A Design For Novel Usage of the Funnel Glass From CRTs

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ABSTRACT: *End of life of Cathode Ray Tubes (CRT) based Televisions, Monitors etc., end up as Electronic waste and the disposal of CRT glass poses a major environmental threat, mainly due to the presence of significant Lead in the Funnel part of CRT to an extent of about 30%. The present study attempts to a Novel usage of the Funnel glass from CRTs obtained from E-Parisaraa Pvt. Ltd., India's First Government authorized E-waste recycling facility, Bangalore, Karnataka, as an aggregate substitute in the concrete admixture for application in radiation protection areas. Various proportions of funnel glass of CRTs were experimented by preparing M20 grade standard concrete cubes with various curing schedules. The cubes were subjected to various load bearing standard compression tests and correlated with X-ray Radiation Protection. The study concludes that, up to 30% funnel glass substitution as aggregate in the concrete admixtures can be successfully used for radiation protection walls, dooms of nuclear facilities, besides can also be used for radioactive waste containment and disposal. Accordingly we can utilize this experimental work to construct building with these cement blocks which may control the different radiation rays which solves the hazardous waste disposal problems and it is a sustainable environmental protections.*

Keywords: CRT glass, Concrete admixtures, X-ray, Radiation, Sustainability

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1. Introduction

Concrete is a composite material composed mainly of water, aggregate and cement. Often, additives and reinforcements (such as rebar) are included in the mixture to achieve the desired physical properties of the finished material. When these ingredients are mixed together, they form a fluid mass that is easily molded into shape. Over time the cement forms a hard matrix which binds the rest of the ingredients together into a durable stone-like material with many uses.

Famous concrete structures include the Hoover Dam, the Panama Canal and the Roman Pantheon. The earliest large-scale users of concrete technology were the ancient Romans, and concrete was widely used in the Roman Empire. The Colosseum in Rome

was built largely of concrete, and the concrete dome of the Pantheon is the world's largest unreinforced concrete dome. After the Roman Empire collapsed, use of concrete became rare until the technology was re-pioneered in the mid-18th century. Today, concrete is the most widely used man-made material.

The Disposal of CRT funnel glass is a big problem as it contains hazardous compound like lead, arsenic, phosphorous etc, in it. Cathode Ray Tubes (CRT) based Televisions, Monitors etc., end up as Electronic waste and the disposal of CRT glass poses a major environmental threat, mainly due to the presence of significant Lead in the Funnel part of CRT to an extent of about 30%. The present study attempts to a Novel usage of the Funnel glass from CRTs obtained from E-Parisaraa Pvt. Ltd., India's First Government authorized E-waste recycling facility, Bangalore, Karnataka, as an aggregate substitute in the concrete admixture for application in radiation protection areas. Accordingly we utilize this experimental work to construct building with these cement blocks which may control the radiation rays which is a sustainable environmental protections.

2. Cathode Ray Tube

CRT glass is the largest item by weight. However, because of the 2 different types of glass used in CRT manufacture, the glass fractions have to be sorted to achieve a separation of the 2 type of glass, i.e. panel glass sorted from funnel glass. Panel glass has virtually no lead content, whilst funnel glass normally has a lead content in the 20-25% range. The lead, in the form of lead oxide, is included as shielding against the X-Rays inherent in TV's and monitors. It is essential to separate the two qualities of glass to maximize the recycling revenues.

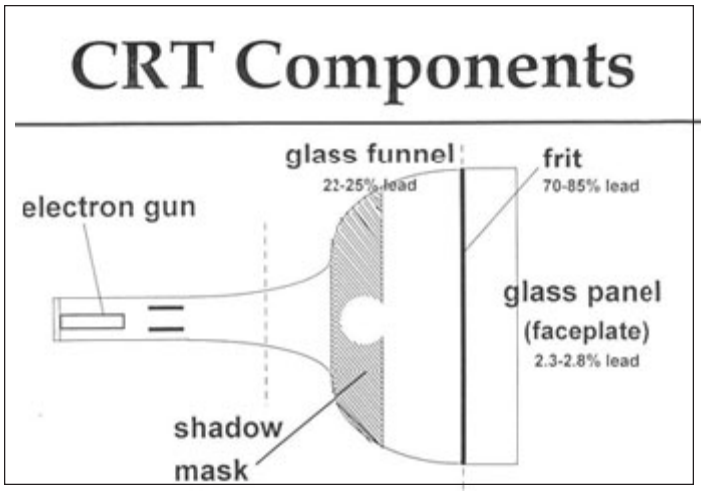


Figure 1. CRT Component

CRTs are made from two types of glass joined by a high lead glass solder known as frit. The screen glass (panel glass) is typically lead free. The rear part of the CRT known as funnel glass contains around 20% lead and the glass frit contains up to 90% lead.

