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AGRO WASTE: OPPORTUNITIES FOR DEVELOPMENT OF VALUE ADDED CIVIL ENGINEERING PRODUCTS

Karm P. Balar[1], Paresh S. Mistri[2], Hiren A. Rathod[3]
PG. Student, Civil Engineering, S.N.P.I.T & R.C, Umrakh, Bardoli, Gujarat, India [1]
PG. Student, Civil Engineering, S.N.P.I.T & R.C, Umrakh, Bardoli, Gujarat, India [2]
Assistant Professor, Civil Engineering, S.N.P.I.T & R.C, Umrakh, Bardoli, Gujarat, India[3]

Abstract*: This exploration work is an effort to try to develop the awareness & importance of industrial waste management & its utilization in productive manner in construction industry. In today's more environmentally-Conscious world, a more responsible approach to the environment is to increase the use of by-products of one industry which is disposed of as waste as raw material for some other industry. Traditionally materials like clay, sand, stone, gravels, cement, brick, block, tiles, etc. are being used as major building materials in construction sector. All these materials have been produced from the existing natural resources and will have intrinsic distinctiveness for damaging the environment due to their continuous exploitation and increasing cost incrementally. Hence it is essential to find functional substitutes for conventional building materials in the construction industry. For above purpose the exploration study is carried out for determining the scope of utilization of rice husk, jute fiber and coconut fiber (agriculture industry), in construction industry. All these wastes prove the slogans true that are "refuse to resource" & "wastes to wealth". In our country annually huge quantities of wastes are produced by the industries. Instead of disposing-off these wastes if they are utilized in such a manner then it will provide an eco-friendly solution, simultaneously solving the problem of pollution and raising the step towards economy & obviously towards progress of the nation.
***Keywords*: spent wash, distillery waste, fiber, agro waste**

I. INTRODUCTION

This exploration work is an effort to try to develop the awareness & importance of agro waste management & its utilization in productive manner in construction industry. Traditionally materials like clay, sand, stone, gravels, cement, brick, block, tiles, etc. are being used as major building materials in construction sector.

Hence it is essential to find functional substitutes for conventional building materials in the construction industry. For above purpose the exploration study is carried out for determining the scope of utilization of Coir fibre (Coir industry), Rice husk (Rice mill), Ground nut hulls (Oil mills), Jute fibre (Jute mills), Cotton waste (Textile mills), Bagasse (Sugar mills), Corn cobs (Corn mill), Sisal fibre (Sisal plant), Rice straw &Wheat straw (Farms), Banana fibre (Banana plant), spent wash (alcohol procedure) in construction industry.

1.1 WHAT IS AGRO-WASTE?

There are so many sources from which waste can be produced. Some are very important waste from different sources are consider as below…

1. **Animal Waste**
    - Manure
    - Animal Carcasses
    - Pesticides, Insecticides,
    - Herbicides, etc.
2. **Hazardous & Toxic Waste**
    - Pesticides
    - Insecticides
    - Herbicides, etc.
3. **Food Processing Waste**
    - Increased production of processed food
    - Maize: only 20% caned 80% is waste
    - Crop Waste
    - Coms talks
    - Sugarcane
    - Bagasse
    - Drops and culls from Fruit & Vegetables Pruning
4. **Agricultural waste**
    - Rice husk
    - Spent wash
    - Coir fibre
    - Jute fibre
    - Corn cobs
    - Ground nut hull
    - sisal fiber
    - Cotton waste

II. DETAILS OF AGRICULTURAL WASTES

2.1 RICE HUSK ASH

Use of rice husk ash in embankment is also important option which requires due exploration. Use of waste material like Rice husk ash, as substitute road construction material is required, not only for economical consideration but for environmental consideration also. Rice husk is a major agricultural by product obtained from the food crop of paddy. It contains 16 to 18 % pure silica by weight and on burning the rice husk yields 20-25% ash with more than 90% silica. About 35 million ton of paddy is produced in India, which yields more than7 million ton of rice husk annually. One ton of rice husk, on completion of combustion, produces 200 kg of ash.

