Use Of Rice Husk As Fuel For Burning Bricks

By

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Abstract :

India is an agricultural country and about 26.5 million tonnes of rice husk is obtained every year as waste material from rice mills. So far, this material has no other substantive use and it creates disposal prms.

About 9.6 million tonnes of coal is required every year by brick industry to get colossal number of bricks fired in kilns. This demand of coal is not fully met by railways and more than half of the requirement is transported by road which involves high cost of coal at kiln sites.

The average calorific value of rice husk is 2800 K.cal/kg which is about 40% of the grade I coal (1750 K. cal/kg). Rice husk can well compensate the demand of coal energywise if some technique is developed for its utilisation as fuel in burning bricks in small scale and commercial kilns.

This paper describes the details of the technique of firing bricks in kilns using rice husk as fuel and the results of field trials undertaken at different kilns.

Introduction:

About 9.8 million tonnes of coal is required annually or burning about 5000[1] crores of building bricks in commercial kilns. Transportation of such a colossal amount of coal is not fully met by railways; more than half of it is transported by road which considerably increases the cost of coal at the kiln site. Problem of coal is aggravating day by day due to installation of many other industries and diminishing reserves of coal.

In India about 26.5[2] million tonnes of rice husk is obtained as waste material every year from agricultural sector which finds no substantive use so far. As it is a hard fibrous material, it has got very little nutritious value and also not easily digestable by cattles. Hence it is not used as a feed for cattles. It has about 20% silica [3] as mineral content which is an inert material and is not considered good for manure purposes in the fields. Consequently a problem of its disposal arises in rice mills where it is found in heaps.

This waste material can be utilised as renewable source of fuel, if some technique is developed for burning this in commercial kilns as Bull's/ Trench kilns or small intermittent kilns.

The calorific value of rice husk is 2800 K.Cal/kg which is about 40% of calorific value of grade I coal (7150 K. Cal/kg). Hence it can compensate the demand of coal energywise. Attempts have been made to develop a technique for burning rice husk in brick kilns as fuel.

Field trials have been conducted in three ways:-

1. For firing 15-20,000 bricks in small capacity intermittent type kiln.
2. Partial substitution of coal with rice husk as a fuel in Bull's trench kiln for commercial production of bricks.
3. Use of rice husk and firewood instead of coal as fuel in Bull's trench kiln.

1. Use of the rice husk in small intermittent type kiln

An intermittent type of small brick kiln has been designed and got constructed for firing about 15,000 bricks. The dimensional details of the kiln are given in Fig. No. 5. Two walls of 30 ft/ (9.14 m) length and 7.5. ft/ (2.31 m) height were constructed parallel at a distance of 8 ft between them. The walls were 3 ft/ (0.91 m) thick at the bottom with staggering to 1 ft 6 inches (0.47 m) thick at the top. One end of wall was 3 ft/ (0.91 m) thick from top to bottom with flue hole over which chimney is to be fitted. Four number of

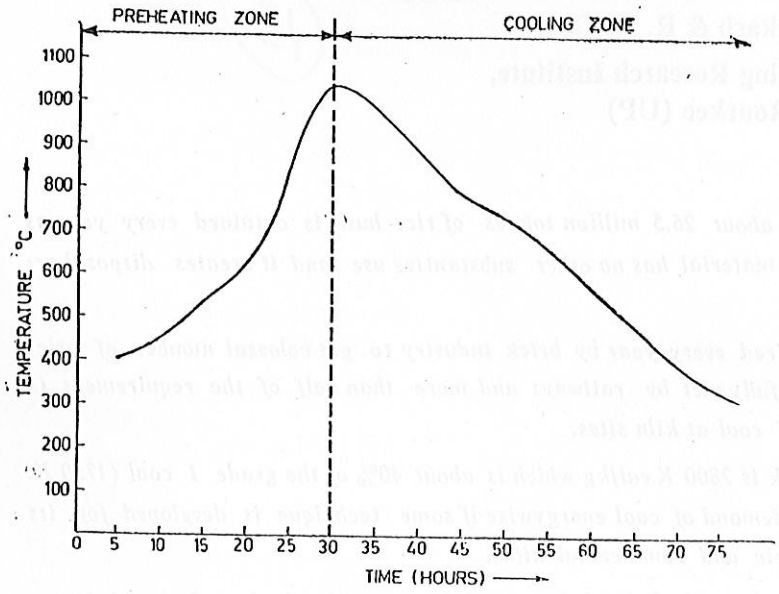


Fig. 1: Graph showing the rate of rise of temperature of bricks in the preheating zone and rate of cooling of bricks in cooling zone in Bull's trench kiln.

