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ENERGY EFFICIENT SOLAR DRYER FOR SAGO INDUSTRIES

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ABSTRACT: India is a tropical country which has large amount of available solar radiation which can be harvested and converted to suitable from that is required by the energy utilizing process of our industries. Sago is one of the main food items that are in taken by the most people of India. The raw sago is not consumed directly instead it is processed by sago processing industries which produce processing of a consumable from of sago called starch. The sago include of drying of sago particles in open air convection method or by using electrically operated oven for sago drying.

In open air convection the area required for drying sago is more and suitable for large scale processing and the usage of electric oven requires huge amount of electricity for the effective drying of sago particles, to avoid these constraints we have designed an device known as step type solar dryer which use solar energy as its energy source and has high efficiency by reducing the total time for drying out the moisture content in sago particles. We have employed glass covers which the entry of dust particles to the sago particles thereby increase the purity of sago processing. The main advantage of this device is its efficiency in energy conversion of solar radiation it is exposed to it. We hope this device would be transformed in to an essential device in sago processing industries in near future due to its clean and green energy of operations which reduce the cost of production

KEYWORDS: L angle, flat, wood, glass, aluminum.

1 INTRODUCTION

The sago industries mostly use fire wood or other nonrenewable sources of energy sources like electricity supplying heat to sago pan. This cause an huge in processing amount for the starch production due large price of these nonrenewable source of energy and also these cause an huge in impact on environment by degrading to higher level by which an environmental agencies requires an ban on this entire industries. In order to overcome these defect of starch industries we decided to design an model of solar operated starch pan for starch production, as solar is ecofriendly source of energy and it is available globally at free of cost but it require an inevitable technique to convert it to our need energy from.

2 SOURCES OF SAGO

Sago is a powdery starch made from the processed pith found inside the trunks of the sago palm Metroxylon sago. The genus name Metroxylon is derived from Greek and means heartwood, while the species name sagu is from a local name for the food. Sago forms a major stable food for the lowland peoples of New Guinea and the Moluccas where it is often cooked and eaten as a form of pan cake with fish. Sago looks like tapioca and both are pearly grains of starch, but tapioca is made from the root of the cassava plant. They are similar but are not identical when used in recipes.

Because sago flour made from Metroxylon is the most widely used from, sago plans grow very quickly, up to 1.5m of vertical stem growth per year, in the fresh water swamps and lowlands in the tropics.

3 STUDY OF SAGO AND ITS PROCESSING

3.1 OVERVIEW OF SAGO

Sago is a starch extracted from the pith stems, Metroxylonsagu. It is a major stable food for the lowland peoples of New Guinea and the Moluccas, where it is called saksak and sago. It is traditionally cooked and eaten in various forms, such as rolled into balls, water to form a paste, or as a pancake.

Sago looks like many other starches, and both sago and tapioca are produced commercially in the form of “pearls”. Sago pearls are similar in appearance to tapioca pearls, and the two may be used interchangeably in some dishes. This similarity causes some confusion in the names of dishes made with the pearls.

Because sago flour made from Metroxylon is the most widely used from, the project discusses sago metroxylon and tapioca which are the prime form of starch sources.

3.2 IMPORTANT FACTS ABOUT SAGO

- Preparation
- Nutrition
- Uses
- Botany
- Cycad sago

Are the important facts to be studied about sago to understand the characteristics of sago particles under impact of various process of starch preparation from the sago Materials.

3.3 PREPARATION

Sago is made through the following process:

- The sago is filled with starch content.
- The trunk is split lengthwise and the pith is removed.
- The pith is crushed and need to release the starch.

The pith is crushed and strained to extract the starch from the fibrous residue.

The raw starch suspension is collected in a setting container. They are felled just before flowering, when the stems are richest in starch. One palm yield 150 to 300 kg of starch.

3.4 NUTRITION

Sago flour metroxylon is nearly pure carbonhydrate and has very little protein, vitamins, or minerals. However, as sago a palms are typically found in areas unsuited for other forms of agriculture, sago cultivation is often the most ecologically form of land-use, and the nutritional deficiencies of the food often be compensated for with other readily available food.

One hundred grams of dry sago yield 355 calories, including an average of 94 grams of carbonhydrate, 0.2 grams of protein, o.5 grams of dietary fiber, 10 mg of calcium, 1.2 mg of iron, and negligible amounts of fat, carotene, thiamine, and ascorbic acid. Sago can be stored for weeks or months, although it is generally eaten soon after it is processed.

