International Journal of Scientific Engineering and Science
Volume 2, Issue 1, pp. 96-99, 2018. ISSN (Online): 2456-7361

A Review Study on the Effect of Replacement of Cement by Crushed Fluorescent Lamp

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Abstract— *A construction material composed of cement aggregates (fine & coarse aggregates) water & admixtures is known as concrete. Nowadays, the use many waste materials like pulverized fly ash & ground blast furnace slag is done by many researchers. By this process, the possibility of using Fluorescent Glass Powder as a partial replacement of cement for new concrete is examined considerably. By performing various tests, the observations practically showed that glass powder can be used as cement replacement material up to particle size less than 75 micrometer to prevent alkali silica reaction. Glass powder is divided into two grades. One is Glass Powder with size less than 90 micron & another is glass powder having particle size from 90-105 micron so as to study the size effect of glass powder. Observations showed that the initial strength gain is very less on 7th Day but increases considerably on 28th Day. So as to evaluate the durability and strength of concrete along with control specimen 10%, 20%, 30% replacement of fine aggregate with fluorescent tube light waste, investigations has been carried out. This paper depicts the above conducted investigations and their observations as well.*

Keywords— *Fluorescent lamp, Acid test, Alkaline test, cement, fine and coarse aggregates, fluorescent glass powder, fire resistance, compressive strength, flexural strength.*

I. INTRODUCTION

Due to the emphasis placed on suitable construction, the interest of construction community in using waste or recycled materials in concrete is increasing. A material which could be recycled & used many times without changing its chemical property is nothing but glass. There are numerous uses of waste glass. It is crushed into specific into specified sizes as water filtration, grit plastering, sand replacement in concrete, etc. Glass is amorphous with high content of silica. Major researches and studies have been done regarding the use of glass concrete which is the chemical reaction that occurs between silica & alkali. Silicate reaction can be very detrimental to stability of concrete, untill appropriate precautions are taken to minimize its effects. So the main aim of this work is to compare the performance of concrete containing glass powder with performance of other conventional concretes.

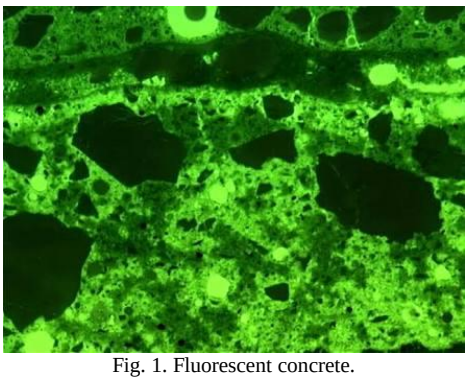

Fig. 1. Fluorescent concrete.

Finely crushed fluorescent tube light waste are used as a partial replacement of fine aggregate in concrete and compared it with conventional concrete in this study. By conducting various investigations, the results obtained showed, it is found that fluorescent tube light waste can be used as a fine aggregate replacement material up to particle size less than 4.75mm. Essential test on cement, fine aggregate, coarse aggregate, fluorescent tube wastes and concrete of different mix are carried out to increase compressive strength, flexural strength and split tensile strength of concrete by using fluorescent tube lights waste by replacing fine aggregate to the following 10%, 20% & 30%.

II. MATERIALS

Hydration occurs when reaction of water with cement is done thereby resulting in formation of hard material. Proper proportion of ingredients were taken. The weights of cement were replaced at successive interval of 6%, 8%, 10%, 12%, 15%, 20% and 25%. They are described in detail in detail with their following properties.

1. Cement

Cement of grade 43 of Portland cement was used throughout the work.

2. Fine Aggregates and Coarse Aggregates

Clean river sand were the fine aggregates used in this investigation, having maximum size of 4.75mm, confirming to grading zone III. The coarse aggregate used was machine crushed blue granite having its shape as angular.

3. Glass Powder

Glass powder was made with the help of water glass which was easily available in local shops. Glass waste is very hard material. Glass powder in the concrete has to be powdered before adding it. In this studies glass powder ground in ball for a short period of 30 to 60 minutes resulted in particles less than 150um and sieved in 75mm.

