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Recycle of waste polythene and use this recycled polythene to produce construction block

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Abstract-Waste polythene is one of the hazards which pollute environment extensively. Recycle of waste polythene would help in two ways- first it will clean environment and secondly recycled material can be used as a raw material for other products. Now a days, bricks or construction blocks are produced through conventional procedure. This procedure causes erosion and destruction of fertile land surface all over the country and as a result reducing the crops production area. Other adverse effects of these brick production procedure are that it causes deforestation and air pollution. To avoid these types of environment pollution, a new energy efficient and pollution free process has been developed to produce construction blocks by using sands of different mesh sizes and other ingredients. Use of sands, on the other hand helps to renovate the river bed. The strength of the produced construction blocks has been measured and compared to that of the conventional product.

Keywords: Polythene, recycle, environment, construction block.

1. Introduction:

In Bangladesh, now a day's polythene bags (or shopping bags) and other polythene products are used extensively. After using these polythene products, users through it in the environment. These waste materials [1] are not bio-degradable and causes harm for environment. We can easily use this waste material for producing construction block [2] or a product substitute of conventional fire burn bricks. To use these waste material, at first we need to recycle it and then use the recycled material to produce construction blocks. Other ingredients for producing construction blocks are sand of different mesh sizes, water, cement and binder. The production procedure does not require any heating of the ingredients and as a result the procedure is not energy consumable.

The production process of these blocks is also pollution free. The traditional fixed chimney kiln brick production process causes severe and long term replenish able environmental pollution and destruction. This type of environmental pollution sometimes causes threat to human health and also animal health where brick kilns are near to their residence or habitat. Such as skin diseases, diseases of respiratory organs, hearing organ etc of human. Animals also suffer from different diseases.

In present, there are about 1250 traditional brick fields in and around Dhaka city. Each brick field produces almost 6 to 10 million bricks per year. Total production of bricks in Bangladesh is 15 billion bricks per year and this production increasing 5 to 6 % per year.

15 billion clay bricks per year consumes topsoil of 1,00,000 acres of land which can produce 5,00,000 metric ton of rice.

To produce this big number of bricks per year, total carbon emission is 8.75 million tones of CO_2 equivalent per year.

So, it is very essential to save our environment and substitute the traditional brick producing procedure by the present one.

2. Materials and equipments used:

Materials and equipments used to produce construction blocks in the present procedure are easily available and equipments or machinery can be fabricated / produced (or erected) locally using local technology. Materials whose chemical properties are very close to that of polythene, can also be recycled and used in the same procedure.

Among the raw materials, sand of different mesh sizes are used in large quantities, which is easily available and is the main component to produce construction block in cold process.

According to the capacity of the plant, raw materials and equipments / machinery used for production of construction block in the present energy efficient and environment friendly procedure are -

A. Raw materials used:
The raw materials used in the project are
a) Waste polythene
b) Coarse sand, mesh size 40, commercial grade
c) Fine sand, mesh size 60, commercial grade
d) Cement, commercial grade
e) Water
f) Binder (Ad-mixture)

B. Machinery used:
a) Heat gun (3000W) (or any other available technique to melt polythene)
b) Grinding machine (220V, 300W, 2800 rpm)
c) Weighing balance
d) Sieve (different mesh sizes, such as 40, 60, 100 mesh sizes)
e) Hydraulic press machine with mold to produce construction block.

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SL NO	ITEMS	DIMENSIONS	MATERIALS	QUANTITY
1	Hydralic press (1)	Shown in fig.	ASTM A-36G60	1
2	Top house	Shown in fig.	ASTM A-36G60	1
3	Bottom house	Shown in fig.	ASTM A-36G60	1
4	Bush base plate	76X460Xt12	ASTM A-36G60	1
5	Guid plate	228X460Xt12	ASTM A-36G60	2
6	Spandle holder ring	Ø76Xt16	ASTM A-36G60	1
7	Spandle holder plate	305X305Xt12	ASTM A-36G60	1
8	Stay bar	435X51Xt10	ASTM A-36G60	1
9	Pressure gauge nozel	Ø10	ASTM A-36G60	1
10	Hydralic press (2)	Shown in fig.	ASTM A-36G60	1
11	Hydralic press base plate	228X406Xt32	ASTM A-36G60	1
12	Guid stick	Ø38XL576	ASTM A-36G60	2
13	Bush	Ø76XL76	ASTM A-36G60	1
14	Pin holder plate	203X203Xt25	ASTM A-36G60	1
15	Pin	Ø25XL101	ASTM A-36G60	4
16	Punch plate	119X240Xt12	ASTM A-36G60	2
17	Die shifting bar	25X976Xt5	ASTM A-36G60	4
18	Brick die	Shown in fig.	ASTM A-36G60	2
19	Ruber foot	Ø63XL56	Ruber	4
20	Hydralic oil control valve	-	-	1

