



## The use of Polystyrene from Ballpen Barrels and Wood Ash as Additives in Making Lightweight Bricks

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### Abstract

*This study aimed to determine the ability of polystyrene in ballpen barrels of making a brick to be more compacted than the ordinary clay bricks. Polystyrene is a synthetic aromatic hydrocarbon polymer made from the monomer styrene that also makes a brick denser. The Wood ash from burned wood are usually used by the gardeners as a good source of potash. Wood ash has an ability of making the bricks lighter than the usual clay bricks. Additional wood ash is better than coal ash, because coal ash has a dangerous chemicals that may harm human. The goal of this study is to lessen the ballpen barrels and wood ash that are not disposed properly and make this in a creative way. Five test was conducted to determine the potential of polystyrene and wood ash namely water absorption test, drop test, efflorescence test, compressive test and heat resistance test. Based from the data gathered, it concluded that polystyrene from ballpen barrel and wood ash with the ratio of 50% Cement, 25% Wood Ash, 25% Ballpen Barrels is effective additives in production of lightweight bricks.*

## Introduction

The overwhelming weight of bricks accounts for the awesome mass of development and in this way causes more defenselessness against seismic tremor powers. In this manner, the analysts attempted to decrease the thickness of the bricks, as well as make strides warm cover properties. The impact of PS-type and its substance within the blend, additionally the impact of terminating prepare temperature of the bricks on thickness, water retention and compressive quality, are explored and examined in this paper (Veyseh et al., 2003). In this paper, endeavors have been made to ponder the behavior of fly cinder bricks by taking diverse extents of fly cinder and cement. At that point different tests such as comprehensive quality test, water retention record, efflorescence, weight test, auxiliary test were performed in arrange to have comparison with routine bricks (Kumar et al., 2014).

Fly cinder utilization in concrete as fractional substitution of cement is picking up significance day by day. To think about the utilize of fly fiery remains in concrete, cement is supplanted somewhat by fly cinder in concrete. Impact of fly fiery remains on work capacity, setting time, compressive quality and water substance are examined. To consider the affect of halfway substitution of cement by fly fiery remains on the properties of concrete, tests were conducted on distinctive concrete blends Mixes blends (Kesharwani et al., 2017)

A lightweight mortar can be created in several ways and basically depends on the discuss figure, that's diminishing the thickness of a fabric comprise in counting discuss in its structure, which can be done by supplanting the coarse total (sand) by discuss. Hence, the discuss incorporation within the fabric structure favors the arrangement of bubbles (purge space) interior the concrete or mortar. Subsequently, when it dries out the discuss gaps produce a lightweight fabric (Chandra & Berntsson, 2003)

It has near structure and cannot retain water. It has great affect resistance. The EPS globules can be effortlessly blended into mortar or concrete to create lightweight fabric with a wide extend of thickness. An application of lightweight EPS mortar incorporates dividers, cladding boards, tilt up boards and composite flooring (Gawale et al., 2016).

It appears that the fly cinder included building bricks sensibly great properties and may ended up competitive with the customary building bricks. Utilize of fly fiery debris as a crude fabric for the generation of building bricks isn't as it were reasonable elective to clay but moreover a arrangement to troublesome and costly squander transfer issue (Tutunlu et al., 2001).

Standards utilized in Canadian building codes are arranged by the Canadian Standards Association (CSA). The method utilized to plan and reexamine CSA benchmarks is comparative to ASTM's. The sole CSA standard for brick, A82 Let go Stone work Brick Made from Clay or Shale, is comparable in substance to the ASTM measures for confront brick and empty brick. It too incorporates test strategies (Canadian Guidelines Associations)

Generation of lightweight clay bricks and squares with higher warm cover properties is conceivable by utilizing combustible added substances in suitable sums and molecule sizes. One of the materials utilized for this reason is polystyrene froth. Polystyrene froth is, hence, utilized as a pore-forming fabric within the brick body for reducing warm conductivity conjointly thickness of brick which leads to mass decrease of building and progressing its resistance to seismic tremor powers (Ismail et al., 2003).

The overwhelming weight of bricks accounts for the extraordinary mass of development and hence causes more vulnerability against settlement and seismic tremor powers. Within the display work, it is, in this manner, attempted to diminish the thickness of the bricks. Due to the unsustainable mining of clay soil for clay brick making, cement bricks have been presented into the industry giving more options (Jain. 2011)

The bricks are said to be around 30% lighter than ordinary bricks, can be delivered with much more prominent compressive and malleable qualities, and can be coated to make strides their water assimilation characteristics. He demonstrated that terminated bricks made from bolsters of 72% fly-ash, 25% foot cinder, and 3% sodium silicate met commercial determinations. It is additionally worth noticing that as of late India has been driving the way in fly-ash brick fabricating (Lishmund, 1972)

The conventional development materials such as concrete, bricks, empty pieces, strong pieces, asphalt pieces and tiles are being created from the existing normal assets. This harms the environment due to persistent investigation and exhaustion of common assets. Additionally, different poisonous substances such as tall concentration of carbon monoxide, oxides of sulfur, oxides of nitrogen, and suspended particulate things are constantly radiated to the climate amid the fabricating handle of development materials (Kemp et al., 2013).

