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Fabrication of solar drier for rice processing industries

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Abstract -In that India, rice preparing is the extremely biggest agro industry. Essential handling of rice fundamentally includes evacuation of husk and the hidden grain layers from paddy in real rice processing frameworks. Before expulsion of husk, crude paddy is saturated, bubbled and dried utilizing steam. Drying process requires warm vitality. It is gotten from age of stream utilizing rice husks, ignition of non-renewable energy sources, biomass assets or wood as a fuel. Consuming of rice husk brings about Biogenic carbon dioxide discharge. The downsides of these arrangements are that utilizing fire causes contamination, steam requires parcel of water (which is now rare nowadays), utilization of wood prompts deforestation and open drying in daylight takes additional time. Keeping in mind the end goal to address the above issues, a proto kind drier utilizing sunlight based vitality is created and tried in this task. The exploratory outcomes uncover that there is extensive investment funds in working expense and no natural contamination.

Key words: sustainable power sources, sunlight based vitality, sun oriented gatherers, warm exchangers, dryer.

I. INTRODUCTION

Rice is a vital nourishment edit in India and second most vital yield on the planet. It is the staple nourishment for the world's most thickly populated locale and for several millions in Asia, Africa and Latin America. In India, rice handling is the exceptionally most seasoned and the tremendous agro preparing industry. At exhibit it has a turnover of more than Rs. 36,500 cores for each year. India forms around 85 million tons ofpaddies for every year and gives staple nourishment grain and other important itemsrequired by the populace. As oflate, in excess of 50 % ofthe general rice generation is handled by present day factories, 40 % by ordinary plants, and the rest of the 10 % by hand beating (Shwetaet al.2011).In the present setting of worldwide vitality emergency each nation has been investigating the potential outcomes of lessening the utilization of vitality and contamination. Answers for vitality emergency are emphatically reliant on the innovation of how vitality is utilized. Typically in rice Plants, rice husk are utilized to produce stream and the same is utilized for drying reason. The idea of utilizing of sun oriented vitality is taken up in this task work. Proto type drier utilizing sun powered vitality is created and tried in this undertaking.

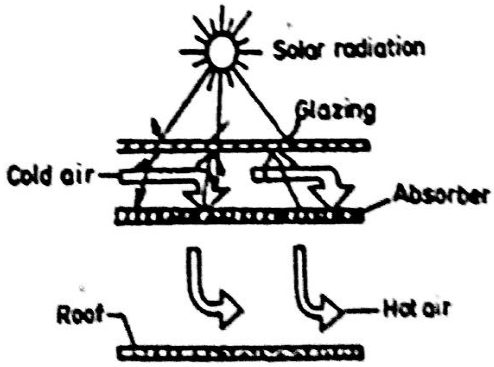

Fig 1.Schematic solar dryer setup

II. LITERATURE SURVEY

The present examination was proposed to know the degree of learning, effect of mechanical mediation including reception of homestead automation hones by Paddy, Ragi and Sugarcane cultivators. Significant endeavours are made to survey the accessible writing as having an immediate or circuitous bearing on show ponder.

1)M.Mohanraj, P. Chandrasekar: The execution of a roundabout constrained convection sun based drier coordinated with warm capacity material was planned, manufactured and explored for stew drying. The bean stew was dried from beginning dampness content 72.8% to the last dampness content around 9.2% and 9.7%. Warm effectiveness of the sun powered drier was assessed to be around 21% with particular dampness extraction rate of around 0.87 kg/kW h .

2) Momoho.l YusufThe present examination was proposed to know the degree of learning, effect of mechanical mediation including reception of ranch automation hones by Paddy, Ragi and Sugarcaneproducers.

3) Bukola O. Bolaji and Ayoola P. Olalusi:The drying rate, authority proficiency and level of clammy expelled (dry premise) for drying yam chips were 0.62 kgh-1, 57.5 and 85.4% individually. The dryer adequate capacity to dry nourishment things sensibly quickly to a protected dampness level and at the same time it unrivaled nature of the dried item.

4)Design of mixedmode natural convection solar crop dryers: Application of standards and general guidelines; F.K.Forson,m.a.a.nazha,F.O.Akuffo,H.Rajakauna Department of Mechanical Engineering, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana Department of Mechanical Engineering, De Montfort University .

5) Fudholi A, K. Sopian, M.H. Ruslan, M.A. Alghoul and M.Y. Sulaiman (2010).

Survey of sun powered dryers for rural and marine items, Renewable and Sustainable Energy.

III. SUMMARY OF LITERATURE:

The results of literature review reveals that solar energy is extensively used for drying agriculture produce like chilly, tapioca, and paddy.

IV. STATEMENT OF PROBLEM

Drying process requires thermal energy. It is obtained from generation of steam using rice husks, combustion of fossil fuels, biomass resources or wood as a fuel. Burning of rice husk results in Biogenic carbon dioxide emission. Loss of natural resources like wood. It creates pollution in the atmosphere.

Steam requires lot of water (which is already scarce these days); use of wood leads to deforestation and open drying in sunlight takes more time. Causes deforestation and low rainfall.

