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Experimental Study on Fly Ash Bricks Incorporated with Cigarette Butts

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Abstract: The world is dealing with a serious problem of litter of cigarette butts, so it is necessary to recycle the waste material of cigarette butts. Utilization of cigarette butts in building materials is one of the practically applicable way to achieve sustainable solution. This paper presents an experimental study on fly ash bricks with cigarette butts. The experimental program involves casting of fly ash bricks specimens using M53 grade cement out of which specimens were tested as control specimens without mixing cigarette butts and specimens were incorporated with cigarette butts. 500grams of cigarette butts i.e. around 800 cigarette butts were grinded. The objective of present work was to study effect of addition of 0.5% cigarette butts in the fly ash mix and find out the effect of cigarette butts on properties of fly ash bricks. The experimental results showed that the addition of cigarette butts in fly ash bricks made a slight decrease in its compressive strength.

I. INTRODUCTION

Discarded cigarette butts are one of the most common type of litter found around the world. An estimated 4.5 trillion cigarette butts are littered worldwide every year.¹ These cigarette butts are made up of cellulose acetate which has very poor bio degradability and it can take many years for them to breakdown.² The remains of tobacco and harmful toxic chemicals which is entrapped in these cigarette butts reach into the ground and water thus contaminating them. Hence it is important to find a practical solution to minimize the problem of litter of cigarette butts. There are two recorded investigations made prior to this investigation to find a way to solve the world's cigarette butt problem. A research was conducted at the RMIT University, Australia in which the use of these butts in the construction of asphalt concrete roads⁴ and in the manufacture of fired clay bricks⁵ was done. Due to the poor bio degradability of cigarette butts, these cigarette butts can be recycled into fly ash bricks by incorporating them into fly ash bricks. Fly ash bricks is one of the major construction materials and considering the huge and rapidly growing construction industry, the need of fly ash bricks is continuously increasing. In India fly ash bricks are manufactured according to specifications given in IS 12894:2002.

II. EXPERIMENTAL PROGRAM

The main objective of this experimental work is to recycle the cigarette butts, considering this objective, fly ash bricks were selected as building material and test were conducted on fly ash bricks with and without cigarette butts.

A. Materials used in fly ash bricks

- 1) **Cement:** Ordinary Portland Cement (OPC) of 53 grades conforming to IS 12269: 2013 is used.
- 2) **Pulverized Fuel Ash (Commonly Known as Fly Ash):** Pulverized fuel ash commonly known as fly ash shall conform to Grade 1 or Grade2 of IS3812.
- 3) **Bottom Ash Bottom:** Ash used as replacement of sand shall not have more than 12 percent loss on ignition when tested according to IS 1727
- 4) **Sand:** Deleterious materials, such as clay and silt in sand, shall preferably be less than 5 percent.
- 5) **Lime:** Lime shall conform to Class C hydrated lime of IS712.
- 6) **Additives:** Any suitable additive considered not detrimental to the durability of the bricks such as gypsum, cement, etc., may be used.
- 7) **Water:** Potable water free from acids, alkalis and salts is used.
- 8) **Cigarette Butts:** Cigarette butts littered on the roads were collected. 500 grams of cigarette butts i.e. 800 butts were taken. These butts contained remnants of tobacco which was removed. The cigarette butts were then oven dried at 150°C for 24 hours to disinfect them. So, these butts were grinded in a mixer in order to break the compacted filter into smaller fibrous material.

Figure 1 shows the oven drying of cigarette butts.

Figure 2 illustrates the grinded cigarette butts



Figure 1: Oven Drying of Cigarette Butts at 150°C



Figure 2: Grinded Cigarette Butts

B. Mix proportioning

For manufacturing of fly ash bricks, 55% fly ash, 35% stone dust, 10% cement, 0.5% grinded cigarette butts were used. The design was carried out as per the specifications given in IS 12894: (2002).

C. Casting of fly ash brick

In this investigation, fly ash bricks of length 230mm, breath 150mm and thickness 70 mm were casted. Figure 3 shows the mixing of grinded cigarette butts. Figure 4 clearly shows how the fine cellulose acetate fibers have mixed with the constituent materials.