Pressure driven conductivity or basically penetrability (k) of naturally blended cementitious-based materials could be a key pointer of hydro mechanical properties (i.e., inactive steadiness, pumping, formwork weight and plastic shrinkage) and their advancement with time (Demir et al., 2005)

Traditionally, estimations of the respirable clean division are conducted employing a tornado pre-selector. In any case, as cheaper elective permeable polyurethane froth (PUF) embeds are progressively being utilized in a assortment of settings and applications (Bogdanovic et al., 2006).

It is fascinating to feature some additional ingredients to supply bricks of fine quality. Ash is one such material which will improve brick quality (Dondi et al., 2002)

Therefore, this type of commercial waste residue are often mixed into pervious brick by sure technical means that and used for urban pavement or riverside paving, which might not solely cut back rain runoff and cut back phosphorus pollution, however additionally recycle industrial waste (Wu et al., 2016).

It is a typical apply within the timber product producing business to draw power for the commercial processes from the wood wastes by developing little scale boilers units and victimization wood wastes as chief sources of energy. what is more within the presence of correct emission controls like static Cottrell precipitator, there's just about very little or no emission, therefore rendering it Associate in Nursing environmentally safe fuel. Wood wastes' fuels area unit most well-liked quite alternative biomasses (herbaceous and agricultural) thanks to reduced ash and alternative residue production (Cheah & Ramli, 2011).

Concrete that is being wide utilized in the development business has unlimited opportunities for innovative applications style and construction techniques. Factors like strength, workability and sturdiness of the normal concrete area unit endlessly being changed to create it a lot of appropriate for a fixed construction purpose. This has become a lot of realistic because of the advancement of technology. Many studies are disbursed to spot substitutes for fine aggregates (2, 3) and for cement (3) in producing concrete product that may enhance the properties whereas reducing the price (Aggarwal et al., 2007).

Within the current amount of energy production, power plants that run from biomass have low operational value and have continuous offer of renewable fuel. The wastes generated from the biomass industries like wood, woodchips, wood bark, and arduous chips) will be used as fuel provide a far better method for his or her safe and economical disposal. Different nonwoody and agricultural wastes as their combustion produces comparably less ash and different residual material.

Important drawback arising from the usage of forest and timber material as fuel is expounded to the ash made in significant quantity once the combustion of such wastes. It is ordinarily discovered that the hardwood turn outs a lot of ash than softwood and also the bark and leaves usually produce a lot of ash as compared to the inner a part of the trees (Elahi et al., 2015)

## **Methods**

The method of research used by the researchers is experimental. It is a research wherein the effect of polystyrene from ballpen barrels and fly ash in bricks will be observed. The term experimental design refers to a plan for assigning experimental units. The ballpen barrels were collected from the students of Parang High School on last July 23, 2019. The wood ash were collected at "Inihauz" and "Andoks" in G. Del Pilar St. Parang, Marikina. The ballpens that collected were crushed and pulverized. And the wood ash that were collected were set aside. And the wooden molder were made. After the collection and preparation of materials, the researchers proceeded in making bricks. The researchers dried the bricks for 15 days. After the curing days (15 days) the researchers proceeded to tests.

### **Test conducted on Bricks**

#### **Water Absorption Test**

4 bricks was taken and the bricks was weighted dry and the average dry weight of 4 bricks was calculated. Bricks was then immersed in water for a period of 72 hours. After 72 hours of immersion, bricks were weighed again and average of 4 bricks was calculated. The difference of the final average weight and initial average weight indicates the amount of water absorbed by the bricks. It should not in any case exceed 20% of average of weight of dry bricks.

$$\text{Water Absorption} = \frac{\text{Dry weight} - \text{Wet weight}}{\text{Dry weight}} \times 100$$

### Drop Test

Bricks was weighed using a beam balance, and then allowed to drop from a height of about 1 meter. The shattered pieces picked up and the largest piece was weighed to determine the shattered (final) weight.

$$\text{Drop Test} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100$$

### Efflorescence Test

The bricks were placed vertically in a dish 30 cm x 20 cm approximately in size with 2.5 immersed in distilled water. The whole water was allowed to absorb by the brick and evaporated through it. After the bricks appear dry, a similar quantity of water was placed in the dish, and the water was allowed to evaporate as before. The brick was examined after the second evaporation.