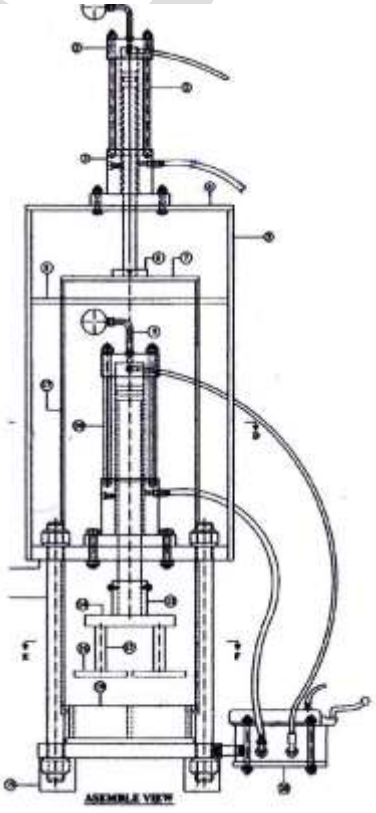

Fig 2(a): Hydraulic press machine for producing construction blocks.

3. Production process:

The production process of the construction block followed through the following steps-

a) At first waste polythene of different colour, thickness, size and shapes were collected. This waste polythene has some foreign materials or dirt with them when collected. Wash this waste polythene with plenty of water to get clean material. Dry this material in open air (or in a dryer if possible) and form solid lump/ball/cube (approximately $\frac{3}{4}x\frac{3}{4}x\frac{3}{4}''$ to 1″x1″x1″ or with diameter $\frac{3}{4}''$ to 1″) or any other size by heating the clean waste polythene with the heat gun. Grind these solid lumps in a grinding machine up to 100 mesh sizes or near sizes.
b) Sand of 40 mesh size and 60 mesh size were collected and separated from pebbles or any other substances like straw etc. if required. Take weight of coarse sand (40 mesh size) 40%, fine sand (60 mesh size) 40%, cement 10% and waste polythene 10%.
c) In the next step, mix the above materials with water (add 4 cc binder /Ad-mixture with 1 liter water). The amount of water depends on moisture content of the ingredients. If sand is comparatively moist, it needs to add less amount of water in comparison to the sand which is not so moist.
d) Load the mixed materials in the mold of the machine.
e) Press the mixed raw materials up to 1700 to 2000 psi, hold this pressure for certain time and then release pressure.
f) Collect the wet product from the mold and keep it to dry at NTP.
g) After 6 to 12 hour (depending on proportion of ingredients used) dip the product in water for approximately 2(two) weeks so that it can attain its strength after proper setting.
h) Collect the construction block from water and keep it at NTP. These blocks are ready for use.

4. Results and discussion:

Test of several parameters of the produced construction block have been performed. Based on these test results, we can take the decision as bellow.

Compressive strength of the construction blocks is a major test parameter. Compressive strength is directly depends on amount of cement used, pressure applied during production, quality of the sand used and also the amount of ad-mixture used.

Effect of ad-mixture and hydraulic pressure used during production, on compressive strength of the product is illustrated in figure 4(a) and figure 4(b).

a) From figure 4(a) it is clear that compressive strength of the product increases with the increase of amount of ad-mixture in one liter of water which is used for preparing the mixture to produce construction blocks. Addition of ad-mixture causes increase of compressive strength of the product because it helps to make proper bonding between the ingredients used for producing construction blocks. Ad-mixture also helps to attain strength of the product.

b) From figure 4(b) we can say that, compressive strength of the construction block also increases with increase of hydraulic pressure which is given to the product during production. The cause of increasing compressive strength in this case is that this hydraulic pressure makes to dense or come close of the ingredients. As a result compressive strength of the products increases.