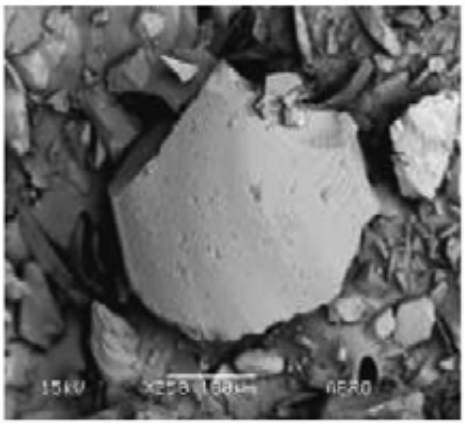
3. Materials and Methodology

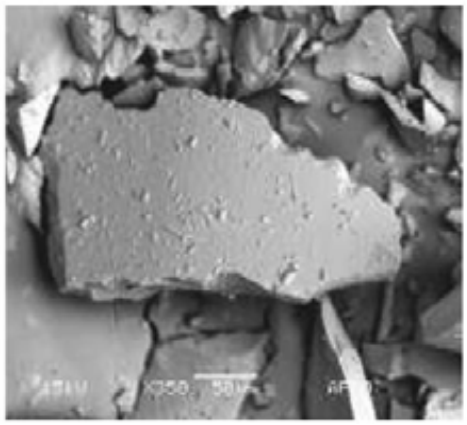
In its simplest form, concrete is a mixture of paste and aggregates, or rocks. The paste, composed of Portland cement and water, coats the surface of the fine (small) and coarse (larger) aggregates. Through a chemical reaction called hydration, the paste hardens and gains strength to form the rock-like mass known as concrete.

Within this process lies the key to a remarkable trait of concrete: it's plastic and malleable when newly mixed, strong and durable when hardened. These qualities explain why one material, concrete, can build skyscrapers, bridges, sidewalks and superhighways, houses and dams.

• Collection of CRT Sample

Here CRT funnel glass sample is collected from available source (E-Parisara Pvt Ltd).





Panel Funnel

Figure 2. CRT Funnel Glass

• Preparation of Leaded Concrete Block

Concrete blocks are prepared by using CRT funnel glass as admixtures by varying the percentage of glass and cubes are casted and kept for curing.

• Subjecting the Perpared Block to Following Tests

Compression test.

Radiation test.

3.1 Methodology

• Proportioning The process of relative proportions of cement, sand coarse aggregate and water, so as to obtain a concrete of desired quality is known as the proportioning of concrete.

• Mixing Dry mix and wet mix.

• Compacting Compacting with compacting bar, Compacting with vibrating hammer or table

• Curing Pounding or immersion, Fogging or Sprinkling, Saturated wet covering, Water retaining techniques, Curing of concrete by adding chemicals.

3.2 Proportioning

The key to achieving a strong, durable concrete rests in the careful proportioning and mixing of the ingredients. A mixture that

Figure 3. Batching And Mixing Of Concrete

Figure 4. Mixing Of Concrete

Figure 5. Curing Of Concrete Blocks

does not have enough paste to fill all the voids between the aggregates will be difficult to place and will produce rough surfaces and porous concrete. A mixture with an excess of cement paste will be easy to place and will produce a smooth surface; however, the resulting concrete is not cost-effective and can more easily crack.

Portland cement's chemistry comes to life in the presence of water. Cement and water form a paste that coats each particle of stone and sand—the aggregates. Through a chemical reaction called hydration, the cement paste hardens and gains strength.

The quality of the paste determines the character of the concrete. The strength of the paste, in turn, depends on the ratio of water to cement. The water-cement ratio is the weight of the mixing water divided by the weight of the cement. High-quality concrete is produced by lowering the water-cement ratio as much as possible without sacrificing the workability of fresh concrete, allowing it to be properly placed,consolidated, and cured.

