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Design and Fabrication of Pneumatically Operated Rice Husk Compacting Machine

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ABSTRACT: This project work deals with the design of pneumatically controlled small scale compressing machine to carry out compression operation, since Rice husk takes more space while transporting thus increases cost. Reduction in space in transportation and cost is being the main aim of this project work is obtained by modification in pneumatic design. Subsequently it results in reduction in amount of space requirement. And further the fabrication of the machine is developed on the basis of calculations with respect to compression force requirement.

KEYWORDS: Rice husk, Compressing Briquetting, pneumatics

I. INTRODUCTION

Rice husk:

The rice husk, also called rice hull, is the coating on a seed or grain of rice. It is formed from hard materials, including silica and lignin, to protect the seed during the growing season. Each kg of milled white rice results in roughly 0.28 kg of rice husk as a by-product of rice production during milling.

Rice husks have been attracted as value added material towards waste utilization and cost reduction in domestic and industrial processing. Rice husk (RH) is widely available in rice producing countries like China and India which contributes 33% and 22% of global rice production respectively, as by-product of the rice milling. RH content ranges from 16-25% of paddy (Della et al., 2002; Giddel et al., 2007; Soltani et al., 2015). Every year approximately 500 million tonne paddy produced by world and 120 million tonnes of paddy produced by India, it gives around 24 million tonnes of RH per year (Shwetha et al., 2014). Rice husk ash (RHA) is the by-product of RH, when it burnt in ambient atmosphere.

20 million tonnes produced per year by world (Koteswara and Pranav, 2011; Soltani et al., 2015). Due to low density and less commercial interest of RH, handling as well as transportation it is problematic, which creates disposal and serious environmental problems (Pode, 2016).

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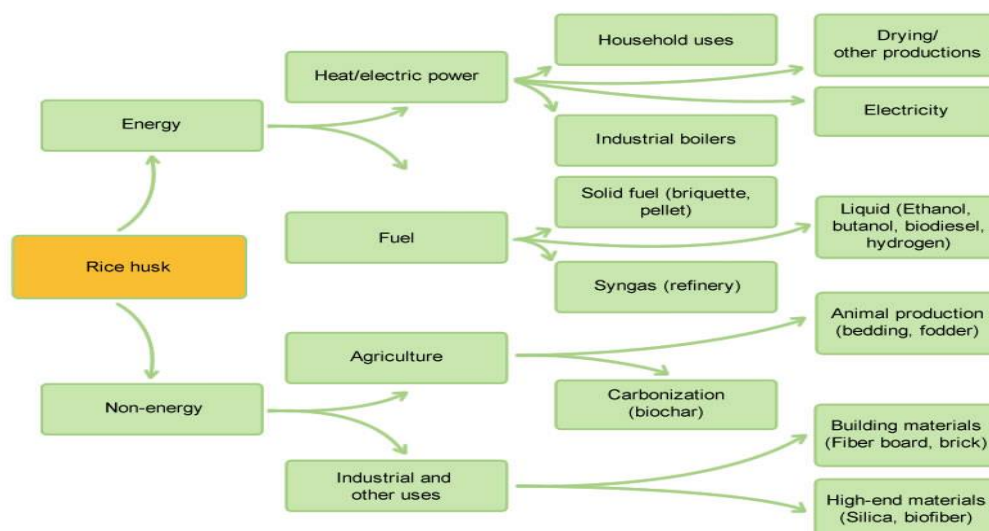
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(Fig 1) Rice husk produced in rice mill by separating the husk and rice

Utilization of the rice husk

Rice husk was long considered a waste from the rice milling process and was often dumped and/or burned. But because it can be easily collected and is cheap, some amount of rice husk has always been used as an energy source for small applications, such as for brick production, for steam engines and gasifiers used to power rice mills, and for generating heat for rice dryers. The high silica content of rice husk ash makes it a good additive for the steel and concrete industries. To a lesser degree, rice husk ash is used as soil conditioner, activated carbon, insulator, and others. More recently, creation of electrical power on a small to medium scale—up to 5 megawatts—has been piloted throughout Asia, with some promising approaches but also some demonstrated limits. Failure was mostly due to feedstock supply problems once the formerly free waste rice husk becomes a traded commodity and due to logistical problems and the high cost when transport distances become too large.



(Fig 2) Rice husk used in many industries the above diagram shows the rice husk uses

Briquetting:

Briquetting process is the conversion of agricultural waste into uniformly shaped briquettes that is easy to use, transport and store. The idea of briquetting is using materials that are not usable due to a lack of density, compressing them into a solid fuel of a convenient shape that can be burned like wood or charcoal. The briquettes have better physical and combustion characteristics than the initial waste. Briquettes will improve the combustion efficiency using

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the existing traditional furnaces. In addition to killing all insects and diseases as well as reducing the destructive fires risk in countryside.

Rice husk pellets and briquettes have a density of about 500 to 600 kg per cubic meter, 5 times that of their loose form. This increase in density leads to a reduction in transportation cost and increase in the performance of energy conversion processes. The advantages of using rice husk briquettes and pellets recently stimulate a fast growth of these business models in rice production.

The advantages of briquetting

- Get rid of insects
- Decrease the volume of waste
- Efficient solid fuel of high thermal value
- Low energy consumption for production
- Protect the environment
- Provide job opportunities
- Less risk hazardous



(Fig 3) Rice hush bricks after the compression/briquetting process

Pneumatics:

Pneumatics is a branch of engineering that makes use of gas or pressurized air. Pneumatic systems used in industry are commonly powered by compressed air or compressed inert gases. A centrally located and electrically powered compressor powers cylinders, air motors, and other pneumatic devices.

