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A CASE STUDY

A great opportunity in prospective management of rice husk

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ABSTRACT

India is a major rice producing country and the husk generated during milling is mostly used as a fuel in the boilers for processing paddy, producing energy through direct combustion or by gasification. Rice milling industry generates a lot of rice husk during milling of paddy which comes from the fields. About 20 million tones of rice husk ash is produced annually. Lots of ways are being thought of for disposing them by making commercial use of this RHA. A reliable and readily available energy supply is critical for economic development. Bringing renewable and sustainable energy supplies to areas of rural India can help people to escape from a cycle of poverty. During milling of paddy about 78 per cent of weight is received as rice, broken rice and bran. Rest 22 per cent of the weight of paddy is received as husk. This husk is used as fuel in the rice mills to generate steam for the parboiling process. This husk contains about 75 per cent organic volatile matter and the balance 25 per cent of the weight of this husk is converted into ash during the firing process, known as rice husk ash (RHA). This RHA in turn contains around 85 - 90 per cent amorphous silica. So for every 1000 kgs of paddy milled, about 220 kgs (22 %) of husk is produced and when this husk is burnt in the boilers, about 55 kgs (25%) of RHA is generated.

KEY WORDS : Technology upgradation, Energy, Power generation, Rice husks, Fluidized bed combustion

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Rice milling generates a by product known as husk (Fig.1) which surrounds the paddy grain. During milling of paddy about 78 per centof weight is received as rice, broken rice and bran .Rest 22 per cent of the weight of paddy is received as husk. This husk is used as fuel in the rice mills to generate steam for the parboiling process. This husk contains about 75 per cent organic volatile matter and the balance 25 per cent of the weight of this husk is converted into ash during the firing process, known as Rice Husk Ash (Fig.2). This RHA in turn contains around 85 per cent - 90 per cent amorphous silica.

Rice is major food grain for the people of the southern and some of the northern states in India, and also for the people of at least 15 other countries in the world. Production of rice/ paddy is associated with the production of essentially two byproducts, rice husk and rice bran. The term rice husk refers to the byproduct produced in the milling of paddy and forms 16-25 per cent by weight of the paddy processed. In the majority of rice producing countries much of the husk produced from the processing of rice is either burnt for heat or dumped as a waste. India alone produces around 120 million tones of rice/ paddy per year, giving around 24 million tones of rice husk per year. Farm income can be increased both directly and indirectly if economically profitable means of utilizing rice husk generated is utilized in industry. There are many reported uses of rice husk such as a fuel in brick kilns, in furnaces, in rice mills for parboiling process, in the raw material for the production of xylitol, furfural, ethanol, acetic

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Fig. 1 : Rice husk which provides the mills an abundant supply of raw materials for the production of rice bran oil. It is a good source of silica

Fig. 2 : Carbonized rice husk ash abbrevated as RHA will be obtained after burning the rusk husk and it is a major source of silica

acid, lignosulphonic acids, as an cleaning or polishing agent in metal and machine industry, in the manufacturing of building materials, etc. Despite having so many well established uses of rice husk, little portion of rice husk produced is utilized in a meaningful way, remaining part is allowed to burn in open piles or dumped as a solid waste or it is used as a cattle feeding. Farmers are getting very less prices for their harvested paddy.

After bagasse, rice husks are probably the largest mill-generated source of biomass available for energy use. As large quantities of rice husks are normally available at the rice mills there are no additional efforts or costs involved in the collection of this biomass for use as an energy source. Due to the availability of large quantities at any given location, rice husks can be put to use for comparatively larger energy applications, like generation of steam for process heating applications. In the northern parts of India, like in the states of Haryana and Punjab, due to the practice of dry milling of paddy rice, there is practically no captive consumption of husks within the rice mills. Thus, large quantities of rice husks are available for use as fuel.

In rice mills where the practice of boiling of paddy prior to milling is practiced, a part of rice husks generated is used in-house. Due to the demand for both the process steam and electricity at the same location, with the added advantage of in-house availability of the fuel, facilities for simultaneous generation of power and steam can be constructed.

A reliable and readily available energy supply is critical for economic development. Bringing renewable and sustainable energy supplies to areas of rural India can ensure we can help people escape from a cycle of poverty. Most India farmers are small holders with limited technology for processing and preserving food. Reliable energy systems are needed to power such technologies and at the same time create employment. This research will create a wealth of ecological and economic benefits along the entire biomass chain, and will offer valuable new research in an evolving industry,