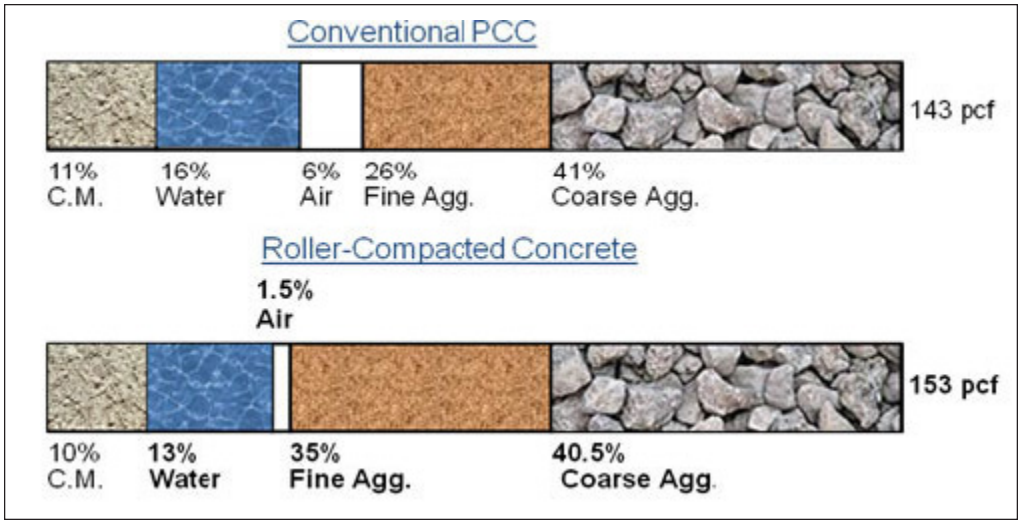
3.3 Tests Conducted on Materials Cement

- Specific Gravity.
- Finess
- Standard Consistency
- Setting Time.

4. Results

Sample	Percentage %	Weight of cube (kg)	Area (mm^2)	Load (kgf)	Compression strength (N/mm^2)
1	0	8.248	22500	57800	22.58
2	10	8.307	22500	44200	19.53
3	20	8.402	22500	44400	19.35
4	30	8.085	22500	38600	16.82
5	50	8.326	22500	38600	16.82
6	75	8.325	22500	32600	14.20
7	100	8.277	22500	29600	12.90

Table 1. Compression strength for 7 days



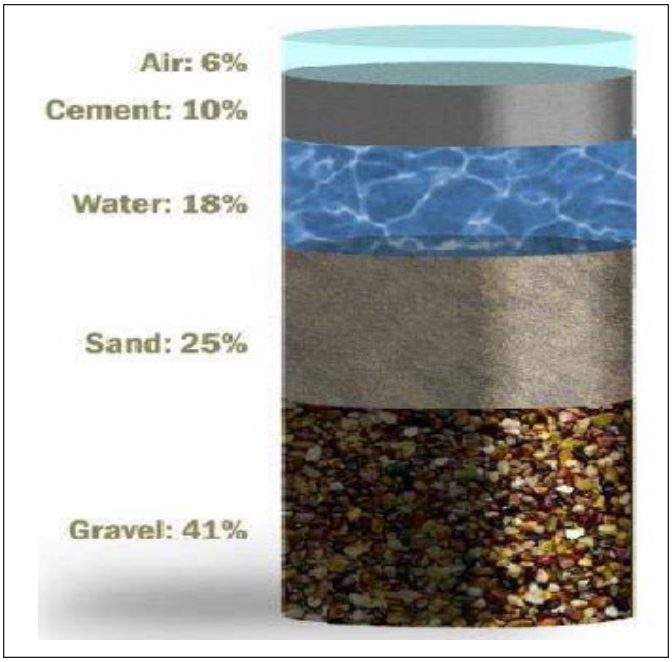


Figure 6. Proportioning of Concrete Mixing

5. X-ray Shielding Effectiveness Test

AIM To determine the resisting capacity of leaded concrete block when subjected to x-ray penetration.

Apparatus X-ray source, x-ray measuring unit, lead sheet, and concrete block to be tested.

Procedure

• Place the concrete block in position in **x-ray** machine by taking necessary precautionary measures.

• Keep the lead sheet at the bottom so as to prevent penetration of **x-ray** to surrounding area.

• Switch on the **x-ray** machine and allow the **x-rays** to pass through the block.

• Once the rays are allowed through the block, take the block out of the machine and take the indent of the film.

• Wash the indent film and get the required x-ray film.