3.5 USES OF SAGO

Sago starch is either baked resulting in a product analogous to bread or a pancake or mixed with boiling water to form a paste. Sago can be made into steamed pudding such as sago plum pudding, ground into a powder and used as a thickener for other dishes, or used as dense glutinous flour.

The starch is also used to treat fibre, making it easier to machine. This process is called sizing and helps to bind the fibre, give it a predictable slip for running on metal, standardize the level of hydration of the fibre, and give the textile more body. Most cloth and clothing has been sized; this leaves a residue which is removed in the first wash. In Indonesia and Malaysia, sago is used in making noodle and white bread. Globally, its principal use is in the form of pearls. In Brunei, it is used for making popular local cuisine called the ‘Ambuyat, in some of the countries in the Africa.

3.6 Pearl Sago

It is a commercial product, closely resembles pearl tapico. Both typically are small (about 2 mm diameter) dry, opaque balls. Both may be white (if very pure) or colours naturally grey, brown or black, or artificially pink, yellow, green, etc. when soaked and cooked, both becomes much larger, translucent, soft and spongy. Both are widely used in south asian cuisine, in a variety of dishes and around the world, usually in pudding. In india, pearl sago us called javvarisi, or sabudana (whole grain) and is used in a variety of dishes such as desserts boiled with sweetened milk on occasion of religious fasts. The sago palm, metroxlyon sago, is found in tropical lowland forest and fresh Water swamps across Southeast Asia and New Guinea and is the primary source of sago flour. It tolerates a wide variety of soil and may reach 30 meters in height. The palm genus Metroxlyon contains several species: two of these M. salomonense and M. amicarum, are less- important sources of sago in Melanesia and Micronesia.

Sago palms grow very quickly, up to 1.5m of vertical stem growth per year. The stems are thick and either are self-supporting or have a moderate climbing habit. The leaves are pinnate, not palmate.

3.7 Cycad Sago

The sago cycad, cycas revolute, is a slow-growing wild or ornamental plant. Its common names, “sago palm” and “king sago pale”, are misnomers since it is actually a cycad. Cycads are gymnosperms from the family cycadaceae; palms are angiosperms (flowering plants) from the Arecaceae. The tow taxa are completely unrelated. Interestingly, cycads are also a type of living fossil, having survived since at least the early Permian period.

The processed starch known as sago is made from this and other cycad. It is less-common food source for some peoples of the pacific and Indian Oceans. There are large biological and dietary difference between the two types of sago.

Unlike Metroxlyon palms (discussed above), cycads are highly poisonous: most parts of the plant contain the neurotoxins cycasin and Bmaa. Consumption of cycad seeds has been implicated in the outbreak of parkinsons’s Disease-like neurological disorder in Guam and other location in the pacific.

Cabinet Type Of Dryer

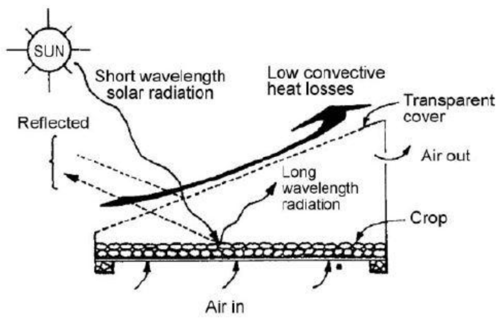

Fig 3.1: Working of Cabinet type of dryer

4 Processing Steps In Sago Industries

A Cold water dispersible, modified sago starch with gelling properties sprepared by pregelatinizing a sago starch that has been converted to a peak viscosity of about 400 Brabender units to about 1000 Brabender units and inhibited, the converted, inhibited starch having a brabender viscosity differential(“BVD”), measured between about 80 and about 90 degree c., of from about -5 BVD to about 25 BVD, wherein the converted, inhibited, pregelatinized sago starch is capable of forming a gel having a gel strength of a least 30 grams within 5 hours from preparation.

The modified sago starch of claim tapico wherein sago starch is reacted with at least about 0.015% of a cross linking agent.

A process for preparing, a cold water dispersible, modified sago starch having gelling properties, the process comprising units ("BU") to about 1000 BU, wherein the brabender viscosity is measured by rapidly heated to 50 degree c. and then heated further from 50 to 95 degree c. at a heating rate of 1.5 degree c. per minute.