Global production of rice is approximately 580 million tons a year, and this is rising as the world population and the consumption of rice increases. Table 1 shows the most rice-growing countries in the world and the potential husk and ash production. The milling of rice produces rice husk, which is a waste material. Rice husk is generated on average at a 20%

rate by weight of the rice that is processed. Most of the husk is burned or dumped as waste. The burning of the husks produces ash at an average of 18% by weight of the husks. Prior to 1970, RHA was usually produced by uncontrolled combustion, and the ash so produced was generally crystalline and had poor Pozzolanic properties. In 1973, Mehta published the first of several papers describing the effect of preprocessing parameters on the Pozzolanic reactivity of RHA (Bouzoubaa, 2001). Rice husks are also a good source of fuel to produce power. Each MW hour of electricity produced requires 1.5 – 2.0 tons of rice husks giving a cost of 2-3 cents per kWhr.

The annual production of rice around the world generates about 116 million tons of rice husks. The estimated energy content of husks is 13.5GJ/tonne giving a global energy potential of 1.57 billion GJ/year. At a cost of US$5/GJ this will have an annual value of US$7.8 billion, which is equivalent to over 1 billion barrels of oil per year. In the USA the following three power plants use rice husk as fuel: A 10.5 MW and a 1.5 MW Agrilectric Power plant at Lake Charles, Louisiana in service since 1984 and 1995 respectively. A 28.7 MW United America Energy Corporation plant at Williams, California. Also, there are two plants in Thailand, at Nakorn Ratchasima, 2.5 NW capacity, and in Pathumthani, 1.5 MW capacity. Recognizing that the potential for using the renewable resource of rice husk, three 22 MW production plants are being set up in Central Thailand in the period 2004-2005 by a Bangkok-based company, A.T. Biopower Co. Limited, at three of the following locations: Nakorn Pathorn, Nakorn Sawa, Pichit, and Singburi.

2.1.1 SCENARIO

TABLE: - 1 RICE PADDY, AND POTENTIAL HUSK AND ASH PRODUCTION IN THE 20 HIGHEST PRODUCING COUNTRIES 2010

Country	Rice, Paddy Production in 2002 (t)	Percentage of Total Paddy Production%	Husk Produced (20%of	Potential Ash Production (18% of husk) (t)
China	17,75,89,000	30.7	3,55,17,800	63,93,204
India	12,30,00,000	21.2	2,46,00,000	44,28,000
Indonesia	4,86,54,048	8.4	97,30,810	17,51,546
Bangladesh	3,90,00,000	6.7	78,00,000	14,04,000
Viet Nam	3,13,19,000	5.4	62,63,800	11,27,484
Thailand	2,70,00,000	4.7	54,00,000	9,72,000
Myanmar	2,12,00,000	3.7	42,40,000	7,63,200
Philippines	1,26,84,800	2.2	25,36,960	4,56,653
Brazil	1,04,89,400	1.8	20,97,880	3,77,618
USA	96,16,750	1.7	19,23,350	3,46,203
Korea	74,29,000	1.3	14,85,800	2,67,444
Pakistan	57,76,000	1	11,55,200	2,07,936
Egypt	57,00,000	1	11,40,000	2,05,200
Nepal	47,50,000	0.8	9,50,000	1,71,000
Cambodia	40,99,016	0.7	8,19,803	1,47,565
Nigeria	33,67,000	0.6	6,73,400	1,21,212
Rest of the	2,90,91,358	5	58,18,272	10,47,289
Total(World)	57,94,76,722	100	11,58,95,344	2,08,61,162

2.1.2 APPLICATION OF RICE HUSK ASH

- Green concrete
- High performance concrete
- Insulator
- Waterproofing chemicals
- Oil spill absorbent

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- Specialty paints

2.1.3 ADVANTAGES OF RICE HUSK ASH

- Considerable reduction in alkali-silica and sulfate expansions.
- Higher frost resistance of non-air entrained RHA concrete compared to similar mixtures of silica fume concrete.
- Higher compressive strength.

