alternative building materials. These would be helpful in saving our precious forest and environment efficiently and economically on commercial exploitation. Developed materials are mostly wood alternatives used in the construction of door shutters, frames, false ceiling, thermal insulation and alike applications. Developed sustainable alternative building materials are good economic replacement of wood and other reconstituted wood products commercially available and would be helpful in cost effective constructions.

3. CONCLUSION

- Manufacturing of sand gets reduced in day-to-day life for construction.
- This major problem can be rectified by the replacement of fine aggregate (Sand) material.
- By using the waste plastic in construction materials, the construction cost of buildings can be reduced and the accumulation of the waste plastic on the earth can be reduced.
- The waste plastic is to be reduced because every year 22 million tons of plastics are decomposed in landfills by this the properties of soil in the earth surface changes for this the partial replacement of plastic in concrete is done.
- When we use the more plastic instead of sand the necessity of the sand will reduce so that the sand mafia will be reduced or even demolished.

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