V. OBJECTIVES

To address the above problem's following objectives are set in this page

A prototype drier using solar energy is developed and tested in this project. The experimental results reveal that there is considerable savings in operating cost and no environmental pollution. Prevent fuel dependence and Reduces the environmental impact.

VI. COMPONENTS USED

The components used for the paddy drier is given below

1. Solar panel

Sun powered board is comprised of energy component. Fuel and air respond when they come into contact through a permeable layer (electrolyte) which isolates them. This response brings about an exchange of electrons and particles over the electrolyte from the anode to the cathode. On the off chance that an outer load is joined to this course of action, an entire circuit is shaped and a voltage is produced from the stream of electrical current. The voltage produced by a solitary cell is normally rather little (< 1 volt), such a large number of cells are associated in arrangement to make a helpful voltage.

Fig. 2 Solar panel

2. Heat exchanger

A warmth exchanger is a gadget used to exchange warm between a strong protest and a liquid, or between at least two liquids. The liquids might be

isolated by a strong divider to avert blending or they might be in coordinate contact its real activity performs in this trial. It is by and large comprised of gentle steel plate. The tallness of the warmth exchanger is 1200mm. What's more, the expansiveness of the Warmth exchanger is 400mm**.**

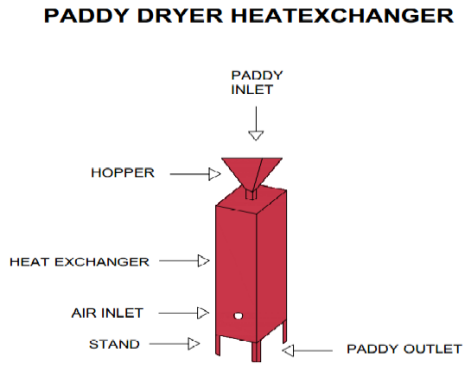

Fig. 3 3-Dimensional view of heat exchanger

3. Blower

Centrifugal blower is used in this project. Blower is used to suck the air into the panel. It consists of motor wounded with aluminium coil. The range of the air blower is 1 hp.

4. Moisture meter

Moisture meter are utilized to gauge the level of water in a given substance. Its shows the dampness level of the paddy. The dried paddies are then kept in the dampness meter. In there the dampness level of the paddy is ascertained and the outcome is acquired as computerized numbers.

Fig.4 Moisture meter

VII. EXPERIMENTAL SETUP

The drying chamber consists of the plenum chamber surrounded by two perforated vertical columns. The plenum chamber is the unit in which the blower delivers the drying air before entering the grain bulk. In the heating chamber, which has four electrical heating coils of 1.20 kW each, air is heated and a backward curved centrifugal fan sucks the heated air into the plenum chamber while residual exits through the vent. In operation, paddy rice is fed into the hopper and then flows into the vertical grain columns surrounding the plenum unit in the drying chamber. Drying takes place between the two perforated parallel screens on either sides of the plenum chamber while the residual air escapes through the vents on either sides of the dryer.

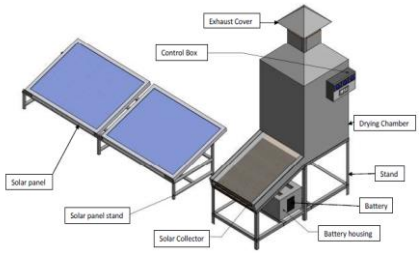

Fig. 5 Experimental setup

VIII. WORKING

The grains are at first put away to the container that and are let into the primary pipe through which high speed air is pass up the diffusive air blower. The measure of paddy moving through the container is controlled by a ball valve. Once the grain fall into the fundamental pipe it is underneath away by the high speed wind current and are re flowed once more into the container. A warming component is likewise set in the gulf of the outward blower to build the temperature of air. These contrast from guide dryers as for warm exchange and vapour expulsion. Depicts the working guideline of backhanded sun powered drying. The harvests in these circuitous sun powered dryers are situated in plate or retire inside a murky drying cupboard and a different unit named as sun powered gatherer is utilized for warming of the entering air into the cupboard.

The warmed air is permitted to course through/finished the wet product that gives the warmth to dampness dissipation by convective warmth exchange between the hot air and the wet harvest. Drying happens because of the distinction in dampness focus between the drying air and the air in the region of yield surface.

IX. MATERIAL

Table.1 Some Materials used for Construction of the Dryer and their Specifications.

Materials	Specifications	Quantity
Galvanized steel sheet	Thickness 1 mm	1 standard size
Perforated galvanized sheet	1200mm x 310 mm, thickness 1 mm	5 pieces
Mild steel sheet	Thickness 1 mm	2 standard size
Blower	1 hp Centrifugal fan with prime mover	1
Thermostat	10^0C – 100^0C (graduated in 5^0 C)	1
Steel pipe	5000 mm mild steel	1 standard length
Moisture meter	0-100deg	1 standard size
PVC pipe	2000 mm	1 standard length
Copper wire	2 mm	6 yards

X. DESIGN CALCULATION

1. Mass of Water to be removed from the Paddy

The mass of water to be removed from the paddy is calculated from the relationship given

$$mw = mi\ [(M_0 - M_f) / (100 - M_f)]$$

a) m_w and m_i are the mass of moisture to be removed and initial mass of paddy respectively in kg

b) M_o and M_f are the initial and final moisture contents of paddy respectively in %

c) m_i =4 kg, M_o = 25 % and M_f = 20% hence, m_w = 2.4 kg. Therefore, 2.4kg of water would be removed from the paddy rice to obtain the shelf-stable moisture content of 10 %.