Inhibited the converted sago starch such that the inhibited starch has a brabender viscosity differential ("BVD"), measured between about 80degree and about 90degree c of from about -35 BVD to about 25 BVD, measured at 7% solids and pregelatinizing the converted inhibited sago starch wherein the converted, inhibited, pregelatinized sago starch is capable of forming a gel having a gel strength of at least 30 grams within 5 hours from preparation.

5 CONVENTIONAL DYRING OF SAGO

5.1 NORMAL DRYING OF SAGO PARTICLES

Sago particles are gets extracted from the roots sago plant called tapioca. The conditioning of sago particles for the actual process called pre conditioning process. Then the output of preconditioning process is taken to the process called drying process in which moisture reduction of sago particles is taken place to enrich the starch content of sago.

The sago particles are rich in moisture content and wet in nature due to the process of preconditioning in which the sago are treated with water do purity the content of sago in tapioca which enable effective enrichment of sago. The process of sago drying is done by open air convection method.

5.2 OPEN AIR CONVECTION OF SAGO

The wet and moisture rich sago particles are get collected from the mixing tank by the process of wet sago picking and then transferred to the drying site of sago industry for drying purpose. Then the collected sago particles are get prepared for the drying by allocating the sago in specified lots of sago in standard weights. Then for the actual drying process the drying surface is get cleaned for dust particles for drying out moisture content in it.

The difference between the temperature of sago particles and the air initiate the heat transfer on the wet sago particles which enable the reduction in moisture content of sago. But the main problem of this open air convection is the very large time obtained b it for reduction of moisture content in the wet sago particles.

After few hours of solar exposure the sago particles are again spread to increase the exposure of solar radiation to all parts of sago particles by the use of sweeping pads and twisting handles provided to the workers. If the dryness level is found to be less than expected than the drying process is get repeated for those sago particles found less dry in inspection process which is done immediately after sago process.

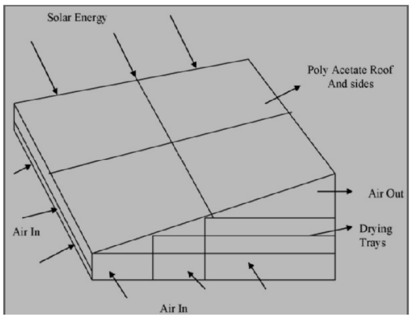

Fig.5.1 Direct solar drying (open air convection type cabinet drier)

5.3 MATERIALS USED FOR FABRICATION OF SOLAR DRYER

The following materials were used for the construction of the efficient solar dryer:

- Wood
- lass
- *aluminium* steel (GS).

- Nails and glue
- Hinges and handle
- paint (black and grey)
- Copper tubes

Fig. 5.2 Sheet Metal Work

6 PROBLEMS IN CONVENTINAL DRYING

6.1 PROBLEMS IN NORMAL DRYING

One of the most challenging food items to deal with is flour and sago particles. It's such an integral part of our diet, which it invades virtually every meal and snack we eat. When you can no longer eat foods that contain wheat flours, everything you put into your mouth becomes a potential food hazard. Fortunately, the manufacturing sector is becoming sensitive to those people who are wheat gluten and a broader variety of food products are becoming available.

The concise oxford dictionary says "any fine powder" as one of the definition of the word "flour". The other definition it offers is "a meal or powder obtained by grinding and usually sifting cereals, especially wheat". In synonymous fortunately, there are a wide variety of other alternatives for extraction of starch from those sources like palm and tapioca

6.2 PROBLEMS IN OPEN AIR CONVECTION

It requires large amount area for drying of sago drying of sago drying in the open area which should be maintained continuously for the entire operational life of the sago drying. The large time is obtained by the convectional open air drying which reduce the chance of expansion of sago industries and remain in same mode of operation as small scale industries Needed the development huge amount of investment is needed for expansion.

The conventional open air drying also has the risk of mixing of sago particles with the impurities likes dust and sand particles and also has the danger of exposing itself to the rain and rain water stagnation which directly affect the total output of sago industries.