Traditionally, part of the rice husk is used as an admixture in poultry feed and the balance is normally a disposal problem, in the absence of any market for the husk. Taking advantage of the lower cost of rice husks, small process industries located near the rice mills started using it as a fuel in their boilers to generate steam. Some of the units started pelletisation of rice husks for use as a substitute for firewood and coal at the household and small industry level, but pelletisation of rice husks, as practiced during those days, had its own set of problems and could not progress further. Such small-sector process industries use fixed, great fire-tube boilers with low capacity, which are manually fired, using coal as the fuel. Such combustion practices and boiler designs are primitive in nature and have built-in problems of partial fuel combustion and low efficiency. As husks were available virtually for free, the boiler efficiency and the degree of combustion were the issues receiving the least attention. Partial and uneven combustion of husks in the furnaces of the boilers also would lead to smoke emissions. The disposal of partially burned husks and ash also created environmental hazards. The development of compact, fluidized bed process steam boilers by the boiler manufacturers led to more efficient and environment-friendly utilization of this widely available bio-fuel resource. As a result, such process steam boilers are now widely used by even the comparatively larger process industries.

World scenario:

India is the world's second largest rice producer, followed by China. The utilization pattern of rice husk differs from

country to country but major end uses include fuel for rice mill furnace boilers, stoves, gasifiers etc. and briquetting. Countries in which rice husk is being utilized on large scale include China, Philippines, Thailand, Japan Italy Brazil, Korea, etc. China is the world leader in rice husk gasification technology. Other major countries where rice husk gasifiers have been developed include Thailand, Philippines, Japan, Indonesia and USA. Rice husk stoves (Fig.3) are being used in Indonesia, Thailand, and Philippines. Three types of stoves are being manufactured *i.e.* packed, natural draft and smouldering. Rice husk briquetting machines have been designed and commercialized in Japan, Switzerland, Thailand, USA etc. Briquetting machine based on 'Fred Hausmann' design is popular.

Fig. 3 : A super low cost blue flame rice husk gas stove, which provides households with an affordable clean-burning cooking device using rice husks as fuel

Indian scenario:

In India, paddy is milled at various levels *i.e.* hand pounding, small hullers, shellers, traditional rice mills and modern rice mills, in which traditional and modern rice mills accounts for about 44.85 and 65 per cent of paddy processed. The husk price varied from Rs. 300 -Rs. 800/t and is high in industrialized states/regions. The average husk price would be around Rs. 400/t. Major non-energy applications of rice husk include animal feed, filling of low lying lands, particle boards/chemical manufacture. Rice mills producing parboiled rice utilize 40-45 per cent of husk generated at mill itself for energy whereas mills producing raw rice sell 100 per cent of rice husk generated. Approximately 50 per cent of total rice produced in India is consumed as parboiled rice. Major R and D Organizations/institutes/private organizations are working in the field of development and commercialization of rice husk energy utilization systems.

Preferred options for India:

The preferred options in India for effective utilization of rice husk for energy in rural areas include:

Electricity generation from medium capacity rice husk gasifiers (50 kW capacity systems) especially in isolated villages where electricity from grid is not available.

Installation of rice husk based stirling engines/small gasifiers pumpsets (5 HP capacity), for irrigation purposes.

Promotion of rice husk briquetting units as a rural industry especially in industrialized rural areas where these briquettes could be used as fuel in boilers, brick kilns etc.

Installation of rice husk stoves in place of stoves utilizing wood /dung cakes as fuel, since these stoves have higher thermal efficiency and result in smokeless cooking.

Technology:

The technology of Fluidized Bed Combustion was earlier available only to large steam users. It was realized medium and small process steam users would find it just beneficial to have access to this technology. The result is the Fluidized Bed Combustion Boilers (Fig. 4) that have developed to cater to the economical and efficient technology needs saving crores of rupees every year. The Fluidized bed combustion technology can be employed as a versatile efficient means of utilizing the vast resource of rice for production of energy. A number of fluidized bed boilers

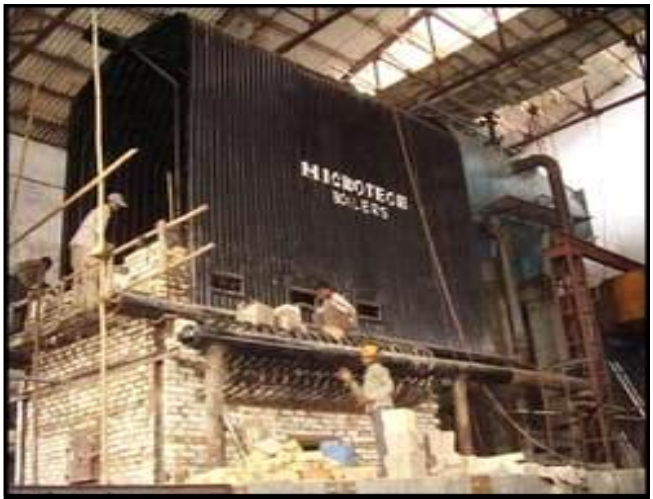

Fig. 4 : Fluidised-bed-boilers provides very high thermal and combustion efficiency upto 87 per cent and is suitable for agro waste like rice husk, groundnut shell, mustard husk, de-oiled

