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www.cenresin.org
ISSN 2277-0119

RICE HUSK AS A POTENTIAL SOURCE OF HIGH TECHNOLOGICAL RAW MATERIALS: A REVIEW

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ABSTRACT

The potentiality of rice husk as a good source of high technological materials is the subject of this research. Every year approximately 600 million tones of paddy are produced globally. This gives around 120 million tones of rice husk (RH) and 21 million tones of rice husk ash (RHA) annually. Major four uses of rice husk ash are in the steel, cement, refractory bricks and semiconductor industry. Besides these, it can be utilized in several other applications. In this literature review we have observed a preliminary analysis of the numerous reported utilization of rice husk. The use of rice husk for electricity generation in efficient manner is likely to transform this agricultural waste into a valuable fuel for industries and thus might help in boosting the farm economy and rural development and at the same time, waste disposal of rice husk is addressed while generation of employment will become possible as amorphous silica production from rice husks ashes will be formalized.

Keywords: rice husk, rice husk ash, industrial utilization, temperature, economic savings.

INTRODUCTION

Rice is grow on every continent except Antarctica and covers 1% of the earth's surface. It is a primary source of food for billions of people, and ranks second to wheat in terms of area and production (FAO, 2002).Production of rice paddy is associated with the production of essentially two byproducts, rice husk and rice bran.Husk, also called hulls, consists of the outer shell covering the rice kernel. As generally used, the term rice husk refers to the byproduct produced in the milling of paddy and forms 16-25% by weight of the paddy processed. In the majority of rice producing countries much of the husk produced from the processing of rice in either burnt for heat or dumped as a waste. Globally approximately 600 million tones of rice paddy are produced each year, giving an annual that production of 120 million tones of rice husk, which on the average is 20% of the rice paddy. Farm income can be increased both directly and indirectly if economically profitable means of utilizing rice husk generated are utilized in industries. The treatment of rice husk as a ◌resource◌ for energy production is a departure from the perception that husks present disposal problems. The concept of generating energy from rice husk has great potential, particularly in those countries that are primarily dependent on imported oil for their energy needs. Rice husks are one of the largest readily available but most underutilized biomass resources, being an ideal fuel for electricity generation. Rice husk ash is a general term describing all types of ash produced from burning rice husks. 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 furfural, sodium silicate, Briquettes molecular sieves (Tejinder, 2000). 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 paddy harvested. Many reasons associated with rice husk for not being utilized effectively (Gidde et al, 2007) include: (1) lack of awareness of it potential to a farmer and industry persons, (2) insufficient information about proper use , (3) socio-economic problems, (4) penetration of technology, (5) lack of interest, (6) lack of environmental concerns, (7) inefficiency of information transfer etc

