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Utilization of Glass Waste as Partial Replacement of Sand in Concrete

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Abstract: ***Solid waste management is one of the major environmental concerns in worldwide. Unfortunately , post-consumer glass represents a major component of solid waste and difficulty in locating convenient markets that will accept glass collected for recycling. The presence and accumulation of this waste caused environmental problems.***
Therefore, using waste glass as fine aggregate replacement in concrete is an interesting possibility for economy on waste disposal sites and conservation of natural resources. To deal with these problems, this study has been conducted through basic experimental research in order to investigate the possibilities of using crushed waste glass as fine aggregate replacement in concrete. An experimental work was performed to study the slump , unit weight, compressive strength, splitting tensile strength, flexural strength, modulus of elasticity, ultrasonic pulse velocity, dry density, water absorption and alkali-silica reaction under different curing age 7, 14 and 28 days. Four concretes mixes with 0%, 5%, 15% and 20% replacement by weight of sand with waste glass were prepared. The compressive, splitting tensile and flexural strength and modulus of elasticity of specimens with 20% waste glass content were 5.28%, 18.38%, 8.92% and
9.75%, respectively, which is higher than the controlled mix at 28 days.
Keywords

I. INTRODUCTION

A. This project is all about the use of glass as aggregate in concrete. Because It has become popular in modern times,
B. This greatly enhances the aesthetics appeal of the concrete.
C. Recent research findings have shown that concrete made with recycled glass aggregates have shown better thermal insulation due to the thermal properties of the glass aggregates.
D. So we are going to increase the strength of concrete by mixing waste glass so that quantity of sand would decrease which comes into use.

II. OBJECTIVE

A. To use of the glass waste in concrete to increase the strength.
B. To use of the glass waste in construction, reduce the environmental pollution as well as providing an economic value for the waste glass.

III. OVERVIEW

The reuse of the waste glass is one of the important issues in many countries due to the increment in solid waste in the environment. The waste glass is considered as an
important solid waste that can be found in the majority of world's countries and is being not much affected by weather conditions and its existence leading to environmental problem Cai jun et al (2007). Thus the suitable solutions must be found to overcome this problem. Accordingly, valuable researches have been conducted to show the possibility of using the waste glass as a building material and adding it as a partial replacement to the concrete mixture without affecting the concrete quality. Therefore the concrete can be produced within acceptable properties.
Many studies aim to replace fine aggregate by certain percentage of crushed waste glass as a fine aggregate to be added to the concrete mixture. In addition, these studies focus on the possibility of using the waste glass as partial or wholly alternative for the conventional concrete materials, that gives a double outcomes, the first is reducing the depletion of the wealth of nature resources. Secondly, reducing the environmental risks by producing non-conventional concrete that is called the glascrete.

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A. Glass

Glass is a unique inert material that could be recycled many times without changing its chemical properties. Unfortunately, a lot of glass become unsuitable for recycling, the efficiency of this process (i.e. recycling) is affected by several factors. Firstly, the efficiency of collecting and sorting methods for different glass colors, where, if different colors (clear, green, amber, etc.) are mixed, they become unsuitable for manufacturing new glass containers. Secondly, it is affected by the level of contaminates that might be presented in the stockpile, and finally the shipping costs. Since not all the cities in countries have the recycling factories. Thus, the main aim of environmental authorities is to reduce, as far as possible, the disposal of post-consumer glass in landfill or recycle to glass products. Therefore, it has been supposed that, if glass could be incorporated in concrete production, it would greatly reduce the disposal of waste glass or its use in lower valued works such as fill or road base materials (Shayan, 2002). On the other hand, the major concern regarding the use of glass in concrete is the chemical reaction that takes place between the silica-rich glass particles (glass aggregate) and the alkali in cement i.e. alkali-silica reaction (Shao et al. 2000).

IV. LITERATURE REVIEW

The utilization of waste glass as a high value material has received a considerable attention recently. Waste glass became a major problem for municipalities nationwide due to the austere changes in the environmental legislations. A matter that is positively encouraging the use of waste glass in different construction applications. This chapter presents a review for some of the available literature related to the usage of waste glass in construction and non-construction applications, but it is specifically focused on the utilization of waste glass as both fine aggregates and cementitious material in the concrete system. A considerable attention is directed towards the possible alkali-silica reaction and the common ways to mitigate its adverse effects.

