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STRENGTH OF CONVENTIONAL CONCRETE BY PARTIAL REPLACEMENT OF FINE AGGREGATE USING GLASS WASTE

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Abstract:

During the past few decades common river sand has become expensive due to excessive cost of transport from natural sources. Large scale depletion of these sources has led to many environmental impacts. In order to overcome these impacts an alternative has to be found in order to replace sand. The glass powder has found to be economic alternative to the river sand. Glass powder is obtained as a waste material after the extraction and processing of glass to form fine particles less than 4.75mm. glass powder has been used in large scale in the highways as a surface finishing material and also used in the manufacture of hollow blocks and light weight concrete prefabricated elements.In this, A study is carried out to be determine the compressive strength of concrete using glass powder as fine aggregate instead of river sand. To achieve strength cement is replaced by silica fume by 10% weight and also 1.2% weight of binder super plasticizer is added to obtain workability.The present investigations mainly focused on the partial replacement of quarry sand by glass powder. About 30% to 40% of waste glass is generated by glass industry. In order to solve the problem of the glass powder, disposal for the glass industry. In order to solve the problem of the glass powder, disposal for the glass industries and also to solve the raw material shortage problem for concrete.

Keywords: Depletion, Workability, Disposal.

1. INTRODUCTION

A large number of researches have been directed towards the utilization of such materials which are easy available and cheaper in cost. For the construction industry, the development and use of blended cements and use of recycled material as aggregate substitute is growing rapidly Construction industry need huge amount of construction material and continuous dependence on natural virgin material will lead scarcity of the construction material and increase in cost of material and construction. To overcome such situation researchers introducing some substitution of material which is cheaper in cost and easily available like bentonite is receiving more attention of users and use of industrial waste in concrete as aggregates. Use of such material not only related to the energy efficiency and environmental aspects of the cement industry, but also improves the durability and life cycle performance and costs of the concrete structures. Bentonite is clay generated frequently from the alteration of volcanic ash, consisting mostly of Montmorillonite of smectite group. It contains variety of accessory minerals in addition to montmorillonite, these minerals may include quartz, calcite, feldspar and gypsum. Bentonite presents strong colloidal properties when comes in contact with water, its volume also increases several times, creating gelatinous and viscous fluid. Bentonite has special properties like hydration swelling, water absorption, viscosity and thixotropy which make it a valuable material for wide range of uses and applications. This reaction is lime consuming, instead of lime

producing, this improves its durability of hydrated cement paste in acidic environments. Reaction products of hydrated pozzolanic cements are very efficient in filling up larger capillary pores this helps in improving the impermeability and strength of concrete.

2. RELATED WORK

The rapid urbanization is creating a shortfall of conventional building construction materials due to limited availability of natural resources. On the other hand energy consumed for the production of conventional building construction materials pollutes air, water and land. In order to meet the ever increasing demand for the energy efficient building construction materials there is a need to adopt cost effective, environmentally appropriate technologies and upgrade traditional techniques with available local materials. The energy required to reuse the recyclable material is less than that of virgin materials [1]. Glass is a common product that can be found in different forms: bottles, jars, windows and windshields, bulbs, cathode ray tubes, etc., thus became integral part of our life. These products have a limited lifetime and generally disposed off after its usage. The current practice is still to landfill most of the non-recyclable glass. Since glass is a non- biodegradable material, these landfills do not constitute an environmental solution [2] and must be recycled in order to avoid environmental problems related to their stockpiling or land filling. Utilization of waste glass has attracted construction industry worldwide due to consumption of concrete in large quantity for widespread construction sites [3]. Use of waste glass as aggregate in concrete has been attempted by many investigators. Those early efforts were thwarted by the problem of alkali-silica reaction (ASR), which was not well understood [4]. Further studies in this field shows that the problem of ASR is not restricted to glass aggregate concrete. It can occur in conventional concrete also.

3. PROPOSED SYSTEM

Strength of concrete is its resistance to rupture under the action of various types of forces. It may be measure in number of ways such as, strength in compression, strength in tension, strength in shear or strength in flexure. The compressive strength of concrete is one of the most important and useful properties of concrete.

Fig.1

It is used as qualitative measure for other properties of hardened concrete. Therefore, the concrete making properties of various ingredients of mix are usually measured in terms of the compressive strength. Glass is a 100% recyclable material it can be recycled without any loss of quality. Now a day's many recycling companies realize that they have a loss in processing glass because recycling process involves collecting, sorting, transporting, beneficiating and manufacturing glass back into new glass

products and has cost embedded in each step of the process. In 2011, 506000 tonnes of glass was sent for recycling and bought in 200000 tonnes. 27300 tonnes of glass couldn't be recycled and sent for disposal. Glass industry produces approximately 0.7% of waste broken glass, which comes under Non hazardous waste. This can be recycled and utilized under building application. Every metric ton of waste glass recycled into new product saves 315 kilograms of carbon dioxide from being released into atmosphere during creation of new glass. If glass waste disposed into landfills it can possibly take million or more years to breakdown. In order to avoid environmental problem that would be created if they were sent to landfills, this need to be recycled and reused. Glass is 100% recyclable material, it can be recycled without any loss of quality for example use of waste glass as cullet in glass production, as an aggregate substitute in concrete, used in reflective paints for highways, to produce fibreglass, as raw material. Mix design is prepared as per IS- 10262:2009. This standard provides the guidelines for proportioning and preparing concrete mixes as per the requirements using the concrete making materials. Two type of mix is prepared one is plain concrete mix using cement, sand and coarse aggregate in proportion 1:2.995:1.775:0.375 and the other concrete mix is prepared using bentonite 0%, 5%, 10%, 15% as partial replacement of cement, and crushed glass as 0%, 10%, 15%, 20% as partial replacement of fine aggregate. With the same amounts of coarse aggregate and water-concrete ratio as in the plain mixes.