- *Mix proportion*

Grade M20 was suggested by Indian standards for control structure for concrete mix design. The ratio of water cement used was 0.50 having cement content of 360kg/m3. The mix

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Volume 2, Issue 1, pp. 96-99, 2018. ISSN (Online): 2456-7361

proportion of materials is 1:1.62:3.4 as per 10262-2009. Natural fine aggregates were also used. Also chemical admixtures were not used of 6%, 8%, 10%, 12%, 15%, 20% and 25% were the percentage of glass powder used in replacement of cements in cement.

- *Testing*

Properties such as compressive, tensile and flexural strength were determined by keeping concrete of having cement ratio of 6%, 8%, 10%, 12%, 15%, 20% and 25% and were tested for 7 days to 28 days. It was all done as per IS recommendation.

III. DURABILITY

The durability of concrete is defined as its skill to prevent weathering action, chemical strike, corrosion or any other process of decay. Strong and durable concrete will resist and survive for its original form, quality and service ability when exposed to atmosphere.

1. *Acid Test*

Chemical means are used in order to find the quantity of weight loss in concrete cubes. 5% of HCL was mixed with one liter of water as per ASTM G20-8 was used to prepare a mixture for acid test. Weight of the cube was calculated after the curing of 28 days. Than, the prepared hydrochloric acid was used for the immersion of the concrete cube for about 30 days. Weights of the cubes were noted after the curing of cubes were done. Hence weight loss of the cube is calculated by,

Weight loss= weight of cube after standard curing of 28 days - weight of cube after taken out from acid test of 30 days.

Weight loss of different types of ASTM G20-8 concrete were compared, from the results of 30 days of hydrochloric acid attack on concrete it was found that there was decrease in hydrochloric attack after the mixing of aggregate by 10%, 20%, 30% of fluorescent light tube waste.

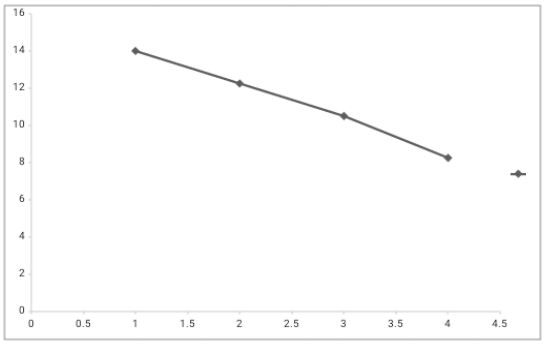

Fig. 2. Variation due to acid attack.

2. *Alkaline Test*

Chemical media are used to find out the quantity of weight loss in concrete cubes. 5% of sodium hydroxide with one liter of water as per ASTM G20-8 was used to prepare a mixture for alkaline test. Weight of the cube was calculated after the normal curing of 28 days. Then, the prepared sodium hydroxide solution for about 30 days. Weights of cubes were noted after the curing of cubes were done. Hence weight loss of cube is calculated by,

Weight loss= weight of cube after standard curing of 28 days – weight of cube after taken out from alkaline mixture of 30 days.

According to ASTM G20-8 test was carried out to obtain the weight loss of different types of concrete. The weight loss of the ceramic concrete was decreased after the attack of 30 days of sodium hydroxide.

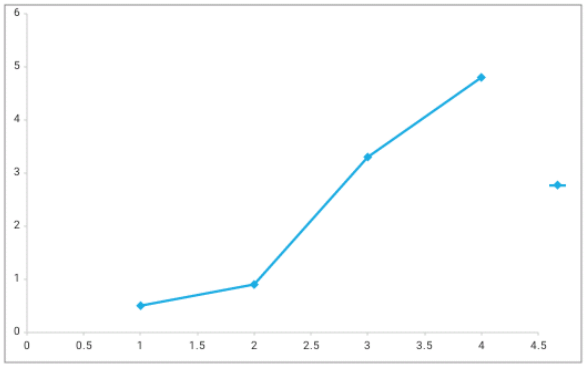

Fig. 3. Variation due to alkaline attack.