2. Quantity of Air Required for Drying the Paddy

The quantity of air required for drying the paddy rice can be calculated from the basic energy balance equation for drying process

$$m_a c_{pa} (T_B - T_C) = m_w$$

a) m_a is the mass of drying air in kg

b) C_{ap} is the specific heat capacity of air at constant pressure in J/kg ^{0}C

c) T_B and T_C are the initial temperature and final temperature of drying air respectively in ^{0}C

If ambient air at temperature T_C (42 ^{0}C) and relative humidity (70%) is heated to temperature T_B(50 ^{0}C)

This heated air is used to remove water, m_w (2.4 kg) from paddy rice of mass M_o (4kg) until an equilibrium is reached. The temperature of drying air will reduce from T_B to T_C and the humidity ratio, w, will increase from W_B to W_C with increment of $\Delta W_{CB} = (W_C - W_B)$.

It follows therefore that the mass of air required to remove moisture in the drying process is represented by $m_a = [(m_W / (\Delta W_{CB} \times n)]$

a) m_a is the mass of air required to remove moisture from the paddy m_w is the quantity of water to be removed

b) ΔW_{CB} is change in humidity ratio which is the moisture that can be removed by the heated air

c) And n is the pickup factor..

Given that ambient temperature and relative humidity of40 ^{0}C and 70%

W_B = 0.016 kg/kg dry air and W_C = 0.0236 kg/kg dry air, hence,

ΔW_{CB} = 0.076 kg/ kg dry air. Therefore, using a pick up factor of 0.25 and substituting m_w = 2.4 kg and ΔW_{CB} = 0.0019 kg/ kg dry air into above resulted in m_a = 1910.52 kg. Since drying is to be carried out at 1 h per batch, hence, m_a = 955.26 kg/h or 0.265kg/s. Therefore the mass flow rate or quantity of moisture to be removed from the fish per unit time is 0.265 kg/s

3. Size and Type of air blower the Heated Air to the Drying Chamber

The size can be deduced by calculating the volumetric flow rate of the heated air which was given by Axtell

$$m_v = m_a \times v_s$$

a) mv is the volumetric flow rate of the drying air in m^3/s and v_s is the specific volume of the drying air in m^3/kg. Substituting vs. = 0.871 m^3/kg and m_a = 955.26 kg, hence, m_v = 832 m^3/h .Therefore, a 1hp blower of speed0.230 m^3/s 2.5m^3/mis selected for the dryer.

4. Energy Required to Heat the Quantity of Air Meant for Drying the Paddy

In order to select the heating element for the dryer, the quantity of heat energy required for raising the drying temperature to 45 ^{0}C from ambient temperature of 27^{0}C is calculated.

$$Q = m_a (h_2 - h_1)$$

a) Qis amount of heat energy in kJ/s
b) m_a is air mass flow rate in kg/s
c) h_1 is specific enthalpy of air at inlet in kJ/kg air;
d) h_2 is specific enthalpy of air at the drying temperature in kJ/ kg air.

With h_1 = 68.0 kJ/kg air; h_2 = 86 kJ/kg air; and m_a = 0.265 kg/s hence, Q = 4.7 kJ /s or 4.7 kW. Therefore, heater each of 1.20 kW each or 3 units of 1.6 kW each can be used.

XI. RESULTS AND DISCUSSION

Hot air enters the system with 60 deg, and leaves at 75deg then it enters into the heat exchanger. Before entering the heat exchanger the moisture content of the rice will be 20deg.Next entering into heat exchanger it attains 18deg where it stays there for few minutes, finally it leaves at 17deg.

XII. APPLICATIONS OF GRAIN DRYER

1. It is used in the agricultural fields.
2. Mainly used for rice mills.
3. It is used for food production system etc.,

XIII. CONCLUSION

A mechanical vacuum helped paddy drier was produced which can be effortlessly manufactured. The innovation can be utilized as a part of the drying coir and different seeds, for example, wheat, and so on , the sunlight based dryer is gainful than the sun drying systems . Sun oriented dryers do have weaknesses. They are of little use amid shady climate. Amid reasonable climate they can work too well. In spite of the fact that daylight based dryers incorporate a basic cost, they convey better looking, better tasting, and more nutritious foods, enhancing both their sustenance regard and their attractiveness. They additionally are speedier, more secure, and more proficient than customary sun drying methods. The audit of writing survey proposed that the execution of sun oriented dryer is subject to episode sun oriented radiation and barometrical conditions. Additionally the outline of sun based dryer assumes a vital part in accomplishing require drying attributes. The consideration of sun oriented gatherer give preferable execution over when items are specifically presented to daylight in sunlight based dryer.

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