A. Glass Waste



B. General Application Of Wastes Glass

Glass cullet is recycled container glass (previously used for bottles, jars and other similar glass vessels) prior to processing. The material is typically collected via bottle banks, curbside collection schemes and from premises handling large quantities of containers. The primary aim for cullet collecting is processing it for returning to the glass making process to manufacture new glass products. The term ―Cullet also refers to waste glass produced as a result of breakage and rejection on quality control grounds during manufacturing process. Crushed, graded glass cullet has been extensively investigated and tried in a number of construction and non-construction related applications (Meyer, 2001). Reindl (2003) reported that the glass cullet could be exploited in a variety of uses, including road construction aggregate, asphalt paving, concrete aggregate, building applications (glass tiles, bricks, wall panels, ... etc), fiber glass

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insulation, glass fiber, abrasive, art glass, landscaping, reflective beads, hydraulic cement, and other applications. The critical requirement in all these applications is that, the correct characteristics and physical properties of the glass cullet for the targeted application should be well understood and defined. Weitz (2005) reported that the American Association of State Highway and Transportation Officials (AASHTO) had recognized the use of recycled materials in pavement and created a new specification titled ―Glass Cullet Use for Soil Aggregate Base Course.‖ The specification illustrates that when properly processed, glass cullet can be expected to provide adequate stability and load support for use as road or highway bases. Crushed glass cullet that has been used as aggregate in road construction or bituminous concrete pavements is popularly known as ―glassphalt.

A number of field trials of glassphalt pavements have been carried out since 1971. It was observed that holds heat longer than conventional asphalt. This may be advantageous when road works are carried out in cold weather or when long transport distances are required. Furthermore, the glass particles will increase the reflectivity of the road surface, therefore, improve the night-time road visibility Smith (2004) indicated that ground glass could be added to clay during manufacturing of brick to save energy costs and produce bricks that are more resistant to frost damage. Glass powder will serve as ―fluxing agent‖ through melting process leading to reduce melting temperature and period. The manufactured brick has also proved lower water absorption and higher compressive strength. Hadlington (2002) presented a summary of works conducted by other researchers or organizations. For example, he quoted from Dryden Aqua Company that tiny glass particles could be used as filtration media for purifying water. The colored glass (green or amber) have been ground into particles of less than a tenth of a millimeter, during this process a net negative electrical charge will be left on the particles surfaces, which enables them to attract grays. A second effect can occur in filters made from colored glass grains. Those filters can split oxygen molecules into single highly reactive oxygen, which is responsible for drawing microbes to the surface of the grains and killing them.

C. Use Of Waste Glass In Concrete

A lot of studies have been conducted about the possibility of using ground waste glass since 1960s,1970s and 1980s , as aggregates or cement replacement (Pike et al. (1960), Scmidt et al(1963), Phillips et al (1972) and Johnston (1974)) .However this studies were not accuracy . In the past 10 years, the use of glass as cement concrete aggregates has again come under investigation due to high disposal costs for waste glasses .

Mould



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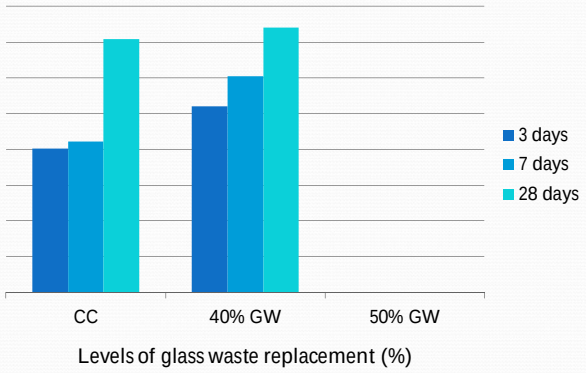
V. RESULT

COMPRESSIVE STRENGTH RESULTS FOR CONVENTIONAL CONCRETE VS GLASS WASTE CONCRETE (N/mm2)

