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Production of Insulating Bricks Using Unwana Clay, Edda Clay, Kaolin and Wood Soft Dust

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Abstract
Production high fired kiln insulating bricks was carried out using local clays from Edda, unwana, kaoli in Ebonyi state and various soft wood dust was employed too. It was observed that the bricks, through the analysis of the results, the total shrinkage % percentage of each batch is: Batch 1: 43.5%, Batch 2: 19.5%, Batch 3:39.2%, Batch 4: 33.9% and Batch 5: 31.3%. From all indications batch 3 is the best recipe for lightweight insulating bricks, it is made up of mixture Edda clay and saw dust. Batch 2 which has total shrinkage percentage of 19.5% was fired to 1250^{o}C, but batch 3, 1040^{o}C, indicating a good material for insulating bricks.

Key words: Clay, Insulating Bricks, Kaolin and Sawdust

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I. Introduction

Insulating bricks are soft and light in weight. They can be easily cut by hand saw or any other hand tool like chisel or even drill bit. Their body is made of tiny air spaces similar to honey comb effect. The insulating bricks are mainly used industrial and hobby kilns heated up with either electric spiral elements or gas burners furnaces, both for hot face lining or outer back-up insulating bricks are refractory and of course withstand very high temperatures range.

II. Methodology

The clays and saw dust, after collection was left to dry for two months after which it was crushed and sieved with 30 mesh sieve to remove other impurities. Dust was equally left to dry for 30 days and thereafter sieved with 30 mesh sieve to obtain the particle size required for the work. The dust was then weighed and soaked in required quantity of water for four days. The kaolin, because it had been already processed into a required state, it did not required further preparation before use. Two types of wooden mould were used for the production. Percentage of each material as shown on the table 1 and 2 was weighed out and then mixed thoroughly to ensure complete homogeneity, covered with ploythene and left to age for three days. At the third day the bricks were moulded using the wooden mould. Quantities of the mix were packed into the mould and a heavy iron object was used to beat the mass severally for total compaction. As this was achieved, the mould was dismantled to free the bricks.

III. Drying Of The Bricks

The process of drying was that the bricks were left on the cemented floor of the workshop for the natural air to dry. This was for 7 days and then they were moved into the electric drying cabinet where they dried completely after 14 days.

IV. Pre-firing and loading

The bricks were pre-fired in a pit 60cm x 45cm x 23cm. A layer of tiny pieces of dried wood was made on the floor of the pit. The wood was place done across the other and dust spreads over the mould. Spaces were left for air of combustion to enter. The bricks were then loaded leaving space next to another.Another layer of tiny wood was made over the bricks which were covered with dust and life leaves. The life leaves were to prevent fast burning and for the bricks to absorb heat gradually. Finally, large woods were stood around the walls of the pit while other larger once were placed horizontally and perpendicularly over the layer covering the bricks until a pyramidal shape was formed. Tiny pieces of wood and dust were poured at some points and fire was lit. Some more life leaves braches were used to cover the entire set up to achieve slow burning to prevent introducing sudden heat to the brick .At the end of the pre-heating the bricks were taken off the pit, the ash dust was brushed off and the bricks loaded in an electric kiln and fired to 1250^{o}C. This firing lasted for another 10 hours.

Table1: Batch compositions for production are as shown on the table

MATERIAL	**Batch i**	**Batch ii**	**Batch iii**	**Batch iv**	**Batch v**
Kaolin	60%	40%		50%	
Edda Clay			40%		50%
Dust 4	40%	60%	60%	50%	50%
Water	4000ml	4000ml	400ml	3600ml	3600ml
Wet weight	3.38kg	803.5g	783.8g	883.39g	890.4g

