STUDY OF CRUSHED GLASS AS REPLACEMENT OF FINE AGGREGATE IN CONCRETE FOR RIGID PAVEMENTS

Zahir Abbas,[1] Annes Khan[2]

[1]Assistant Professor, Department of Civil Engineering, Desh Bhagat University, Mandi Gobindgarh, ,India

[2]Assistant Professor, Department of Civil Engineering, Desh Bhagat University, Mandi Gobindgarh, ,India

ABSTRACT

The uncompact voids content of a fine aggregate provides some general measure of its angularity and texture as voids content increases with angularity and decreases for a well-graded material. The voids content affects the concrete mix design and performance. A high voids content of aggregates typically requires more cement paste to provide the same workability for a given mix design

The voids content was determined according to BSEN1097-3 1998:(Tests for mechanical and physical properties of aggregates – Part 3). This test uses a sample of dry aggregate which is 1.2 to 1.5 times the mass of aggregate required to fill the test container. This container is filled to over flowing by resting the scoop on top of the rim of the container - this prevents aggregate segregation. Surplus aggregate is then removed from above the top of the container and the aggregate surface is levelled with a straight edge, taking care not to compact any part of the upper surface.

Keywords: Waste glass, fly ash, green taxes.

INTRODUCTION

Each year around twenty five billion tonnes of concrete square measure used to construct buildings, road, dams, pavement, and even artworks. The concrete trade, because of its sheer size, includes a goodish impact on the setting. Concrete consists chiefly of cement, coarse combination, fine combination and water. Usually around seventy fifth to ninetieth of the quantity of structural concrete consists of raw materials extracted from the bottom. standard structural concrete is therefore a conspicuous client of primary resources and this can be a significant concern within the drive to realize property among construction.

Waste glass

One of the issues arising from continuous technological, industrial development and increasing population is that the disposal of waste materials that square measure made. These waste materials include iron, glass, ceramics, and concrete. Demand to scale back waste has created the necessity to seek out a use for waste product rather than doing away with the materials in landfills. Several outside of the concrete trade regard concrete as an appropriate host for waste materials, rendering the waste materials innocuous and finding a This can be associate environmental tax on the industrial exploitation of combination to deal with the environmental prices related to production that don't seem to be already lined by regulation, as well as noise, dust, visual intrusion, loss of pleasantness and harm to diverseness. Several alternative countries, notably those within the EU, build increasing use of "green taxes" and have introduced similar taxes to pursue environmental aims. The general price of lowland, notably the lowland Tax is increasing. The tax is guilty by weight and there square measure 2 rates: lower rate applies to those inactive (or inert) wastes; customary rate applies to any or all alternative subject waste.

LITERATURE REVIEW

One way for the construction industry to improve its performance with regard to sustainable development would be to use concrete with reduced Portland cement content.There is a variety of products of industrial processes which have some cementitious properties e.g. fly ash, ground granulated blast furnace slag, condensed silica fume, and consideration has been given to substituting some of them for cement. Another strategy to improve the environmental 'considerateness' of the construction industry is to use waste products as substitutes for conventional fine and coarse aggregates-suitable wastes include construction debris,waste glass,dredged material, quarry spoil and mining spoil. The key to successful usage of these wastes lies in the identification and exploitation of the properties in here ntinth ewaste material which can improve the properties of concrete and thereby increase their value (Dhir et al., 2005), combined with elimination or suppression of any harmful effects from using a specific waste material.

Shao et al. (2010) also examined the pozzolanic activity of ground glass and its effect on compressive strength by making concrete wherein 30% of the cement was replaced by ground glass. The results showed that ground glass having a particle size finer than 38?m did exhibit pozzolanic behaviour and the finely ground glass helped reduce concrete expansion by up to 50%. This agreed with the findings of Topcu and Canbaz (2004) that waste glass contains a high amount of silica and if it is finely ground (and thus amorphous) it would be expected to show pozzolanic activity. Compared to fly ash concrete, concrete containing only ground glass exhibited a higher strength at both early and late ages. The high early strength gain was possibly attributable to the high alkali content glass (soda-lime lamp material) that was used.

Castro and Brito (2013) found that the size of waste glass aggregate had a significant effect on concrete workability. If waste glass was used as fine aggregate the water- cement ratio needed to be increased to compensate for the loss of workability. However the replacement of up to 20% of conventional aggregate by crushed glass showed, within the limits of experimental error, an increase in compressive strength up to 13.6%. In addition the inclusion of glass aggregate reduced water absorption (capillarity was lowed by 10.1%, immersion fell by 3.8%), reduced carbonation (by 21.7%) and lowered shrinkage (by 7.4%).

