Utilization of meshed glass as a fine aggregate in concrete

Peerzada Zaid Bin Gulzar[1], Puneet Sharma[2]
[1]PG Student, Department of Civil Engineering/Chandigarh University, Gharuan, Mohali Chandigarh Punjab
[2]Assistant professor, Department of Civil Engineering/Chandigarh University, Gharuan, Mohali Chandigarh Punjab

Abstract- The utilization of waste materials in concrete production is very much helpful to reach the goal of the sustainable construction. Waste glass is a major component of the solid waste stream in many countries. It can be found in many forms, including container glass, flat glass such as windows, bulb glass and cathode ray tube glass. Glass is a 100% recyclable material with high performances and unique aesthetic properties which make it suitable for wide-spread uses. Glass is widely used in our lives through manufactured tract products such as sheet glass, bottles, glassware, and vacuum tubing. Glass is an ideal material for recycling. The use of recycled glass helps us to save energy. The objective of this paper is to review utilization of meshed glass in concrete.

Keywords: Glass, concrete, Compressive strength, Concrete; Waste glass, alkali-silica-reaction, fine aggregate.

Introduction

Glass is widely used in our lives through manufactured products such as sheet glass, bottles, glassware, and vacuum tubing. Glass is an ideal material for recycling. The use of recycled glass helps save of energy. The increasing awareness of glass recycling speeds up inspections on the use of waste glass with different forms in various fields. One of its significant contributions is to the construction field where the waste glass was reused for concrete production. The application of glass in architectural concrete still needs improvement. Since the demand in the concrete manufacturing is increasing day by day, the utilization of stone chips as coarse aggregate leads to exploitation of natural resources. Recent research findings have shown that concrete made with recycled glass aggregate are capable to provide better long term strength and better thermal insulation due to its better thermal properties of the glass aggregates. The objective of this paper is to review utilization of meshed glass in concrete.

Literature Review

Vikas Srivastava et al, 2013 "studied the glass waste as a coarse aggregate in concrete. This paper shows that while using waste glass as coarse aggregate replacement, 28 days strength is found to marginally increase up to 20% replacement level. Marginal decrease in strength is observed at 30 to 40% replacement level of waste glass with coarse aggregate. Waste glass can effectively be used as coarse aggregate replacement. The optimum replacement level of waste glass as coarse aggregate is 10%. It is observed that when coarse aggregate is replaced by 10% glass waste, the compressive strength at 7 days is found to increase by about 14.63% on average.

T. S. Serniabat et al, 2014 "studied use of waste glass as coarse aggregate in Concrete: A Possibility towards Sustainable Building Construction. In this paper the performance of 9 different concrete mixes containing different ratios of glass crushed to 5 mm - 20 mm maximum size and glass marble of 20 mm size as coarse aggregate. Ordinary Portland cement type 1 and fine sand less than 0.5 mm were used to produce standard concrete cylinders. Compressive strength tests were carried out on concrete specimens at various ages. The paper presents the necessity of sustainable construction in present world and the possibility of waste glass recycling and using into concrete production. The study focuses on practical use of glass as coarse aggregate in concrete instead of stone chips or brick chips. Stone chips are costly and needed to collect straight from natural resource, brick chips are also expensive and its production causes environmental pollution. In this context, it can be said that waste glass may open a new path of economic and pollution free concrete construction if desired strength can be achieved. During the study, maximum of 3889 psi compressive strength was found from several mixes, which is quite acceptable; though rough textures in glass samples would have provided better bond and better strength.

S.P. Gautam et al, 2012 "studied the use of glass wastes as fine aggregate in concrete. Laboratory experiments were conducted to further explore the use of waste glass as coarse and fine aggregates for both ASR (Alkali-Silica-Reaction) alleviation as well as the decorative purpose in concrete. The study indicated that waste glass can effectively be used as fine aggregate replacement (up to 40%) without substantial change in strength. While using waste glass as fine aggregate replacement, 28 days strength is found to marginally increase up to 20% replacement level. Marginal decrease in strength is observed at 30 to 40% replacement level of waste glass with fine aggregate. Waste glass can effectively be used as fine aggregate replacement. The optimum replacement level of waste glass as fine aggregate is 10%.