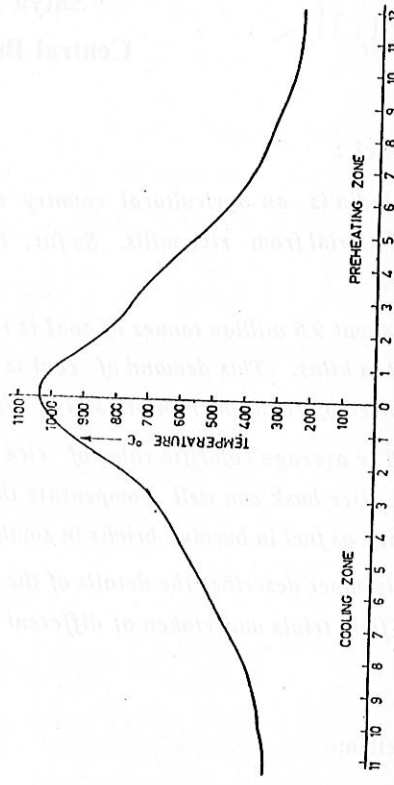


Fig. 2: Graph showing the variation of temperature of bricks in preheatings and cooling zone of the kiln.

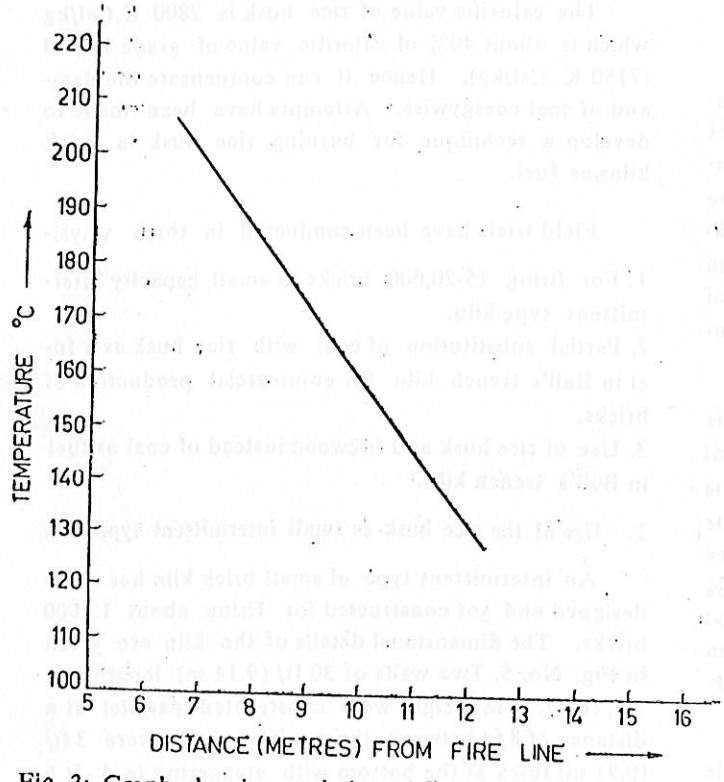


Fig. 3: Graph showing variation of flue gas temperature with distance of chimney from the fire line.

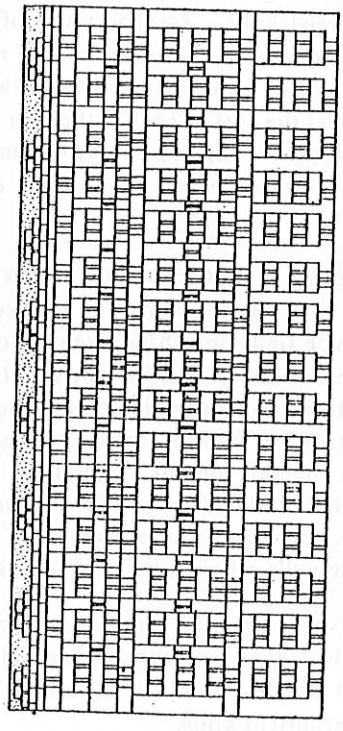


Fig. 4: Setting details of bricks in Bull's trench kiln using rice husk.