2.2 COCONUT COIR

Coconut Coir is a lingo-cellulosic natural fiber. It is a seed-hair fiber obtained from the outer shell, or husk, of the coconut, the fruit of Cocos-nucifera. The coarse, stiff, reddish brown fiber is made up of smaller threads, each about 0.03 to 0.1 cm long and 12 to 24 micro meter in diameter; coir is composed of lignin, a woody plant substance, and cellulose.

The individual fiber cells are narrow and hollow, with thick walls made of cellulose. Mature brown coir fibers contain more lignin and less cellulose than fibers such as flax and cotton and are thus stronger but less flexible. The coir fiber is relatively waterproof and is the only natural fiber resistant to damage by salt water. The fibrous layer of the fruit is separated from the hard shell manually by driving the fruit down onto a spike to split it (de- husking).

2.2.1 Manufacturing process

Harvesting and husking

- Coconuts that have ripened and fallen from the tree may simply be picked up off the outer layers covering the coconut seed are processed and spun into fibers commonly known as coir.
- The ground Coconuts still clinging to the 40-100 ft. (12-30 m) tall trees are harvested by human climbers. If the climber picks the fruit by hand, he can harvest fruits from about 25 trees in a day.
- If the climber uses a bamboo pole with a knife attached to the end to reach through the treetop vegetation and cut selected coconuts loose, he can harvest 250 trees per day.
- (A third harvesting technique, in which trained monkeys climb trees to pick ripe coconuts, is used only in countries that produce little commercial coir.)
- Ripe coconuts are husked immediately, but unripe coconuts may be seasoned for a month by spreading them in a single layer on the ground and keeping them dry. To remove the fruit from the seed, the coconut is impaled on a steel-tipped spike to split the husk.
- The pulp layer is easily peeled off. A skilled husker can manually split and peel about 2,000 coconuts per day. Modern husking machines can process 2,000 coconuts per hour.

Retting

Retting is a curing process during which the husks are kept in an environment that encourages the action of naturally occurring microbes. This action partially decomposes the husk's pulp, allowing it to be separated into coir fibers and a residue called coir pith. Freshwater retting is used for fully ripe coconut husks, and saltwater retting is used for green husks.

2.3 SPENT WASH

India is a major producer of sugar in the world and contributes substantially to economic development. The by-products like bagasse and molasses of the sugar factories are also economically more important.

During the production of ethanol large quantity of waste water is discharged which is known as spent wash (effluent). So called discharge water (Spent wash) is supposed to contain plant nutrients and also heavy metals.

If such effluent water is discharged as such in the stream, may pollute the soil as well as potable water.

Besides, the sugar factory claim that the effluent is rich in nutrients and can also be used safely in agriculture as a source of liquid fertilizer. In fact effluent is dark coloured, acidic, high biochemical oxygen demand (BOD) and chemical oxygen demand (COD) liquid consisting of biodegradable organic and inorganic constituents.

Under such circumstances, it's a high time to find out the merits and demerits of such effluent under different types of soil nearby different sugar factories under study.

Approximately 400 KL of spent wash per annum is generated by over 250 distilleries in India. It was estimated that about 15 litres of spent wash is discharged for every litre of alcohol produced.

The contribution of distillery waste in India to organic pollution is approximately seven times more than the entire Indian population. No wonder distilleries are therefore considered as one of the most polluting industries in India.

Treatment and safe disposal of spent wash has been a challenge for a long time.