II. REQUIRED COMPONENTS

Double acting pneumatic cylinder:

A double acting pneumatic cylinder is one where the thrust, or output force, is developed in both extending and retracting directions. Double acting cylinders have a port at each end and move the piston forward and back by alternating the port that receives the high-pressure air, necessary when a load must be moved in both directions such as opening and closing a gate.

Double acting cylinders are typically used in all applications where the thrusts and stroke lengths required are in excess of those available from single acting cylinders.

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(Fig 4) Double acting cylinders used in the compression process

Directional control valves:

5/2-way valves are used to actuate double acting pneumatic actuators, such as cylinders, rod less cylinders, grippers and rotary actuators. Double acting actuators require compressed air to move in both directions. To decide whether a mono-stable or bi-stable 5/2-way valve should be applied, it is necessary to know more about the system's design and requirements.



(Fig 5) 5/2 pneumatic DC valve and hand lever used to control path of the air flow

Pneumatic pipes:

Specialized in manufacturing, exporting and supplying an assorted array of Pneumatic Pipes, we are recognized as a prominent firm in this domain. Available in different sizes and dimensions, these pipes are abundantly used for supplying fluid materials in industries through compressed air or by partial vacuum system. The offered pipes are manufactured as per defined international standards using superior quality raw materials and modern machinery. Moreover, these Pneumatic Pipes can be availed from us in standard as well as customized option as per clients specific need.

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(Fig 6) Pneumatic pipethrough which the air flows

Ms Square Fabrication Base:

Metal fabrication is the process of turning raw metals into pre-made shapes for assembly use. For example, the panels that comprise the frame of an automobile are made through custom metal fabrication processes, which are usually performed at a fabrication facility and then sent to an auto assembly plant.



(Fig 7) Ms Square Fabrication Base used to hold the entire load of the machine

Compressor:

A compressor can compress air to the required pressures. It can convert the mechanical energy from motors and engines into the potential energy in compressed air. A single central compressor can supply various pneumatic components with compressed air, which is transported through pipes from the cylinder to the pneumatic components.

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(Fig 8) Compressor used to compress the air and supply it to the machine

Sheet metal:

Many different types of metal can be made into sheet metal, including aluminium, brass, copper, steel, titanium, tin and **stainless steel**. Sheet metal is available in a variety of different metal types and thicknesses. Choosing the right sheet metal gauge and thickness is essential to any metal fabrication project

Arc welding:

Arc welding is the process of joining two metal work pieces together using a flux covered electrode which is melted in an electric arc and becomes a fused part of the pieces being welded. Arc welding requires time, effort and patience to master as the weld rod position is very delicate to the position of the work piece.

Specifications

- Vertical Double acting cylinder of 10 bar pressure, 100 mm bore dia, and stroke length is 160 mm
- horizontal Double acting cylinder of 10 bar pressure, 80 mm bore dia, and stroke length is 200 mm
- one 5/2 Directional control hand lever
- one 5/2 Directional control valve
- Dimensions of compression cylinder is 15×15×22 cm

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III. WORKING PROCEDURE



(Fig 9) Compacting Machine which produces Rice husk bricks

1. First mix the rice husk and rice powder in right proportion since mixing of rice powder will increase the bonding of rice husk.
2. Then add some water for moisture content
3. Then load the mixture inside the compression cylinder through hopper.
4. Then give forward motion to the vertical cylinder for compression action by using valves or levers.
5. Then give backward action to the vertical cylinder.
6. After compression give forward motion to the horizontal cylinder to push the block out of the machine.
7. Then leave the block to dry and to solidify
8. After the block is completely dried so there will be no moisture content so moisture content is negligible.
9. Then repeat the above procedure for to make more blocks.

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IV. EXPERIMENTAL CALCULATIONS

Brick Dimension:

1. Length- 22 Cm
2. Breath- 15 Cm
3. Height- 15 Cm

Calculated volume:

$$\begin{aligned}\text{Volume (2)} &= \text{length} \times \text{Breath} \times \text{Height} \\ &= 22 \times 15 \times 15 \\ &= 4950 \text{ Cm}^3\end{aligned}$$

1 brick weighs about 4 kg if we mix the rice powder and moisture weight the total weight of the husk will be 3 kg

Lorry Dimension:

1. Length- 716.25 cm
2. Breath- 222.56cm
3. Height- 185.92 cm

Calculated volume:

$$\begin{aligned}\text{Volume (2)} &= \text{length} \times \text{Breath} \times \text{Height} \\ &= 716.25 \times 222.56 \times 185.92 \\ &= 29629257 \text{ Cm}^3\end{aligned}$$

Number of brick in 1 lorry is

$$\begin{aligned}&= 29629257 \text{ Cm}^3 \div 4950 \text{ Cm}^3 \\ &= 5985.70\end{aligned}$$

Before compression of rice husk we can only load 3600 Kg of rice husk but after compression we can load up to 17957 Kg of rice husk

Cost Reduction:

- To a lorry to travel with load the lorry owner will charge about 32Rs for 1 Km
- Assume if a lorry is to travel a 100Km then the lorry owner will charge 3200
- And 1 lorry can be loaded with 3600Kg of rice husk
- AND 1 LORRY CAN be loaded with 17957Kg of rice husk if it is compressed
- Hence we can save up to 4 times travel charges

V. CONCLUSION

The transportation of rice husk is very problematic since its properties are such that it can fly away with heavy wind and it consumes more space so it is assumed that the transportation costs more to reduce this problem the machinery using pneumatics which is in this report can play a vital role that is by reducing space. And since it is in a brick shape after compression it will not fly off to heavy wind and it weighs more. And the design and fabrication is very simple and since the pneumatics costs less than hydraulics the complete cost of the machine reduces. There for small scale industries who cannot afford heavy hydraulic machine can make use of this machine.

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