### Compressive Strength Test

Compressive test was done at the Institute of Civil Engineering, University of the Philippines-Diliman. The brick samples will be subjected to hydraulic press.

### Heat Resistance Test

The brick samples was subjected to high amount of heat. The brick samples was place in dry oven for 24 hours with the temperature of 80° C.

### Statistical Analysis

In this study, the researchers get the difference on the initial weight and final weight of the bricks before and after the test to determine the changes happened

Table 1. Ratios of Measurement

Brick no.	Cement	Fly Ash	Ballpen Barrels
Brick 1	50% - 500 g	25% - 250 g	25% - 250 g
Brick 2	75% - 750 g	12.5% - 125 g	12.5% - 125 g
Brick 3	50% - 500 g	30% - 300 g	20% - 200 g
Brick 4	50% - 500 g	20% - 200 g	30% - 300 g

Table 1 shows the ratios of cement, polystyrene, and wood ash used by the researchers in manufacturing the bricks based from the recommendation given by the personnel from City Engineering Office.

### Result and Discussion

Table 2. Water Absorption Test

Brick no.	Initial Weight	Final Weight	Average
1	635 g	642.29 g	7.29
2	605 g	681.53 g	76.53
3	500 g	544.39 g	44.39

4	505 g	546.29 g	41.29
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Table 2 shows the water absorption test wherein Brick number 1 absorbed less amount of water compared from Bricks number 2, 3, and 4.

Table 3. Drop Test

Brick no.	Initial Weight	Final Weight	Average
1	635 g	635 g	0
2	605 g	375 g	38.02
3	500 g	310 g	38.00
4	505 g	505 g	0

Table 3 shows the result of drop test wherein Brick numbers 1 and 4 have the same initial weight and final weight. While Bricks number 2 and 3 shows difference on the initial and final weight.

Table 4. Efflorescence test and Heat Resistance Test









BRICK NO.	BEFORE THE TEST	AFTER THE TEST
1		
2		
3		
4		

Table 4 shows the effects of Efflorescence test done on bricks and the effect of of high amount of heat on brick samples. All brick samples changed in color after the test.

Table 5. Compressive Strength Test

Brick no.	Maximum Load [N]	Compressive stress at Maximum Load [ MPa ]	Thick ness [mm]	Width [ mm ]
1	16,017.10352	3.20342	25.00000	200.00000
2	40,331.72656	8.06635	25.00000	200.00000
3	15,816.30664	3.16326	25.00000	200.00000

4	21,779.36719	4.35587	25.00000	200.00000
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Table 5 shows the result of compressive strength test. Brick number 2 shows a significant difference among the four brick sample. It has the greater amount of pressure before it breaks.

Based from the data gathered by the researchers, polystyrene from ballpen barrel and wood ash from grilling stores as an additive for bricks shows a significant effect. This is supported by the various test conducted. First, in water absorption test, brick number 1 with a ratio of (50% Cement, 25% Wood Ash, 25% Ballpen Barrels) absorb less amount of water.

Based from the study of Zhang & Zong (2014), a brick absorbs less amount of water is one of the good quality of a brick. (Zhang & Zhong 2014) a brick absorbs less amount of water is one of the good quality of a brick. Second, in drop test, brick number 1 with ratio of (50% Cement, 25% Wood Ash, 25% Ballpen Barrels) and 4 with the ratio of (50% Cement, 20% Wood Ash, 30% Ballpen Barrels) shows less number of pieces after the test and according to the study of Mendoza, John Elbert, a brick with less number of pieces after dropping is more durable. (Ritchie, 1965)

Third, efflorescence test shows that brick number 1 has a less formation of salt deposits on the surface of masonry. According to Ritchie (1965), the more salt deposits that are present in the brick, has more results in severe disfiguration of buildings. (Aubert et al., 2013)

Fourth, in compressibility test, it shows that brick number 2 with the ratio of (75% Cement, 12.5% Wood Ash, 12.5 Ballpen Barrels) can hold up to 8.06635 MPa of pressure. According to Aubert (2013) a construction material that can hold high amount of pressure is 100 to 110 MPa. (Burns, 2003). Lastly, in heat resistance test shows that, high amount of heat has no significant effect on brick samples. According to Burns (2013) a construction material that can hold high amount of heat is 982°C.

## Conclusion

Based from the data gathered, it concluded that polystyrene from ballpen barrel and wood ash with the ratio of 50% Cement, 25% Wood Ash, 255 Ballpen Barrels is effective additives in production of lightweight bricks. However, various ratios of additives have different response on different test conducted. The researchers recommend the following for the improvement of the study. Increase the curing period of the bricks approximately 28-30 days. An oven for Fire resistance. A heavy duty hydraulic press for testing how much amount of pressure can the bricks handle. And a rubberized/metal molder for easily to make the bricks.

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