and combustors using rice-husk as fuel have been engineered for manufactured and installed applications like process steam for parboiling and oil extraction and hot gas generation for fertilizer industry. The combustion of rice husk in conventional method leads to very high burnt combustibles. This is mainly because of the nature of the fuel, in which carbon is trapped in carbon free white in colour and rich in silica. The white ash is also having a market value as a by – product. The rice husk fired fluidized bed boilers offer advantages like excellent combustion, quick start-up low pollution and simple operation and maintenance. Compared to a boiler efficiency of 55-60 per cent achievable with stepped grate furnace, the fluidized bed combustion technology offered will give a high efficiency of the order of 75-80 per cent, the other advantages are quick start-up, low pollution, simple operation and maintenance.

Applications of husk:

For energy related applications, rice husk is being utilized as a fuel for various applications *i.e.*

As a fuel in rice mill furnaces, especially in mills producing parboiled rice, energy is utilized for steam/hot water and hot air for dying. Inclined step grate type rice husk furnaces are in use at majority of installations although high efficiency cyclone/ suspension furnaces are being designed and developed. This is the largest single source of rice husk consumption for energy.

As a fuel in boilers for steam generation in rural based industries, generally Lancashir type boilers are in use, although trend is towards fluidized bed combustion boilers. This constitutes the second largest application of rice husk for energy.

As a fuel in rice husk gasifier, for generation of producer gas used for various applications such as electricity generation, running of diesel pump sets, furnaces etc. Down draft design of rice husk gasifier are popular.

Impacts:

The use of rice husks for process steam generation has the following benefits. It is a carbon-neutral and renewable source of energy, thereby reducing the emission of greenhouse gases.

Results in a reduction in emissions of sulfur and other pollutants associated with the use of fossil fuels, thereby improving local environmental conditions;

Results in an improvement in the efficiency of the husk-fired boilers, leading to its acceptability by the industry and other stakeholders as an acceptable practice, develops the local economy by creating a market for rice husks

Meets the thermal energy requirements of the process industry in a more cost-effective manner

Finally generates employment at the local level for collection and supply of rice husks.

Suggested action plans:

In order to promote rice husk utilization technologies for energy, greater awareness will have to be created in rural areas regarding their advantages through other options.

Promotion and demonstration of feasible rice husk energy utilization technologies in rural areas could be achieved through rural exhibition/ melas, T.V programmes, establishment of technology demonstration centres etc. DNES, NRDC etc. can play a vital role in technology promotion.

High cost of technologies / equipments has been one of the major hindrances in wide scale adoption of technologies in rural areas. It is recommended that low cost technologies/equipment should be developed by R and D institutions by way of usage of cheaper materials, design improvement etc.

It is recommended that capital subsidy of 30-40 per cent should be provided on biomass briquetting equipments as briquettes are renewable form of energy and helps in conservation of coal, in line with government policy of providing subsidies to biomass gasifiers, stoves, etc.

A few R and D areas have been identified with respect to rice husk energy utilization technologies of energy. Development of special alloy dyes for briquetting machines is necessary which can withstand highly abrasive nature of husk.

Rice husk gasifier based electricity generation systems (50kW capacity) are ideal for isolated rural areas. Since cost of these systems is high (50 kW system costs Rs. 7 lacs), these could be promoted by State Governments / State Electricity Boards. North Eastern States such as Assam, Arunachal Pradesh, Manipur, etc. offer lot of potential for such systems. These systems would lead to lots of benefits like employment generation, diesel oil savings etc.

Rice husk briquetting units would be a viable option for industrialized rural areas where briquettes could be used as boiler fuel in place of coal. Entrepreneurs could be encouraged by State Financial Institutions, State Industrial Development Corporations, District Industrial Centers etc., to establish such units in rural areas thereby generating employment. Loans on liberal terms could also be provided by financial institutions.

Conclusion:

A low-cost rice husk gas stove is convenient to use, almost similar to LPG stove. Almost no smoke is observed during operation. It can be considered an environment-friendly technology since it can address the problem of rice husk disposal and CO_2 emission is very minimal compared with the traditional direct combustion stoves. This facility will support the rural farmers and their families with a cheap, renewable and reliable energy source, which will allow the villages to create more income and get rid of the fuel poverty.

Training is very essential for effective dissemination of technologies and can be imparted to rural youth/people in technology demonstration cum training centres by representatives of technology/equipments suppliers. It is recommended that further in-depth studies should be initiated to identify appropriate rice husk energy utilization technologies for major regions (region wise) since feasibility of various identified technologies would vary from place to place, state to state and would depend on a number of factors, like husk prices, extent of industrialization in area, husk generation source in area etc.

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