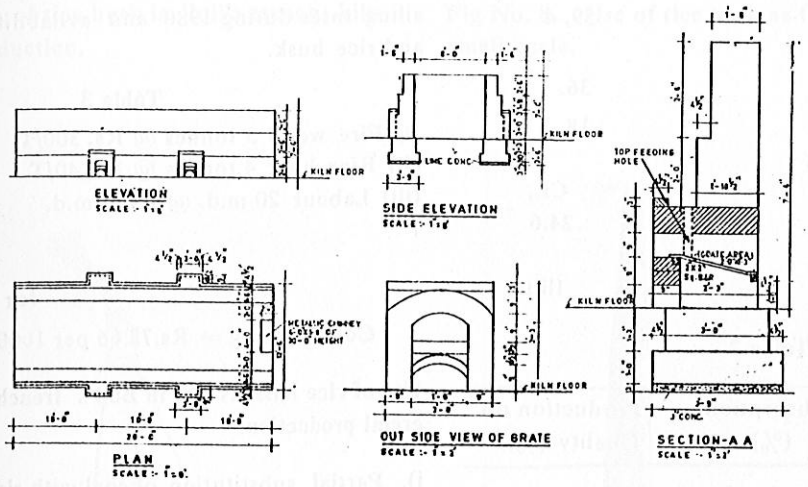


Fig 5. Design of brick kiln using rice husk as fuel

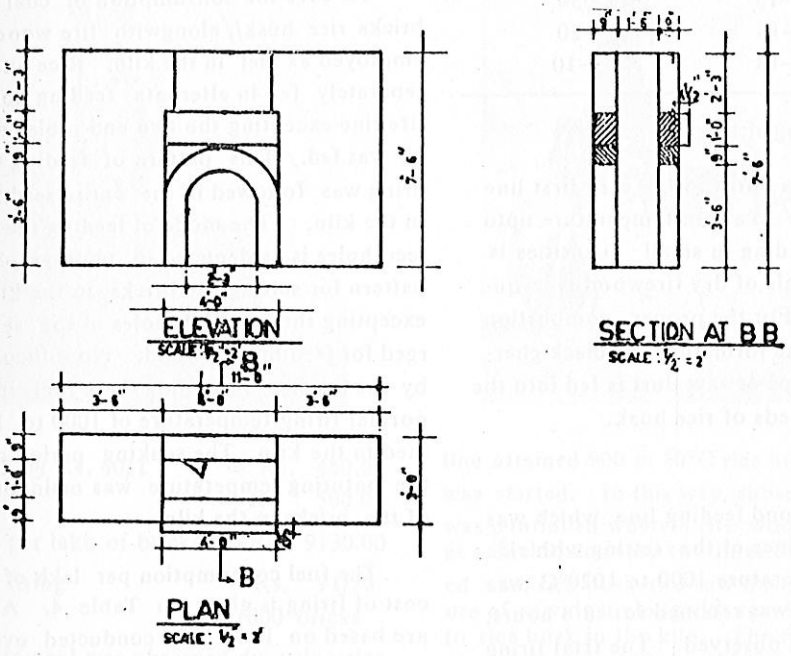


Fig.6: Details of flue at chimney base

fire boxes two in each side wall were made front to front as shown in Fig. 6. These fire boxes were utilised for feeding the fire wood and clearing the ash from the bottom. One sheet damper (size 4' 6" x2')/ (1. 37-x0.61m) at the base of chimney was provided to control the draught created by chimney.

Setting pattern of bricks in the kiln

Bricks were moulded from alluvial soils of Roorkee (Table 1) and were set according to the setting normally adopted in Bull's trench kiln. One firewood feeding line was set after every two rice husk feeding lines. This helped in proper combustion of rice husk and movement of flame in forward direction. A layer of 15 cm thick ash was put on the top of the brick setting to check radiation losses and to prevent the ingress of cold air into the setting .Fig. No. 4 shows the setting of bricks in commercial kiln.