Sample	Percentage %	Weight of cube (kg)	Area (mm^2)	Load (N)	Compression strength (N/mm^2)
1	0	8.146	22500	60000	26.16
2	10	8.463	22500	55800	24.32
3	20	8.435	22500	65600	28.60
4	30	8.216	22500	46600	20.31
5	50	8.529	22500	47000	20.49
6	75	8.357	22500	38400	16.74
7	100	8.481	22500	47600	20.75

Table 2. Compression strength for 21 days

Sample	Percentage %	Weight of cube (kg)	Area (mm^2)	Load (N)	Compression strength (N/mm^2)
1	0	8.115	22500	65400	28.51
2	10	8.225	22500	51800	22.58
3	20	8.276	22500	66600	29.03
4	30	8.522	22500	69200	30.17
5	50	8.590	22500	39800	17.35
6	75	8.721	22500	38000	16.56
7	100	8.168	22500	41200	17.96

Table 3. Compression strength for 28 days

Various graph showing relation between strength, load, % of glass, no of days of curing

Figure 7. Failure of Cubes due to Compression Load

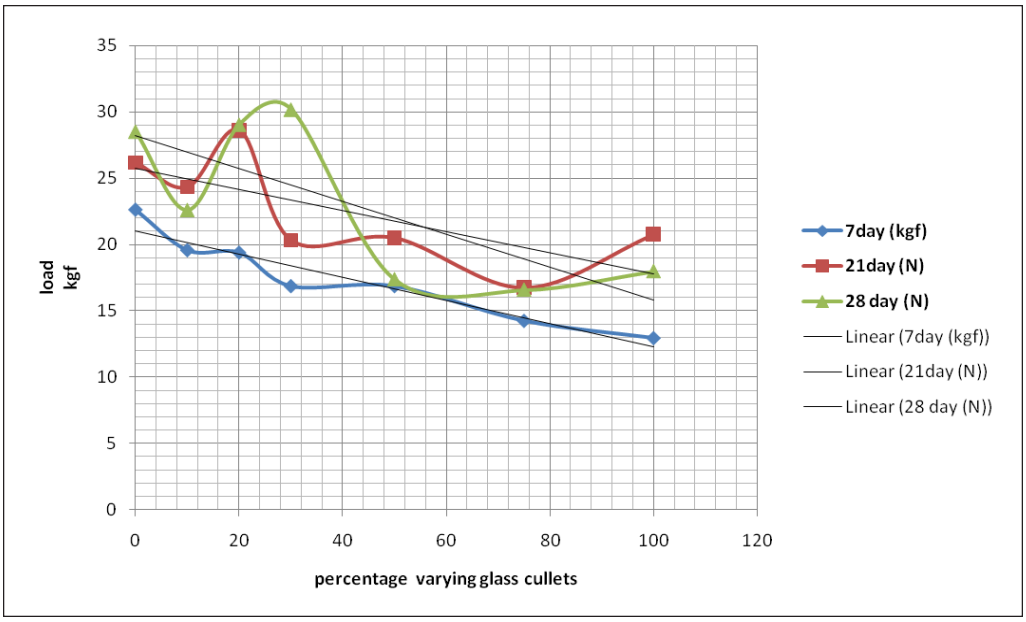


Figure 8. Various graph showing relation between Load Vs. Percentage varying glass culets

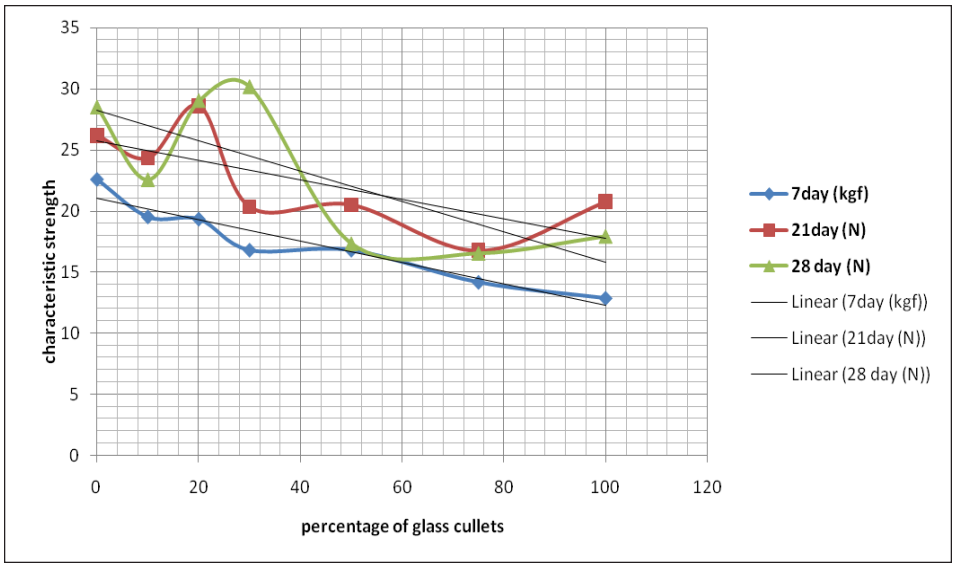


Figure 9. Various graph showing relation between strength, V/s % of glass, no of days of curing

6. Conclusion

• Based on the study carried on the strength behavior and Radiation behavior of CRT funnel glass used following conclusions are drawn.

