Agricultural Wastes as Fuel for Kiln Firing

By

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1.0 Introduction

1.1 The clay products industry has been experiencing acute shortage of fuel for firing kilns over the past several years. The situation has become particularly desperate in the clay building materials industry which meets the entire country's requirement of bricks, tiles and similar materials. This sector of the industry receives the lowest priority in the movement of coal by rail so that the industry receives coal in a thin trickle. The purchasers have practically no choice in the matter of selection of the grade of coal required by them and they have to accept whatever coal is supplied by the coal mines authority.

1.2 The position regarding availability of firewood is equally bad. Except in forest areas, firewood is either not available or is available at uneconomical rates. This has resulted in many woodfired roofing tile kilns changing over to coal wherever possible.

1.3 Under the circumstances, the industry is seriously considering using alternative fuels. Use of fuel oil is at once ruled out by its high cost. In some regions, viz. Tamil Nadu & Gujarat, firing of brick kilns by lignite has been adopted despite the fact that lignite contains a large quantity of moisture and its calorific value is only 50-60% of bituminous coal. The availability of large quantities of agricultural wastes such as rice-husk (about 20 million tonnes) is now being explored as a possible fuel for brick and tile burning. Similarly in some regions, groundnut shells (e.g. Gujarat) and cashewnut shells (e.g. Karnataka and Kerala) are available as agro-waste and can be used as alternative fuels. Saw dust though not an agro-waste, has already found limited use in brick burning, wherever it is available as a waste product saw mills.

2.0 Technical problems in using Agro-wastes as Fuels.

2.1 The main technical problems that arise in using the agricultural wastes mentioned in 1.3 are summarised below:—

— large bulk of the materials like rice husk. This leads to problems in transport, handling and storage of the materials. Preferably the husk should be stored in a covered space as wet husk is difficult to feed and does not burn properly. Tubs of much large capacities compared to present coal tubs will have to be placed on top of brick kilns for storing rice husk, etc. Against the average calorific value of 6,000 K.Cal/kg of slack coal, the calorific value of rice husk and similar agro-wastes is around 300 K Cal/kg. Hence, if used alone, nearly double the quantity of the fuel will have to be handled and fed into the kiln to reach the usual burning temperature of 950-1,000°C.

— Rice husk and most other agro-wastes produce only short flames which die out soon after feeding into the kiln. This is a serious disadvantage.

— As the transfer of heat to bricks or tiles in a kiln takes place principally by convection, production of short flames reduces the rate of rise of temperature of the brick or tile body. Again, after the volatile matter has burnt out the combustion of the residual fuel takes place at a slower rate than coal or firewood. Thus heat transfer is not sustained at a uniform rate. Particular difficulty is experienced in subjecting the goods to soaking heat at the maximum temperature for the required duration (usually 3-4 hours). As the temperature tends to fall too quickly in the cooling zone immediately behind the full fire zone, maintenance of the back up heat for preheating the incoming air becomes difficult.

— Rice husk contains about 15% ash. As large quantities of husk must be fed, the ash collecting within the brick setting tends to

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choke trace holes and thus restricts ingress of air required for combustion.

— To ensure proper combustion of the husk and uniform distribution of heat in the kiln chamber some changes in the pattern of setting becomes necessary.

3.0 Use of Agro-Wastes in Clay Processing.

3.1 The combustion energy of Agro-wastes can also be utilised in brick burning by mixing it with clay during processing. Although this method leads to fuel economy, the bricks become highly porous and the crushing strength is also substantially reduced. Therefore, rick husk or saw dust can be mixed with highly plastic clays only in small amounts.

4.0 Firing of Conventional Kilns with Agro-Wastes.

4.1 A type of intermittent brick kiln, already in comercial use in Andhra and Tamil Nadu consists of an archless rectangular chamber with a capacity of 15,000 bricks per charge. Two grates are provided for burning rice husk and on the wall opposite the grates two exhaust flues are provided at the kiln floor level which joins together externally to form a single flue leading to a brick chimney of about 8.0 mm height.

4.2 Bricks are set in the kiln chamber to form two continuous passages between the grates and the exhaust flues, built upto the height of the grates. Above this height, bricks are set in the manner similar to that followed in the Allahabad kilns. The chamber is closed at the top by placing bricks on flat covered over with a layer of ash.

4.3 The front wall into which the grates are built, is recessed and the recessed space is utilised for storing some quantity of rice husk. Two square holes are built through this wall for feeding rice husk directly to the grate. The grate is a flat iron sheet of about 2 mm thickness into which a large number of perforations are cut to provide access for primary air.

4.4 Rice husk fed to the grate burns vigorously for a few minutes. Draught produced by the chimney helps the flames to enter the chamber and the hot gases are distributed throughout the setting. However, the flames die down within 3-4 minutes and thereafter the charred husk burns rather slowly so that after a while charred ash is removed completely by putting out the sheet iron grates and a fresh charge of rice husk is fed when the grates have been replaced.

4.4.1 This process is continued till the bricks are heated to a red heat (about 850°C). Thereafter feeding of fuel is stopped and the kiln is allowed to cool down in about a week.

4.5 In such kilns the distribution of heat is rather uneven. Bricks in several top and bottom courses as also those set in the corners remain underburnt. Bricks set in the central part of the kiln are generally well burnt.

5.0 Development of an Experimental Kiln in CBRI.

5.1 An attempt has been made in this Institute to develop an intermittent/semi-continuous brick kiln fired exclusively with rice husk. The kiln has been designed for top feeding of rice husk in the same manner as coal is fed in Bull's trench kilns.

5.2 The experimental kiln consists of an archless rectangular chamber measuring 25×8×7-1/2 ft height. It has a capacity of 12,000 bricks. The chamber is connected to a 12 ft high metallic chimney placed on top of the end wall. A flue running through the end wall connects the chamber to the chimney.

5.3 Bricks are set in the kiln in the same manner as in the Bull's kiln. Some quantity of firewood is used for initiating the fire. Once the first brick blade has been fired to red heat, feeding of rice husk through the top feed holes is started. The fire gradually advances through the setting upto the last brick blade set close to the end wall.

5.3.1 The method of feeding of rice husk is similar to that of feeding coal except that feeding spoons used are of much larger capacity (by volume). During firing, the large volume of ash collecting below each feed hole is frequently stired with iron rods to ensure complete combustion. Most of the husk burns down to a white ash and little char is left. However, before feeding the husk, the kiln temperature must be above 800°C and a good draught provided, otherwise the husk has a tendency to char heavily.

5.4 In this kiln it has been possible to reach a temperature of about 950°C. The distribution of heat in the chamber was similar to that obtained in a coal fired Bull's kiln. Thus the overall efficiency of this kiln is likely to be higher than the kiln now being used by brick burners in Andhra and elsewhere. The improvement in firing are brought about primiarly by feeding controlled quantities of fuel from the top and allowing it to burn completely within the brick setting instead of burning it externally on grates.

6.0 Use of Cashewnut Shells in Tile Burning.

6.1 In Kerala, in some of the larger centres of tile manufacture, cashewnut shells are being used for firing Hoffmann Kilns. Like rice husk, this material also produced a short flame which dies out within a few minutes. In continuous kilns, the residual char also burns out completely. Normally a temperature of about 800°C is reached in the full fire zone which is considered sufficient for tile burning. This fuel is however more difficult to burn in intermittent kilns unless mixed coal or firewood.

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