Table 1

Physico Chemical Properties of Alluvial (Roorkee) soils

Mechanical Analysis

Clay	%	19. 2

Silt	%	21. 4
Sand	%	59. 4
Atterberg's Limit		
Liquid limit		36. 1
Plastic limit		18. 3
Plastic Index		
Group		CL,
Base exchange capacity meg/ 100 gm of clay		24.6
clay mineral present		Illite

Table 2

Compressive Strength kg/cm²	Water Absorption (%)	Production on Quality (%)
Above 150	12—14	20—25
100 —150	12—15	45—50
50 =100	13—16	15—20
below 50	15—18	8—10

Initiation of Fire and Burning of Bricks

To initiate fire wood is burnt in the very first line to enable the next fire line to attain temperature upto 900°C when rice husk feeding in small quantities is started. About 15-20 quintals of dry firewood is required to initiate the firing. For the proper combustion of rice husk and to avoid the formation of black charcoal sometimes wooden chips or saw dust is fed into the kiln after alternate 2 to 3 feeds of rice husk.

Firing Details

Fire wood was fed in wood feeding line which was repeated after feeding two lines of the setting with rice husk. The usual firing temperature 1000 to 1020°C was achieved. This temperature was retained for 3-4 hours. No charcoal formation was observed. The trtal firing time for firing 15, 000 bricks was 72 hours and the fuel consumption for firing 15,000 bricks was 3 tonnes of fire wood and 4 tonnes of rice husk.

Quality of Bricks

The bricks so manufactured from alluvial soil were sampled as prescribed in IS: 1077-1970 and tested according to IS:3495-1976 for compressive strength and water absorption . The bricks so obtained were also classified IS 2691-1972 and the results so obtained are given in Table 2 .

Cost of firing of bricks in small scale brick kiln

The cost of firing of bricks in small scale brick kiln is given in Table 3 which is subject to local prevailing rates during 1980 and avilability of fire wood and rice husk.

Table 3

(i) Fire wood 3 tonnes @ Rs. 300/T	Rs.600.00
(ii) Rice husk 4 tonnes @ Rs. 40/T	Rs.160.00
(iii) Labour 20 m.d. @ Rs. 6/m.d.	Rs.120.00
	Rs.1180.00

for 15, 000 bricks

Cost of firing = Rs.78.66 per 1000 bricks

Use of rice husk as fuel in Bull's trench kiln for commercial production:

i) Partial substitution of coal with rice husk

To save the consumption of coal in burning the bricks rice husk/, alongwith fire wood and coal was employed as fuel in the kiln. Rice husk and coal were separately fed in alternate feeding holes of the same fire line excepting the two end holes wherein fire wood was fed. This pattern of feeding the fuel during firing was followed in the entire setting of the bricks in the kiln. The mode of feeding the rice husk in the feed holes is as depicted in photograph. Conventional pattern for setting the bricks in the kiln was followed excepting the two end holes of the settings were enlarged for feeding fire wood. No difficulty was observed by the fireman in feeding these fuels in the kiln. The normal firing temperature of 1000 to 1020°c was obtained in the kiln. The soaking period of 4-5 hours at the maturing temperature was maintained during firing of the bricks in the kiln.

The fuel consumption per lakh of bricks and the cost of firing is given in Table 4. Again these data are based on field trial conducted over a commercial kiln in 1980 as mentioned earlier.

Table 4

(A) When only coal and fire wood was used:

i) Coal 10.5 tonnes @ Rs.650/T	=Rs. 6825.00
ii) Fire wood 15.5 tonnes@Rs.300/T	=Rs. 4650.00
iii) Labour	Rs. 300.00
Total cost of firing per lakh bricks	Rs.11,775.00

Cost of firing=Rs. 117/75 per 1000 bricks

(B) When rice husk was used alongwith coal and fire wood :

i) Coal 7 Tonnes @ Rs. 650/T	= Rs. 4550.00
ii) Fire wood 12 tonnes @ Rs.300/T	= Rs. 3600.00

Fig No. 7. Feeding of rice husk in Bull's trench kiln for commercial production.

