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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

Keywords: Polystyrene, Wood ash, Lightweight Bricks, Efflorescence

1.INTRODUCTION

The heavy weight of bricks accounts for the great mass of construction and thus causes more vulnerability against earthquake forces. Therefore, the researchers tried to reduce the density of the bricks, as well as improve thermal insulation properties. The effect of PS-type and its content in the mix, and also the effect of firing process temperature of the bricks on density, water absorption and compressive strength, are investigated and discussed in this paper. (Veiseh, Sohrab & Yousefi, Ali)

In this paper, efforts have been made to study the behavior of fly ash bricks by taking different proportions of fly ash and cement. Then various tests such as comprehensive strength test, water absorption index, efflorescence, weight test, structural test were performed in order to have comparison with conventional bricks. (Ashish, Deepankar & Kumar, Ravi)

Fly ash utilization in concrete as partial replacement of cement is gaining importance day by day. To study the use of fly ash in concrete, cement is replaced partially by fly ash in concrete. Effect of fly ash on work ability, setting time, compressive strength and water content are studied. To study the impact of partial replacement of cement by fly ash on the properties of concrete, experiments were conducted on different concrete mixes. (Chandara Kesharwani, Khushal & Kumar Biswas, Amit & Chaurasiya, Anesh & Rabbani, Ahsan)

A lightweight mortar can be produced in different ways and basically depends on the air factor, that is, decreasing the density of a material consist in including air in its structure, which can be done by replacing the coarse aggregate (sand) by air. Thus, the air inclusion in the material structure favors the formation of bubbles (empty space) inside the concrete or mortar. Therefore, when it dries out the air holes generate a lightweight material. (S. Chandra and L. Berntsson)

It has close structure and cannot absorb water. It has good impact resistance. The EPS beads can be easily mixed into mortar or concrete to produce lightweight material with a wide range of density. An application of lightweight EPS mortar includes walls, cladding panels, tilt up panels and composite flooring. (Gawale, R., Mishra, S., Sambare, H., Kothari, j., & Patil. A. P. M.)

It seems that the fly ash added building bricks reasonably good properties and may become competitive with the conventional building bricks. Use of fly ash as a raw material for the production of building bricks is not only viable alternative to clay but also a solution to difficult and expensive waste disposal problem. (Tutunlu Faith, and Atalay Umit)

Standards used in Canadian building codes are prepared by the Canadian Standards Association (CSA). The process used to prepare and revise CSA standards is similar to ASTM's. The sole CSA standard for brick, A82 Fired Masonry Brick Made from Clay or Shale, is similar in content to the ASTM standards for face brick and hollow brick. It also includes test methods. (Canadian Standards Associations)

Production of lightweight clay bricks and blocks with higher thermal insulation properties is possible by using combustible additives in appropriate amounts and particle sizes. One of the materials used for this purpose is polystyrene foam. Polystyrene foam is, therefore, used as a pore-forming material in the brick body for reducing thermal conductivity and also density of brick which leads to mass reduction of building and improving its resistance to earthquake forces. (Ismail, I., Saim, A. A., & Saleh, A. L.)

The heavy weight of bricks accounts for the great mass of construction and thus causes more vulnerability against settlement and earthquake forces. In the present work, it is, therefore, tried to reduce the density of the bricks. Due to the unsustainable mining of clay soil for clay brick making, cement bricks have been introduced into the industry providing more alternatives. (A.K. Jain)

The bricks are said to be approximately 30% lighter than normal bricks, can be produced with much greater compressive and tensile strengths, and can be glazed to improve their water absorption characteristics. He indicated that fired bricks made from feeds of 72% fly-ash, 25% bottom ash, and 3% sodium silicate met commercial specifications. It is also worth noting that recently India has been leading the way in fly-ash brick manufacturing. (Lishmund, S.R)

The traditional construction materials such as concrete, bricks, hollow blocks, solid blocks, pavement blocks and tiles are being produced from the existing natural resources. This damages the environment due to continuous exploration and depletion of natural resources. Moreover, various toxic substances such as high concentration of carbon monoxide, oxides of sulfur, oxides of nitrogen, and suspended particulate matters are invariably emitted to the atmosphere during the manufacturing process of construction materials. (Xue, Yongjie & Hou, Haobo & Zhu, Shujing & Zha, Jin)

Hydraulic conductivity or simply permeability (k) of freshly mixed cementitious-based materials is a key indicator of hydro mechanical properties (i.e., static stability, pumping, formwork pressure and plastic shrinkage) and their evolution with time. (Demir, Ismail & Baspinar, M. Serhat & Orhan, Mehmet)

Traditionally, measurements of the respirable dust fraction are conducted using a cyclone pre-selector. However, as cheaper alternative porous polyurethane foam (PUF) inserts are increasingly being used in a variety of settings and applications. (Bogdanovic J, de Pater AJ, Doekes G)

It is desirable to add some more ingredients to produce bricks of good quality. Fly ash is one such material that can improve brick quality. (Dondi, Michele & Guarini, G & Raimondo, M. & Venturi, I.)