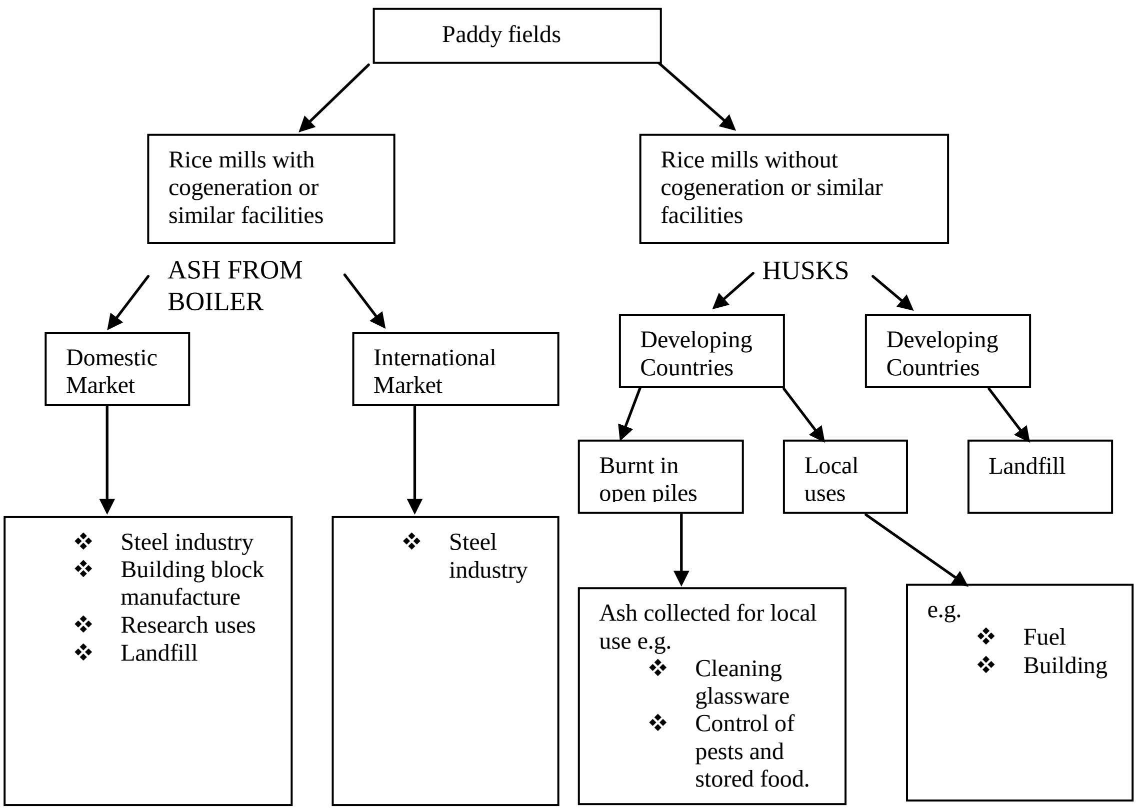

FIG.: Flowchart showing movements of rice husk and ash under two scenarios- mills with cogeneration or similar facilities, and mills without.

POTENTIAL AND CURRENT USES OF RHA

Suitability of RHA mainly depends upon the chemical composition of ash, predominantly silica content in it. Silica content and its mineralogical structure depend upon the combustion time, temperature and turbulence during combustion (Gidde et al., 2007).The chemical properties of ash arising from rice husks are thought to vary from region. The differences have been attributed to the conditions under which the paddy is grown such as climate, soil and use of fertilizers. There is very large potential for RHA containing mainly amorphous silica as a commercial product.

As a Tundish Powder in Steel Casting Industries

RHA is used by the steel industry in the production of high quality flat steel. Flat steel is a plate product or a hot rolled strip product, typically used for automotive body panels and domestic “white goods” products (The UK steel Association). It is produced by continuous casting, which has replaced the older ingot method. In continuous casting a ladle of steel, containing more than 200 tones of molten metal at 1650°C, empties into a tundish, a receptacle that holds the steel and controls its flow in the continuous process. From the tundish the steel passes in a controlled manner to a water cooled mould where the outer shell of the steel becomes solidified. The steel is drawn into a series of rolls and water sprays, which ensure that it is both rolled into shape and fully solidified at the same time (CORUS, 2002). It is in continuous casting that RHA plays a role. RHA is an excellent insulator, having low thermal conductivity, high melting point, low bulk density and high porosity. It is this insulating properly that makes it an excellent “tundish powder”. Tundish powders are used to insulate the tundish, prevent rapid cooling of the steel and ensure uniform solidification (Harold, 2002).

As an Active Pozzolan

Portland cement produces an excess of lime. Adding a pozzolan, such as RHA, combines with lime in the presence of water, results in a stable and more amorphous hydrate (Calcium Silicate). It is stronger, less permeable and more resistant to chemical attack (Chaiyanena, 1992). The potential for good but inexpensive housing in developing countries is especially great. Studies have been carried out all over the world, such as in Nigeria, Kenya, Indonesia, and Guyana on the use of low cost building blocks (Oyetola et al., RHA Market Study, 2003). Ordinary Portland Cement (OPC) is expensive and unaffordable to produce low strength concrete block. Generally around 7Mpa strength is achieved at 14 days with mix proportion of 20:80 ratio of lime: RHA as binder. A study showed that replacing 50% of Portland cement with RHA was effective and the resultant concrete cost 25% less (Tuts, 1994).