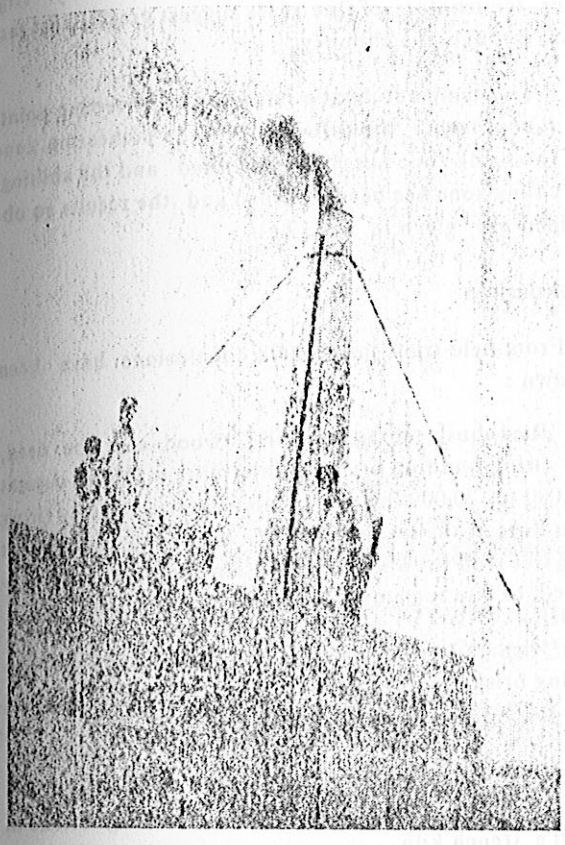
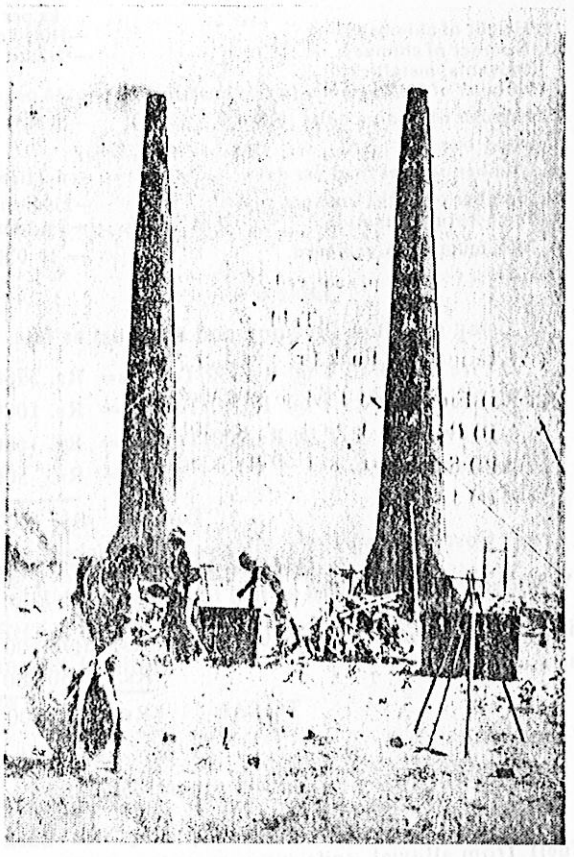


Fig No. 8. Use of rice husk as fuel for firing bricks in small scale.



iii) Rice husk 12 T @ Rs. 40/T	= Rs. 480.00
iv) Labour	= Rs. 500.00
Total cost of firing per lakh of bricks	= Rs. 9130.00
Cost of firing	= Rs. 91/30 per 1000 bricks

About 30% saving in coal was observed dy using rice husk.

Use of rice husk, fire wood and saw dust exclusively for firing in Bull's trench kiln

Field trials were conducted in the commercial Bull's trench kiln, where rice husk, fire wood and saw dust were used as fuel. The details of the kiln and setting pattern adopted are shown in Table 5, and Fig. which is the same as was adopted in case of small capacity intermittent kiln.