Figure 3: Mixing the constituent materials with Grinded Cigarette Butts



Figure 4: Cellulose Acetate fibers mixed with the constituent materials

D. Curing Of Fly Ash Bricks

Before testing of fly ash bricks curing is required. In the case of fly ash bricks air curing is required. The casted bricks were air cured for 14 days as per 12894:2002.

E. Testing

The fly ash bricks were tested as per the IS 12894: 2002. Compressive strength and Water absorption test are the main properties for which fly ash bricks are tested.

As the focus of this work is on recycling cigarette butts, the properties of fly ash bricks manufactured using cigarette butts has been determined experimentally to check whether cigarette butts can be added in fly bricks.

- 1) **Compressive Strength:** The compressive strength of fly ash bricks determined in accordance with the specifications given in IS 3495 (part1): 1992. Fly ash bricks shall be specified in terms of 14 days compressive strength. Apply the load axially at uniform rate of 14 N/mm² per minute till the failure occurs and note the maximum load at failure. The load at failure shall be the maximum load at which the specimen fails to produce any further increase in the indicator reading on the testing machine. Figure 5 shows the compression test in progress.



Figure 5: Compression test

- 2) *Water Absorption Test:* The water absorption of fly ash bricks determined in accordance with the specifications given in IS 3495 (part2): 1992. Dried specimens were immersed in clean water at a temperature of 27 ± 2°C for 24 hours. The specimens were removed and wipe out of traces of water with a damp cloth and weight of specimen was determined. Water absorption, percent by mass, after 24-hour immersion in cold water was calculated by the following formula: $(M_2 - M_1) / M_1 \times 100$ given in IS 3495 (part2) Fly ash bricks should not absorb water more than 15-20% as per IS 3495(part2).
- 3) Quantity of Cigarette butts recycled for fly ash bricks was 500 grams for 24 Fly Ash Bricks, i.e. 800 cigarette butts. Therefore, one Fly Ash Brick were incorporated with 33 cigarette butts.

III. RESULTS AND DISCUSSIONS

A. Compressive strength

The compressive strength of fly ash bricks incorporated with 0.5% of cigarette butts is given table. The compressive strength of fly ash bricks slightly decreased on addition of 0.5% of cigarette butts, but the compressive strength obtained of fly ash bricks incorporated with Cigarette Butts is more than minimum compressive strength required for fly ash bricks (7-10 N/mm²), as per IS 3495(part1). Therefore making it suitable for construction purposes.

Table 1 Compressive Strength of Fly Ash Bricks Incorporated with 0.5% of Cigarette Butts

Sr.no.	Percentage of Cigarette Butts incorporated in Paver Blocks	Compressive Strength (N/mm ²)
1	0	9.15
2	0.5	8.03

B. Water Absorption

The result of the water absorption of the fly ash bricks incorporated with 0.5% percentages of cigarette butts in Table 2. It is observed that with addition of 0.5% of cigarette butts water absorption of fly ash bricks increased, but the water absorption obtained of fly ash bricks incorporated with CB's satisfies the condition given in IS 3495 (part 2).

Table 2 Water Absorption of fly ash bricks incorporated with Cigarette Butts

Sr.no.	Percentage of Cigarette Butts incorporated in Paver Blocks	Water Absorption at days (in %)
1	0	11.26
2	0.5	12.32

- C. Quantity of cigarette butts recycled for fly ash bricks was 500 grams for 24 bricks, i.e. 800 cigarette butts. Therefore, in one fly ash brick 33 cigarette butts were recycled. If a wall of 4x3m is considered then 1,98,000 cigarette butts can be recycled in 6000 fly ash bricks.
- D. From the results obtained it shows that recycling of cigarette butts in Fly Ash Bricks has a great potential for achieving a sustainable environment.

IV. CONCLUSION

A. Based on the Experimental Investigation, the Following Observations Were Made

The experimental study of Fly Ash Bricks with Cigarette Butts was carried out. Determination of compressive strength and water absorption with and without Cigarette Butts were found out. From the results it was concluded that there was a slight decrease in compressive strength with addition of CB's and slight increase of water absorption with addition of CB's. But as stated in IS 3495 (part1) and IS 3495 (part2) the values obtained of compressive strength and water absorption are satisfactory, making it practically applicable for construction purposes.

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