After vehicle and utility emissions cement manufacturing is the largest industrial producer of CO_2 and accounts for over 50% of all industrial CO_2 emissions; for every ton of cement produced 1 to 1.25 tons of CO_2 are produced (Muga et al., 2005). The potential economic savings (U.S.dollars) and reduction of CO_2 emissions(tons) if rice husk ash is utilized on a global basis in the construction of either spring - boxes or gravity fed water systems for the 1billion people world wide that do not have access to safe drinking water, $141 to $451 million could be saved while the total anthropogenic CO_2 emissions could decrease from 0.95 million to 3.8 million tons if rice husk ash were substituted for Portland Cement at a 25% level (Muga et al., 2005).

Manufacturing Refractory Bricks

One of the potentially major profitable uses of RHA is in the in the manufacture of refractory bricks (Adylov, et al., 2005) .Due to the insulating properties, RHA has been used in the manufacture of refractory bricks. RHA Market Study). Refractory bricks are used in furnaces which are exposed to extreme temperatures, such an in blast furnaces used for producing molten iron and in the production of cement clinker. Bricks from RHA were reported to be good heat insulators up to extreme temperatures, such as 1450°C, and have a low thermal conductivity of about 0.3Kcal/m hr °C and good resistance to compression. Such bricks normally contain 80-98% ash and 2-20% CaO+MgO (Gidde et al., 2007).

Silicon Chips

The first step in semiconductor manufacture is the production of a wafer, a thin round slice of semiconductor material, which is usually silicon. Purified polycrystalline silicon (traditionally created from sand) is heated to a molten liquid and a small piece of silicon seed placed in the molten liquid. As the seed is from the melt the liquid cools to form a single crystal ingot which is then grand and sliced to form wafers that form the starting material for manufacturing integrated circuits (RHA Market Study, 2003).Silicon dioxide though naturally generated from sand is extracted after a fusion of high temperature whose procedure requires energy and investment intensive driving the cost of silica higher. It is therefore worthwhile extracting purer silica from rice husk ash with minimal cost which also contributes to the practice of waste management engineering (Omatola, 2009).
The Indian Space Research Organization has successfully developed technology for producing high purity precipitated silica from RHA that has a potential use in the computer industry. A Consortium of American and Brazilian Scientists have also developed ways to extract and purify silicon with the aim of using it in semiconductor manufacture (Science News, 1994). A company in Michigan is purifying RHA into silica for silicon chip manufacture.

Adsorbent for a Gold-Thiourea Complex.

Gold is often in nature as a compound with other elements. One way it is extracted is to leach it by pumping suitable fluids through the gold bearing strata. RHA produced by heating rice husks at 300°C has been shown to adsorb more gold – thiourea than the conventional used activated carbon (RHA Market Study, 2003).

Vulcanizing Rubber

White RHA can be used as filler for natural rubber compounds (Siriwandena et al., 2001). White RHA increases mechanical properties such as, tensile strength, tear strength, resilience and hardness, if used as a partial replacement of silica as a bonding agent.

Soil Ameliorant

There are reports of RHA being used as a soil ameliorant to help break up clay soils and improve soil structure (Confidential Report, 1998).Its porous nature also assists with water distribution in the soil. Research in USA has also been carried out on using it as a potting substrate for bedding plants .It has also been found to increase the pH of the soil, so was recommended for use with plants that require alkaline soil.

Production of Asphalt

Rice husk ash and palm oil fiber have been used as filler for stone mastic asphalt. The physical characteristics of stone asphalt with rice husk ash and palm oil fiber were favorable for surfacing in road construction. The result of asphalt with RHA and palm oil fiber as filler and binder passed standard specifications (Jeffrey et al., 2002).

Other Uses

* in the manufacture of roof tiles
* as a free running agent for fire extinguishing powder

* an abrasive filler for tooth paste
* a component of fire proof materials and insulation
* as a beer clarifier
* extender filler for paint
* production of sodium silicate films
* control of insect pests in stored food stuffs
*as a water purifier
*as a release agent in the ceramics industry
*economic substitute for microsilica /silica fumes
*as repellents in the form of "vinegar-tar"
*as fillers for board protection
*land filling

CONCLUSION

Rice husk has so many well established uses. It is a waste where large quantity is generated, especially in Asian countries. RHA as mentioned has good market value. Developing countries should not only install power plant to generate electricity but a very high quality RHA as well that will further increase the financial benefits and help to improve farm economy indirectly making rice husk a usefully disposal waste.

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