Therefore, this kind of industrial waste residue can be mixed into permeable brick by certain technical means and used for urban pavement or riverbank paving, which can not only reduce rainwater runoff and reduce phosphorus pollution, but also recycle industrial waste. (Wu, M.-H & Lin, C.-L & Huang, W.-C & Chen, J.-W)

It is a common practice in the timber product manufacturing industry to draw power for the industrial processes from the wood wastes by developing small scale boilers units and using wood wastes as chief sources of energy. Moreover in the presence of proper emission controls such as electrostatic precipitator, there is virtually little or no emission, thus rendering it an environmentally safe fuel. Wood wastes' fuels are preferred more than other biomasses (herbaceous and agricultural) due to reduced fly ash and other residue production. (Cheah Chee ban, Mahyuddinr Ramli)

Concrete which is being widely used in the construction industry has unlimited opportunities for innovative applications design and construction techniques. Factors such as strength, workability and durability of the ordinary concrete are continuously being modified to make it more suitable for a specified construction purpose. This has become more realistic due to the advancement of technology. Several studies have been carried out to identify substitutes for fine aggregates (2, 3) and for cement (3) in manufacturing concrete products that would enhance the properties while reducing the cost. (Aggarwal P, Aggarwal Y, Gupta SM)

In the current period of energy production, power plants which run from biomass have low operational cost and have continuous supply of renewable fuel. The wastes generated from the biomass industries like sawdust, woodchips, wood bark, and hard chips) can be used as fuel offer a better way for their safe and efficient disposal. (Prabagar Subramaniam, Kalya Subasinghe, W. R. Keerthi Fonseka)

Wood wastes are commonly preferred as fuels over other herbaceous and agricultural wastes as their incineration produces comparably less fly ash and other residual material. A major problem arising from the usage of forest and timber waste product as fuel is related to the ash produced in significant amount after the combustion of such wastes. It is commonly observed that the hardwood produces more ash than softwood and the bark and leaves generally produce more ash as compared to the inner part of the trees. (MansoorElahi, AsadUllahQazi, Muhammad Yousaf, Usman Akmal)

2.MATERIALS AND METHODOLOGY

2.1Research Design

The method of research used by the researchers is experimental. It is a research wherein the effect of polystryrene from ballpen barrels and fly ash in bricks will be observed. The term experimental design refers to a plan for assigning experimental units.

2.2Collection of Ballpen Barrels

The ballpen barrels were collected from the students of Parang High School on last July 23, 2019.

2.3Collection of Wood Ash

The wood ash were collected at "Inihauz" and "Andoks" in G. Del Pilar St. Parang, Marikina.

2.4Preparation of Materials

The ballpens that collected were crushed and pulverized. And the wood ash that were collected were set aside. And the wooden molder were made.

2.5Making of Bricks

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.

3.TEST CONDUCTED ON BRICKS

3.1Water 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.

Water Absorption= Dry weight – Wet weight/ Dry weight x 100

3.2Drop 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.

Drop Test = Initial weight - Final weight/ Initial weight x 100

3.3Efflorescence 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.

3.4Compressive 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.

3.5Heat 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 80o C.

3.6Statistical 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.

4.RESULTS

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

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]	Thickness [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

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.

5.DISCUSSION

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 S. P. Zhang and L. Zong, a brick absorbs less amount of water is one of the good quality of a brick. (Zhang, S.P. and Zhong, L.) 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, T)

Third, efflorescence test shows that brick number 1 has a less formation of salt deposits on the surface of masonry. According to T. Ritchie, the more salt deposits that are present in the brick, has more results in severe disfiguration of buildings. (Aubert, Jean-Emmanuel & Fabbri, Antonin & Morel, Jean-Claude & Maillard, P.)

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, Jean-Emmanuel et.al, a construction material that can hold high amount of pressure is 100 to 110 MPa. (Burns, Timothy)

Lastly, in heat resistance test shows that, high amount of heat has no significant effect on brick samples. According to Burns, Timothy, a construction material that can hold high amount of heat is 982˚C

6.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.

7.RECOMMENDATIONS

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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