N. Tamanna et al, 2013 "studied the utilization of glass wastes as fine aggregate in concrete. This paper has discussed the feasibility of waste glass in concrete production and its pozzolanic properties in cement in terms of durability and sustainability. Direct Utilization of waste glass as

concrete aggregates has a negative effect on the workability and strength of concrete. But ground glass powders exhibit very good pozzolanic reactivity and can be used as cement replacement. Its pozzolanic reactivity increases as its fineness increases. If aggregates are alkali-reactive, alkalis in the glass powder can causes alkali silica reaction. Besides, fine ground glasses have less ASR expansion. Hence, incorporation of ground glass powder in cement will greatly increase the strength and durability and save natural resources as well as keeping the environment green.

Sadoon Abdallah et al, 2014, "studied characteristics of concrete with waste glass as fine aggregate replacement. **T**his paper systematically investigates the characteristics of concrete containing fine crushed glass during its process, the best ratio of fine crushed glass which leads to higher strength of concrete in order to produce concrete blocks, and the effect of waste glass replacement on the expansion caused by Alkali-silica reaction (ASR). 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 (ASR) were analyzed in terms of waste glass content (0%, 5%, 15% and 20%) under different curing age of 7, 14 and 28 days. It was found that the slump of concrete containing waste glass as fine aggregate replacement decreased with increases in the waste glass content but without loss of workability. The compressive, splitting tensile and flexural strength of concrete with 20% waste glass content increased by 5.28 %, 18.38% and 8.92% respectively at 28 days. The mixes with waste glass replacement showed a denser internal concrete structure or more consistent structure under ultrasonic pulse velocity assessment**.** Water absorption decreased with increase waste glass aggregate ratio. The highest reduction was obtained with 20% of glass aggregate replacement with a reduction of 14.68% at 28-day age compared to control.

Chemical composition of recycled glass types

	SODA LIME		SPECIALTY		
Consti-tuents	**Container (Bottle)**	**Window (Float)**	**E-Glass (Fiber)**	**Borosilicate (Pyrex)**	**Panel (TV)**
SiO_2	74	73	50-55	65-85	62-85
Al_2O_3	1.3	0.15	15-20	1-5	0.5-2.5
CaO	10.5	9	20-25	0-2.5	0-4.5
MgO	0.2	5	<1	..	0-2.7
Na_2O	13	14	<1	3-9	6-11
K_2O	0.3	0.03	<0.2	0-2	4-7
B_2O_3	..	..	0-6	8-15	..
Others*	0-2[(a)]	0-2[(a)]	0-2[(b)]	0-1[(c)]	~20[(d)]

* (a) Fe_2O_3, Cr_2O_3, MnO_2, TiO_2, SO_3; (b) Fe_2O_3, TiO_2; (c) BaO; (d) BaO, SrO, Fe_2O_3, TiO_2, CeO_2, ZrO_2, PbO, ZnO, As_2O_3, Sb_2O_3

Conclusion

On the basis of the existing literature it can be concluded that the different percentages of waste glass as a replacement of coarse and fine aggregate separately has been used and different results has been found. It is observed that when coarse aggregate is replaced by 10% glass waste, the compressive strength at 7 days is found to increase by about 14.63% on average. Compressive and flexure strength increases by introducing the glass waste. Also workability of concrete increases.

References

[1] S.P. Gautam Vikas Srivastava and V.C. Agarwal, 2012 **"**studied the use of glass wastes as fine aggregate in concrete,Youth Education and Research Trust (YERT), J. Acad. Indus. Res. Vol. 1(6) November 2012.

[2] Vikas Srivastava , S. P. Gautam, V. C. Agarwal , P. K. Mehta 2013 **"**studied the glass waste as a coarse aggregate in concrete. *J. Environ. Nanotechnol., Vol. 3(1), 67-71, (2014)* doi : 10.13074/jent.2013.12.132059

[3] N. Tamanna N. Mohamed Sutan and D. T. C. Lee, 2013 "studied the utilization of glass wastes as fine aggregate in concrete" *Energy and Environment (ENCON 2013)* Copyright © 2013 Editor(s), ENCON 2013. *Published by* Research Publishing. ISBN: 978-981-07-6059-5:: doi: 10.3850/978-981-07-6059-5_090.

[4] Sadoon Abdallah, Mizi Fan "Characteristics of concrete with waste glass as fine aggregate replacement" International Journal of Engineering and Technical Research (IJETR) ISSN: 2321-0869, Volume-2, Issue-6, June 2014

[5] Dragica Jevtić, Dimitrije Zakić, Aleksandar Savić, Achieving Sustainability of Concrete by RecycSolid Waste Materials, Mechanical Testing and Diagnosis, ISSN 2247 – 9635, 2012 (II), Volume 1, 22-39.