6.3 DESING OF BEARING

Type of bearing: deep Groove ball bearing

ISI NO	BEARING OF BASIC DESIGN NO (skf)	D (mm)	D1 (mm)	D (mm)	D2 (mm)	B (mm)	R (mm)	R1 (mm)
17BC03	6303	17	23	47	41	14	1.5	1

7 DESIGN OF SOLAR TYPE SOLAR SAGO DRIER

7.1 SPECIFICATION OF STEP TYPE SAGO DRIER

7.1.1 FUNCTION

Drying of sago particle

7.1.2 SPECIFICATION

Collector area : 0.9144* 0.6096 m
Type and model : step type sago dryer
Number of trays : 2 in single step
Insulation (bottom) : Glass wool, 2mm. Thick
Motive power : Natural convection

7.1.3 GENERAL INFORMATION

Step type solar dryer has a collector area of about 0.5574. m2. This multi track step type dryer can hold 2 aluminums trays at a time. The absorber is 20 gauges GI sheet, black painted at the top with bottom insulation. The drier is covered at the top with single layer of 4mm thick plain glass kept at air gap of 7.62mm. At the rear side of the collector, an chimney of 1000mm height are provided. Holes provided at the bottom of the collector just below the first step allow the entry of atmospheric air into the dryer.

7.1.4 COST OF THE UNIT

RS.8000/-

7.1.5 SALIENT FEATURES

Solar drier takes 7 hours for drying 10kg of sago particles, while conventional sun drying takes 11 hours. Thus there is a saving of 4 hours which is 36% when compared to conventional drying.

Basic capacity:

Static (C0) = 630kgf

Dynamic (c) = 1060kgf

Maximum permissible speed = 13000rpm

Design of simply supported beam:

Length of the beam = 24inch = 609.6mm

Calculation of bending moment:

M max = WL^2/8

= (0.724*609.62^2)/8

M max = 33630.9 Nmm2

Calculation of reaction:

Reaction at one end, Ra = WL/2

= (0724*6096^2)/8

M max = 33630.9 Nmm2

Calculation of reaction:

Reaction at one end, Ra = WL^2

= (0.724*609.6)/2

= 220.67N

Reaction at another end, Rv = WL/2

= (0.724*609.6)/2

Calculation of moment of inertia:

$$I = \frac{\pi}{64} * \mathbf{d^4} = \frac{\pi}{64} * (\mathbf{16^4})$$

=3215.36mm^4

Calculation of maximum deflection:

Y max = 5/384* WL^4/EI

(E=2.1*10^5N/mm^2)

= 5/384*(0.724*609.6^4)

2.1*10^5*3215.36

Y max = 155.474N/mm^2

Specification of stand:

Length of frame = 36inch

Breadth of frame = 24inch

Angle of rotation = 110 angle

8 EXPERIMENTAL PROCEDURE OF SOLAR DRYING OF SAGO

We have done the efficiency experiment on the step type solar drier to be used for the sago materials to dry inside of solar drier in the following steps and the values are noted on the observation table.

8.1 STEPS

Analysing the sun rays position the tilting mechanism of solar drier is get adjusted to absorb maximum solar and tilting mechanism is get bolted as fixed position.Check out the temperature on the drier surface and inside of insulation box before loading sago materials.Note down the atmospheric are analysed for its wet temperature before loading and tabulated in the table.

The sago particles are getting loaded on the aluminum trays provided on the solar drier.Solar drier is get closed and exposed to solar radiation directly though glass provided at the top the solar drier

If the desired dryness is achieved on the sago particles the corresponding temperature and the time taken are get noted down on the table.

9 OBESRVATION

9.1 DRYNESS

The wet precipitated from of wet sago particles are get heated to disintegrate into powdery sago particles by loosing wetness to the atmosphere inside the dryer which is perfectly made to increase the solar convection there by reducing the wetness in a quick time interval compare to conventional drying.

9.2 TIME TAKEN

In this stop watch is used for measuring the time taken for drying of sago particles inside the solar drier. Stop watch is started when the sago particles are getting loaded inside the solar drier for drying. During unloading of sago particles after dryness test the stop watch is get stopped and relative time indicated on the stop watch is note down on the table.

10 ADVANTAGES

10.1 ADVANTAGES OF SOLAR SAGO DRYER

- The usage of solar sago dryer were obtained as following
- It uses of solar energy as its source of energy which is present almost everywhere and abundant and available at free of cost.
- It required very less area for drying as compared to the open air convection method there by reducing the total area required for expansion of existing plant which aims at expansion of industry.
- The total time obtained by step type solar sago dryer is very less than the time utilized for normal conventional method which increases the production rate of the sago industry.
- The step type solar dryer is preventing the passage of dust particles along with other impurities to be mixed with sago particles.
- The tilting mechanism present with step type of sago dryer enables all day solar exposure to the sago particles which increase the efficiency of solar dryers available for sago drying.

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