NO. OF DAYS	REPLACEMENT LEVELS OF WASTE GLASS(%)		CONVENTIONAL CONCRETE
	40%	50%	
3	26.3		20.15
7	30.2		20.05
28	37.02		35.45

VI. CONCLUSIONS

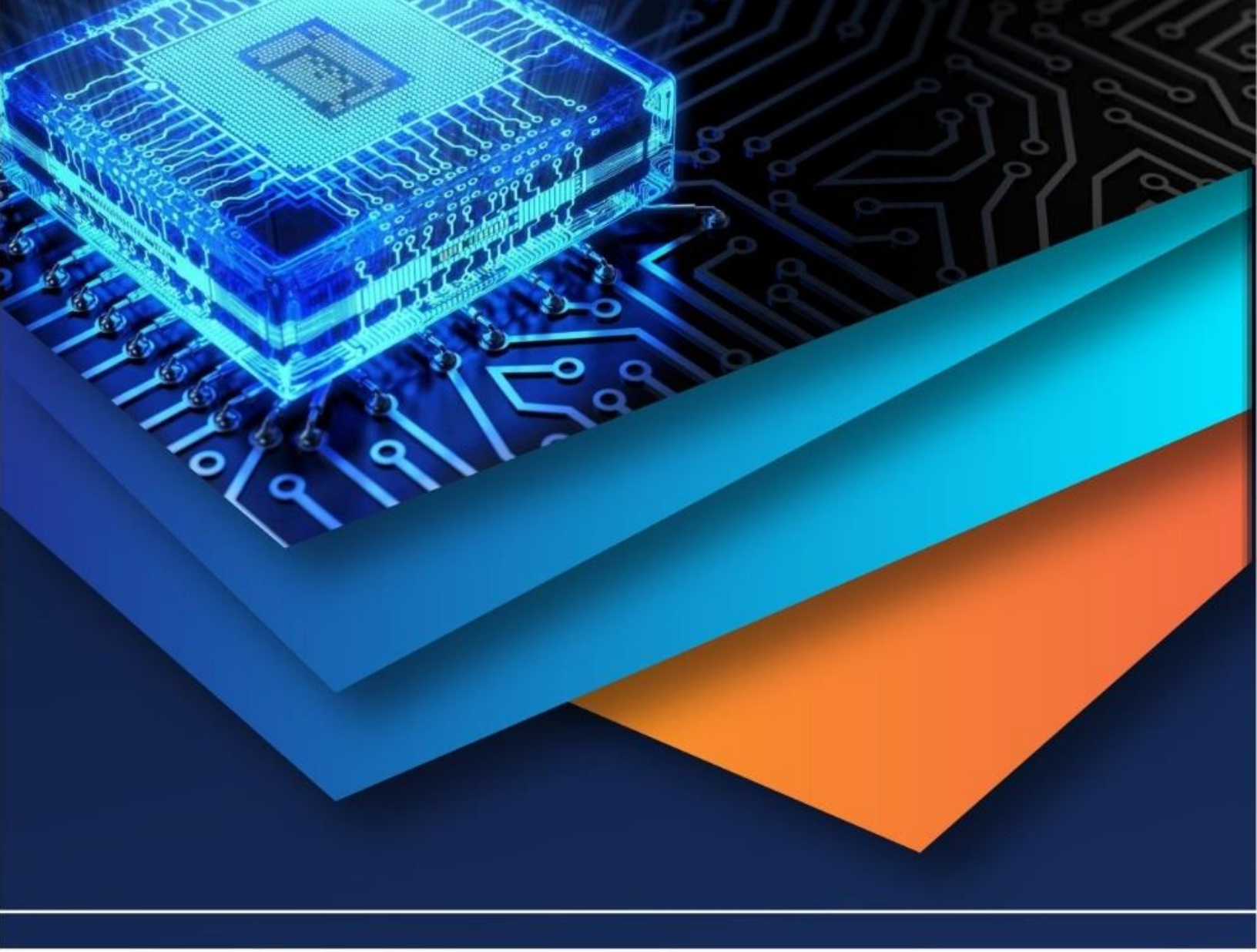
❖Comparison of compressive strength of conventional concrete and glass waste concrete



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