Table 2 Showing different batches

BATCH ONE			
MATERIAL	**%**	**VALUE**	**H_2O**
Kaolin	60	2400g	400mis
Dust	40	1600g	
BATCH TWO			
Kaolin	40	1800g	400mis
Dust	60	2700g	
BATCH THREE			
Edda Clay	60	1800g	400mis
Dust	40	2700g	
BATCH FOUR			
Kaolin	50	2250g	3600mis
Dust	50	2250g	
BATCH FIVE			
Edda clay	50	2250g	3600mis
Dust	50	2250g	

RESULT AND ANALYSIS

Percentage (%) Drying Shrinkage

$$\frac{\text{Wet weight- dry weight}}{\text{Wet weight}} \times 100$$

Table 3: PERCENTAGE DRIED WEIGHT SHRINKAGE

Batch 1	**Wet weight**	**Dry weight**	**Change in weight**
1	3038kg	237.3g	660.7g
2	803.5g	529.3g	274.2g
3	783.8g	672.0g	111.71g
4	883.3g	685g	198.3g
5	890.4g	635.4g	255g

Calculations:

Batch 1: $\frac{ww-dw}{ww} \times \frac{100}{1}$

$\frac{3038g - 2377.3}{3038g} \times \frac{100}{1}$ = **21.7**

Batch 2: $\frac{803 - 529.3}{8} \times \frac{100}{1}$ = **34.1**

Batch 3: $\frac{783.8 - 672.09}{783.8} \times \frac{100}{1}$ = **14.2**

Batch 4: $\frac{883.3 - 685}{883.3} \times \frac{100}{1}$ = **22.4**

Batch 5: $\frac{890 - 635.4}{890.4} \times \frac{100}{1}$ = **28.6**

PERCENTAGE FIRED WEIGHT SHRINKAGE

% Fired Weight Shrinkage is calculated as:-

$\frac{DW - FW}{DW} \times \frac{100}{1}$

The table 4 Showing different results of the batches

Batches	DW	FW	Change in weight
1	2377.3g	1950.7g	426.6g
2	529.3g	431.2g	98.1g
3	653.7g	439.5g	214.2g
4	685.3g	487.3	188g
5	635.4g	533.8	101.6g

Batch 1: $\frac{DW-FW}{DW} \times \frac{100}{1}$

$\frac{2377.3 - 1950.7}{237.3} \times \frac{100}{1}$ = **17.9%**

Batch 2: $\frac{529.3 - 431.2}{529.3} \times \frac{100}{1}$ = **18.5%**

Batch 3: $\frac{653.7 - 439.5}{653.7} \times \frac{100}{1}$ = **32.8%**

Batch 4: $\frac{685.4 - 497.3}{685.3} \times \frac{100}{1}$ = **27%**

Batch 5: $\frac{635.4 - 533.8}{635.4} \times \frac{100}{1}$ = **16%**

Total shrinkage percentage calculated as

$$\frac{WW\text{-}DW\text{-}FW}{WW} \times \frac{100}{1}$$

Batch 1: $\frac{3038\text{-}2377.3\ \text{-}1950.7}{3038} \times \frac{100}{1}$ = **42.5%**

Batch 2: $\frac{803.5\text{-}\ 529.3\ \text{-}431.2}{803.5} \times \frac{100}{1}$ = **19.5%**

Batch 3: $\frac{798.5\ \text{-}\ 672.\text{-}439.5}{798.5} \times \frac{100}{1}$ = **39.2%**

Batch 4: $\frac{883.3685.4\ \text{-}497.3}{883.3} \times \frac{100}{1}$ = **33.9%**

Batch 5: $\frac{890.4\text{-}\ 635.4\ \text{-}533.8}{635.4} \times \frac{100}{1}$ = **31.3%**

V. CONCLUSION

It is observed that through the analysis of the results, the total shrinkage % percentage of each batch is, Batch 1: 43.5%, Batch 2: 19.5%, Batch 3:39.2%, Batch 4: 33.9% and Batch 5: 31.3%. From all indications batch 3 is the best recipe for lightweight insulating bricks. Batch 2 which has total shrinkage percentage of 19.5% was fired to 1250^{o}C, but batch 3, 1040^{o}C

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