In work reported by **Kou and Poon (2009)** recycled glass was used to replace river sand (in proportions of 10%, 20% and 30%), and 10 mm granite aggregate (amounts of 5%, 10% and 15%) to make self-compacting concrete mixes. Fly ash was used in the concrete mixes to suppress the potential alkali-silica reaction. It was found that the slump and air content of the mixes increased with increasing recycled glass content. The initial slump flows of all the mixes prepared were at least 750 mm. In addition, the resistance to chloride ion penetration increased and the drying shrinkage of the recycled glass self-compacting concrete mixes decreased when the recycled glass content increased. The compressive strength, tensile splitting strength and static modulus of elasticity of the waste glass concrete mixes decreased with an increase in recycled glass content. The ASR expansion of all the specimens was significantly reduced by the use of fly ash.

METHODOLOGY

The analysis work was undertaken with the overarching aim of contributive to this state of information concerning the results of replacing fine mixture (sand) in structural concrete with crushed waste glass. It's hoped that the results of the work promote the used of waste glass by the development business to form a hybrid structural material ('glascrete') and thereby scale back the industry's current rate of consumption of primary aggregates. However, a priority for industrial usage of 'glascrete' is that the introduction of crushed glass at intervals a structural concrete combine has the potential to market Alkali silica Reaction (ASR), that is defined by abnormal volume increase of the concrete, with damaging consequences. Previous analysis on the impact of exploitation waste glass has not been conclusive however it's typically united that exploitation fine particles of waste inclose concrete is a smaller amount possible to form vital ASR reaction than the utilization of glass as coarse mixture. As a result of concrete isn't a 'single element or hypothetic material', and since of inherent variation in its elements and also the need to create the analysis relevant to business, experimentation was thought-about the acceptable analysis methodology.

The suitableness of a structural concrete clearly depends on that achieving an appropriate compressive strength when a such that action amount. However, it's conjointly important that once the concrete is in a very freshly mixed state (before any setting or hardening occurs) it's practicable and stable. This primary state affects the power to move and pump the concrete (without segregation) and for it to flow to occupy a selected area and be compacted to allow the specified final form (so harm ought to be stripped once the wet concrete is left to stand). It had been meant that, as so much as potential, experimentation would be undertaken exploitation commonplace industrial tests and procedures so the outcomes would be directly relevant to the requirements of business. Surface texture, aggregate grading and hence concrete properties. Hence, it was desired that waste glass would be crushed and graded to match the particle size distribution of a natural sand provided by a commercial supplier-identifier supplier and source. At the start of the programme, a sufficiently large batch of sand was obtained for the manufacture of all cubes to eliminate variations due to use of different sources and production methods.

Clear (Flint) glass has been chosen as the 'standard' waste glass because it is the most common waste glass. However, it is known that other color's of glass exhibit different amounts of ASR within concrete and so concrete made with green and brown waste glasses was also investigated. Consideration was given to whether the negative effects from ASR could be minimised by combining different proportions of coloured glasses in the fine aggregate for concrete.

A variety of mixes were prepared to find out the effects of different percentages of sand replacement and color of waste glass. The main characteristics investigated were workability and compressive strength. Physical properties, such as density and specific gravity, were also determined for the various concrete mixes. At the same time Ultrasonic Pulse Velocity was used to test and qualitatively assess the homogeneity and integrity of the different concretes.

Research work to date does not show a clear consensus on how the magnitude of any effects of using glass as aggregate in concrete relates to the amount of glass present. Hence, within the research project concretes were produced which had 0, 25, 50 and 100%, by weight, of the conventional fine aggregate replaced by crushed, waste glass. Furthermore, the compressive strength of concrete is dependant on its curing time. Hence, time-dependent hardening was studied over one year by testing of cubes at 7 days, 28 days (the normal testing time), 112 days and 365 days.

An attempt was made to measure the change in the dimensions of concrete cubes with time. Measurements were made on all faces of the cubes to assess distortional changes, preferred direction for changes, non-uniform changes, and overall volume change. The dimensional changes were expected to be small (even if significant ASR occurs), of the order of 0.001 strain, if the concrete containing glass aggregate was to comply with British Standard requirements and appropriate measurement systems were selected. Concrete bars were also made and tested in accordance with the relevant British Standard. For these bars only changes in the length of the bars were measured.

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