At the initial stages, firewood was fed to the first fire line and when the temperature of the next forward line attained 900 ± 20°C rice husk feeding in the line was started. In this way, subsequent firing in the kiln was continued wherein fire wood was repeatedly used as a fuel after every two lines of brick setting being fired with rice husk and saw dust. It was found that the use of saw dust alongwith rice husk helps in burning fo rice husk in the kiln. The maturing firing temperature of bricks 1000 to 1020°C was attained. This temperature was maintained for soaking for 3—4 hours.

The fuel consumption as observed for firing per lakh bricks at the kiln is given in Table 6.

Table 5

Observations made on commercial setting and firing of bricks in Bull's kiln

1. Number of columns in one line	=26 Nos
2. Number of courses in one line	— 19 Nos
3. Number of bricks in one line	— 3350
4. Distance between two columns	— 10 cm
4. Length of one fire line	8.80 metres
6. Distance between two fire lines	— 75 cms

7. Number of chambers in the kiln	— 25 Nos
8. Depth of the kiln	— 2.15 metres
9. Overall length of kiln	—162.4 metres
10. Width of the trench	— 8.80 metres
11. Capacity of the kiln	— 7 lakhs bricks per round
12. Height of chimney	—10.50 metres
13. Number of chimney (movable, metallic)	—2 Nos
14. Number of feeding holes in rice husk line	—14 nos
15. Number of feeding holes in fire wood line	— 9 Nos
16. Number of lines fired per day	— 6-7 lines
17. Number of bricks fired per day	—2500 bricks
18. Temperature retention	—3-4 hours
19. Maximum temp. achieved	— 10 0 ± 20°C

Table 6

(A) Using rice husk firewood and saw dust as fuel

i) Fire wood 13 T @ Rs.300/Tonnes =	Rs. 3900.00
ii) Rice husk 25 T @ Rs.40/Tonnes =	Rs. 1000.00
iii) Saw dust 8 T @ Rs.200/Tonnes =	Rs. 1600.00
iv) Labour =	Rs. 500.00
Total	Rs. 7000.00

Cost of firing = Rs. 70/- per 1000 bricks

When only coal was used as fuel in Bull's trench kiln

i) Coal 18 Tonnes @ Rs.650/T =	Rs. 11,700.00
ii) Labour	Rs. 300 00
TOTAL	Rs. 12,000.00

per lakh bricks

Cost of firing = Rs. 120/- per 1000 bricks

The bricks manufactured (on using rice husk as fuel) from alluvial soils were tested according to IS: 3495 1976 for compressive strength and water absorption. The product manufactured was classified and the test results obtained are given in the Table 7.

Table-7

Compressive Strength kg/cm²	Water Absorption (%)	Quality produced (%)
Above 150	12-14	15-20
100-150	12-15	60-65
50-100	13-16	10-15
below 50	16-20	5-7

Distance and Time temperature curve

One feeding hole was chosen in preheating zone and temperature was recorded with thermocouple after every two hours at a depth of 1.50 metres from the top and at a distance of O.75 metre from the inner wall of the kiln. This temperature was recorded for a total period of 60 hours. The time temperature curve so obtained is given in Fig. 1. Similarly the flue gas temperature at the base of the chimeny from preheating to firing zone and the results so obtained are given in Fig. 3. This indicates that flue gas temperature increases as the firing zone approaches the chimney. Higher temperature of flue gases suggest greater heat losses through the chimney.

The temperature at a reference brick setting point as it approaches the distance from the preheating zone to the firing zone has been recorded and the shifting to coling zone has been recorded and the results so obtained are given in Fig. 2.

Conclusions

From field trials three, main conclusions have been drawn :

1. Rice husk alongwith fire wood can be used, for firing building bricks in intermittent kiln of capacity 15,000 to 20,000 bricks. It can be carried out by firing two lines of the setting with rice husk and subsequent one line with firewood This pattern was repeatedly followed to fire remaining bricks in the kiln setting.

2. Rice husk alongwith coal can be used as a fuel for firing bricks in the commercial brick kilns. A saving up to 25-30% of coal can be achieved.

3. Alternative to coal, rice husk alongwith firewood and saw dust can also be utilised for firing bricks in Bull's trench kiln.

4. In the rice growing areas, the use of rice husk as a fuel for firing building bricks can be economically adopted as a substitute of coal.

Acknowledgement

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