3. *Fire Resistance*

After the normal curing of 28 days test was made for all the ceramic concrete cubes i.e. ceramic waste in each percentage of replacement of 10%, 20%, 30%. An oven was used for about 120 hours at a temperature of 250 c after 28 days. With the fluorescent light waste aggregate all the three cubes of 10%, 20%, 30% aggregate were kept in an oven for 120 hours at 250c. After discharging the cubes from such hot conditions it was found that there were no damage and no change in color.

4. *Compressive Strength of Concrete*

The resistance of the material to break under compression of the hardened concrete was tested after 28 days. Compressive strength of concrete is considered as an index property of the overall quality of concrete. Higher the compressive strength of concrete higher is its durability. Strength of the concrete significantly improved with the ceramic waste aggregate 10%, 20%, 30%.

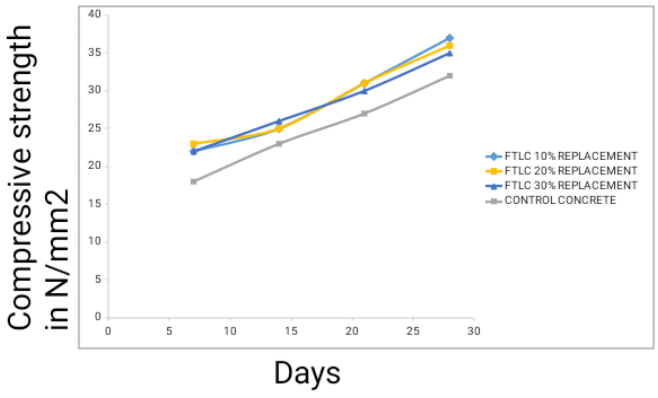

Fig. 4. Comparison of compressive strength of cubes 7, 14, 28 days.

Compressive strength of concrete was affected after more adding of fluorescent tube light beyond 30%. 10% of fluorescent light tube shows impressive compressive strength.

5. Flexural Strength of Concrete

At the age of 28 days the beam specimens were tested for flexural strength of hardened concrete. The ability of the beam to resist bending is carried by flexural test. Fluorescent light waste aggregate in the proportion of 10%, 20%, 30% increased the flexural strength of concrete.

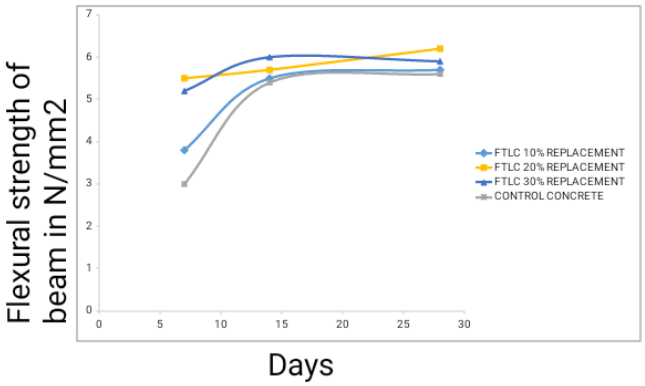

Fig. 5 Comparison of flexural strength of beams 7, 14, 28days.

IV. Conclusion

Durability of concrete increased with the help of fluorescent light tube waste aggregate. Performance of concrete with respect to strength, acid resistance, alkali attack and sustainability under fire was improved. Compressive strength was about 22% higher while split tensile strength was about 0.3% higher and flexural strength was 3.70% high of the fluorescent light tube waste aggregate as compare with the control concrete. Weight loss due to acid attack on 10% aggregate was1.3% while weight loss due to acid attack on 20% aggregate was 1.8% and that of 30% aggregate was 2.2% which are very low. Weight loss due to alkaline attack on 10%, 20%, 30% ceramic aggregates were 0.3%, 1.8%, 2.2% respectively which are also low. Under the explosion condition of 250°c for 120 hours on the fluorescent light tube waste concrete it was observed that there was no damage and no change in color of the cube.

Thus, it can be conclude that 10% replacement of fluorescent light tube waste aggregate serves as an optimum level.

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