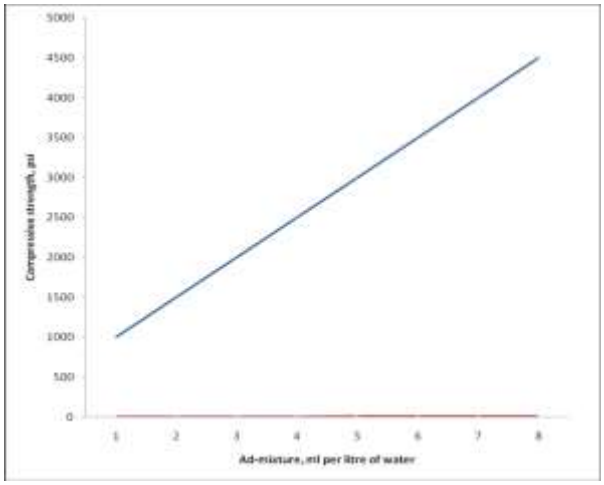

Fig. 4(a): Effect of ad-mixture on strength.

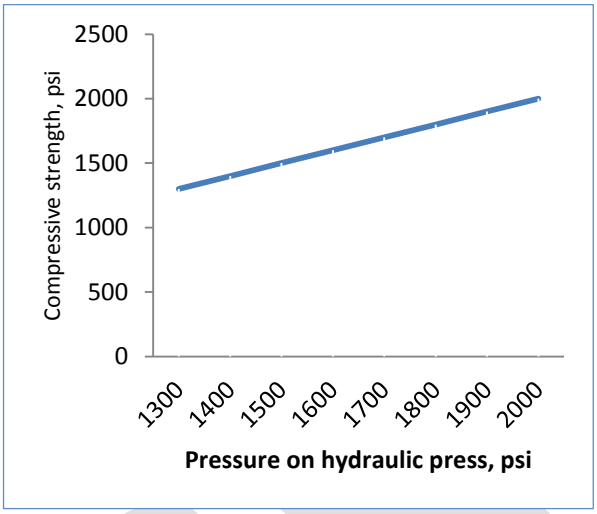

Fig. 4(b): Effect of hydraulic pressure on strength

c) Compressive strength of the construction blocks also depends on moisture content and water absorption.

At higher moisture content of the product compressive strength is comparatively lower.

On the other hand, as the compressive strength increases, water absorption tendency of the product reduces.

d) Thermal conductivity of a typical product is 0.2535 W/(m^oK) at 85^{o}C.

e) Expansibility of the product is 4.80X10^{-7}/^{o}C (0-100^{o}C).

f) Weight comparison with traditional clay fired brick for same dimension of the brick/construction block.

Cold process or present process construction block: 3.175 kg

Traditional clay fired brick: 3.060 Kg

5. Conclusion and recommendation:

Conclusion and recommendation of the work can be drawn as follow-

Conclusion:

a) Waste polythene is recycled and the material after recycle is used to produce construction blocks.

b) The production procedure does not follow conventional one and also energy efficient.

c) The machinery used for producing the product can be fabricated locally using local and simple technology and the fabrication materials are available in the local market.

d) The production procedure has not any adverse effect on environment and it is environment friendly.

e) Also production procedure is not threatening for the health of the worker who are associated with the production of construction block or collection / transportation of the raw materials which are required to produce the construction blocks.

f) Compressive strength of the construction block depends on the quality of the ingredient used specially the quality of the sand and cement used.

g) Compressive strength of the construction blocks can be achieved according to need by selecting raw materials proportion and applied hydraulic pressure.

h) This production procedure eventually save agricultural top soil, help to protect environment from pollution and save greeneries from deforestation.

Recommendations:

a) Further work can be done to produce different shape and size of the product, together with producing hollow shape inside the brick. Test results can be achieved of these products.

b) These construction blocks can be used first experimentally and then commercially for construction of pavements, boundaries or walls of a house or building.

b) One can repeat the procedure to produce construction blocks by using other ingredients such as rice husk ash, fly ash or any other industrial or agricultural waste materials in certain percentage as a filler material.

c) Total production procedure can be atomized.

d) Commercial production can be started as SME which will save agricultural land and help to renovate river bed all over the country.

e) Saving of energy can be calculated.

f) Benefit regarding consumption of soil and environmental pollution can be measured.

g) An assessment regarding protection of agricultural land and trees can be made.

6. Acknowledgement

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