4. ANALYSIS

In this experiment, slump of all mixes with constant water to cement (w/c) ratio for the same group were measured to get information about workability changes due to bentonite and recycled waste glass.

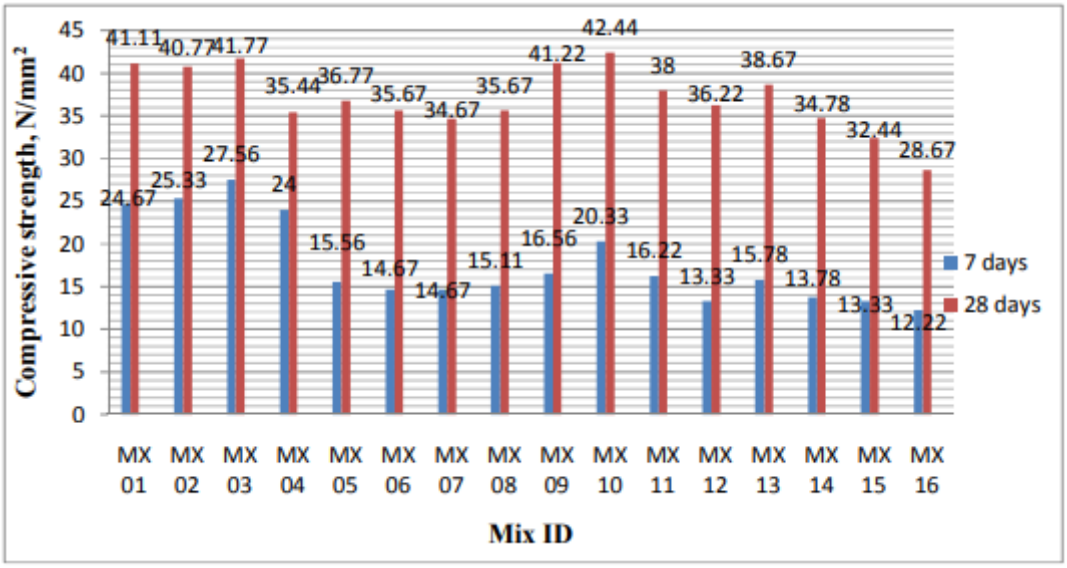

Fig.2.Analysis

When concrete mix with cement substituted bentonite and fine aggregates with A suitable control mix was prepared and subsequently mixes containing replaced cement with bentonite and fine aggregates with recycled waste glass were obtained. Each batch consisted six standard cubes for determination of 7-days & 28- days compressive strength. For each batch of concrete mixed the quantities of various ingredients i.e. cement, bentonite, fine aggregate, coarse aggregate, recycled waste glass, water, super plasticizer were kept ready in required proportions. Firstly the cement, bentonite and fine aggregates

were mixed thoroughly to get a uniform mix in dry form indicated by the uniform colour and no concentration of either material was visible. Then, coarse aggregate were added to this dry mix and turned over twice or thrice in dry state for one minute. Then water was added in to the mix. The concrete mix was filled in the cube specimen in layers each layer compacted either by vibrator or hand and the surface of cubes was finished. Glass is an amorphous solid that has been found in various forms for thousands of years and has been manufactured for human use since 12,000 BC. Glass is one the most versatile substances on Earth, used in many applications and in a wide variety of forms, from plain clears glass to tempered and tinted varieties, and so forth. Hence interest of the construction community in using waste or recycled materials in concrete is increasing. Many attempts have been made by various researchers to utilize waste glass as coarse aggregates, fine aggregates or as a partial replacement of cement with variation in particle size having different proportions and in various types of concretes. The rapid urbanization is creating a shortfall of conventional building construction materials due to limited availability of natural resources. On the other hand energy consumed for the production of conventional building construction materials pollutes air, water and land. In order to meet the ever increasing demand for the energy efficient building construction materials there is a need to adopt cost effective, environmentally appropriate technologies and upgrade traditional techniques with available local materials.

CONCLUSION

The investigation revealed that, as the partial replacement of cement by bentonite and fine aggregates by recycled waste glass in concrete mix increases, the workability of concrete mix decreases. The partial replacement of cement by 10% bentonite and fine aggregates by 0% recycled waste glass in concrete mix results in Increase of compressive strength by 0.27% as compared to controlled mix. The maximum increase in compressive strength was found when partial replacement of cement with bentonite at 10% and partial replacement of natural fine aggregates with recycled waste glass at 10% was 20.33 N/mm2 for 7 days and 42.44 N/mm2 for 28days.

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