2.3.1 CHARACTERISTICS OF WASTE

Spent wash, as it leaves the distillation unit will have a temperature of about **90**˚ C with a smell of burnt Sugar. The color of the spent wash is somewhat reddish brown to dark brown.

Spent wash is highly acidic with a pH between **3.5** and **4.5**. It contains high percentage of dissolved inorganic and organic matter, the latter being particularly responsible for high BOD and polluting nature of the waste.

Spent wash of Indian distilleries also contain higher amount of potash as compared to those from other distilleries abroad. In general potash content ranges from **7** to **15%** of the total solids. Characteristics of spent wash are given below

2.3.2 ADVANTAGE

- Distillery spent wash is a rich source of organic matter and nutrients like nitrogen, phosphorus, potassium, calcium and sulphur. In addition, it contains sufficient amount of micro-nutrients such as iron, zinc, copper, manganese, boron, and molybdenum.
- The effective use of spent wash in different proportions on the Agricultural land has been considered for the performance evaluation.
- It will also use for strengthening of brick work and R.C.C structure.

2.3.3 DIS ADVANTAGE

- Smell of spent wash like a spirit.
- It is dangerous for human, land, and water also, so disposal of spent wash is a big issue for sugar factory.
- A spent wash is very harmful waste of sugar factory so it will convert in to distillery spent wash for further uses.

2.4 JUTE FIBER

Jute, sisal, banana, and coir the major sources of natural fibres, are grown in many parts of

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the world. Some of them have aspect ratios (ratio of length to diameter) > 1000 and can be woven easily. These fibres are extensively used for cordage, sacks, fishnets, matting and rope, and as filling for mattresses and cushions (e.g., rubberized coir). Cellulosic fibres are obtained from different parts of the plants. E.g., Jute is obtained from stem. The biodegradable and low priced jute products merge with the soil after using, providing nourishment to the soil. Being made of cellulose, on combustion, jute does not generate toxic gases.

Due to jute's low density combined with relatively stiff and strong behavior, the specific properties of jute fibre can compare to those of glass and some other fibres. Different geometries of these fibres, both singly and in combination with glass have been employed for fabrication of uni-axial, bi-axial and randomly oriented composites. Amongst these various lingo cellulosic fibres, jute contains a fairly high proportion of stiff natural cellulose.

The first jute mill In India was established in the year 1855. Today the Jute Industry is one of the major industries in the eastern region, particularly in West Bengal. It supports nearly 40 lakh farm families, provides direct employment to about 2.6 lakh industrial workers besides livelihood to another 1.4 lakh persons in the tertiary sector and allied activities. The production process in the jute industry goes through a variety of activities, which include cultivation of raw jute, processing of jute fibers, spinning, weaving, bleaching, dyeing, finishing and marketing of jute products. The jute industry produces goods worth Rs 6500 crore p.a. and contributes to export earnings to the tune of nearly Rs.
1200 crores p.a.

- Jute is the most common best fiber and is second only to cotton in terms of production.
- Jute is widely used for sacking and similar material.
- The species is native to the Mediterranean from where it spread throughout the near and Far East. The plants are herbaceous annuals.
- Jute fibers don't hold up too well because they are brittle.
- Today most jute comes from India, China, and Bangladesh.

2.4.1 APPLICATIONS OF JUTE FIBRE COMPOSITES

The use of natural fibres, derived from annually renewable resources, as reinforcing fibres in both thermoplastic and thermo set matrix composites provide positive environmental benefits with respect to ultimate disposability and raw material utilization. Over the last thirty years composite materials, plastics and ceramics have been the dominant emerging materials. The volume and number of applications of composite materials have grown steadily, penetrating and conquering new markets relentlessly. Modern composite materials constitute a significant proportion of the engineered materials market ranging from everyday products to sophisticated niche applications.

2.4.2 Classification of composites Matrix based

- Polymer Matrix Composites (PMC)
- Metal Matrix Composites (MMC)
- Ceramic Matrix Composites (CMC)

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