• CRP funnel glass is added in the proportion of 10 %, 20%, 30% 50% 75%, 100% by Weight

• At all coarse aggregate replacement by CRT funnel glass there is a gradual increase in Compressive Strength for 7 days, 21days, 28 days.

• At all the initial ages the increase in percentage replacement of CRT funnel glass the Compressive Strength of concrete is found to be decreased from 0-10% replacement and increasing for 30% and then decreasing to 50% and the gradual decrease to 100%.

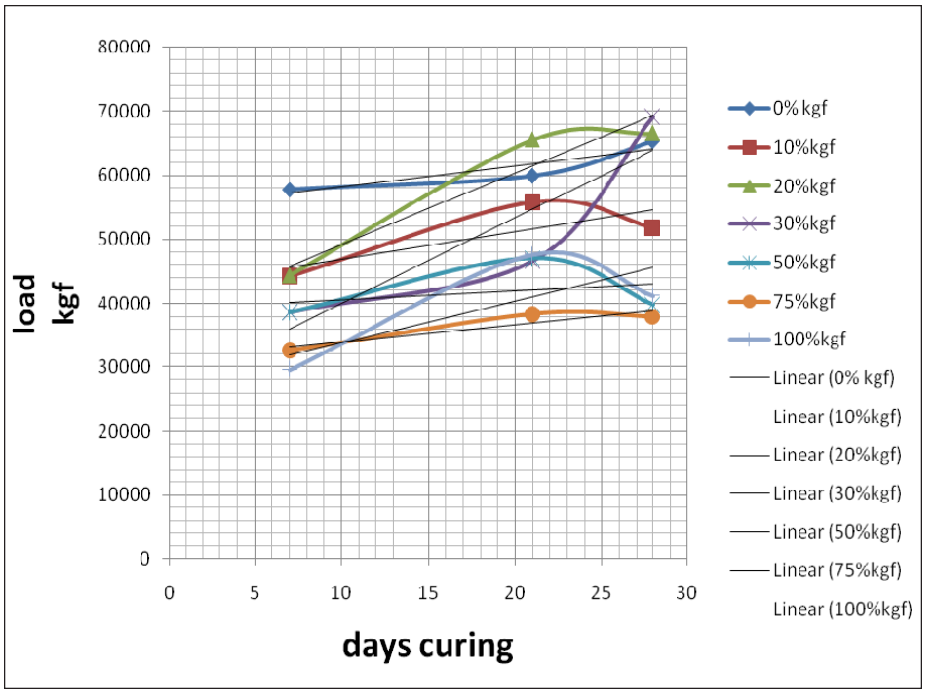


Figure 10. Various graph showing relation between Strength V.s % of glass, no of days of curing

Sl.No	% of lead glass in concrete cube	Weight Of Concrete Cubes	X-ray emitted (keV)	X-ray absorbed (keV)	X-ray passed (keV)
1	0	8.169	1000	94.32	5.68
2	10	8.332	100	97.83	2.17
3	20	8.371	100	98.46	1.54
4	30	8.522	100	99.32	0.68
5	50	8.481	100	98.77	1.23
6	75	8.467	100	98.65	1.35
7	100	8.308	100	97.31	2.69

Table 4. To determine the resisting capacity concrete block when subjected to X-ray penetration

• The CRT lead glass containing concrete block prepared satisfies all the compressive strength conditions of with 30% optimum replacement with concrete block.

• Compressive strength satisfied lead content concrete block now eligible to go through X-ray radiation Penetration test.

• It was found that 30 % of leaded glass in concrete X-ray emitted 100% out of it 99.32% X-ray observed the result found to be optimum.

• The lead content concrete bock which satisfied the X-ray rations test can be use other radiation tests also like alpha (α), beta (β), gamma (γ) races.

• The lead content concrete block which resisted the radiation can be used for the construction wall panels in Hospitals and various places.

Figure 11. X-ray Testing Machine

• By using CRT funnel glass in concrete as replacement the disposal problem of CRT funnel glass will be solved to some extent.

• This experimental work reduces the Hazardous waste to some extent which helps in disposal problems of CRT funnels glass which helps in Environmental Pollution Problems.

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