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Solar based steam cooking system

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ABSTRACT

Advantages and guidelines for cooking with steam are described. Transferring heat energy through steam is the most efficient way to cook and can occur through conduction, convection, or radiation. Steam has 6 times the heat energy found in boiling water at the same temperature. Pure steam is dry and cooks foods quickly, retaining nutrients. Air must be completely excluded from steamers or pressure cookers for efficient performance. Several makes of steamers are described (e.g., forced convection steam cookers and counter units). Variables that affect cooking time in steam are density, shape, and thickness of foods, food temperature, and doneness desired. All restaurant operations should consider having a steamer.

Keywords— *Heat pipe, Renewable, Parabolic, Box, Panel, Solar*

1. INTRODUCTION

Steam is water in the gas phase, which is formed when water boils or evaporates. Steam is invisible; however, "steam" often refers to wet steam, the visible mist or aerosol of water droplets formed as this water vapour condenses. At lower pressures, such as in the upper atmosphere or at the top of high mountains, water boils at a lower temperature than the nominal 100 °C (212 °F) at standard pressure. If heated further it becomes superheated steam.

The enthalpy of vaporization is the energy required to turn water into the gaseous form when it increases in volume by 1,700 times at standard temperature and pressure; this change in volume can be converted into mechanical work by steam engines such as reciprocating piston type engines and steam turbines, which are a sub-group of steam engines. Piston type steam engines played a central role in the Industrial Revolution and modern steam turbines are used to generate more than 80% of the world's electricity. If liquid water comes in contact with a very hot surface or depressurizes quickly below its vapour pressure, it can create a steam explosion.

2. PROJECT DESCRIPTION

In this project, the key point is the system used to increase the ability to obtain maximum sunlight from the sun. Solar tracking is the name of the system used. The solar tracker that we use is compound of three main part; the Electronic (hardware and software) part, Mechanical part, and the Programming part. The electronic part consists of two parts; the hardware which includes all physical components (microcontroller ATmega328 Arduino Uno, light dependent resistors, 10k resistors, solar panel 16v, servo, motor) and the software which contain the same component except the solar panel but virtually on software called ISIS Proteus design. The mechanical part consists of all the physical material used to make the exterior part of the solar tracker like the single axis used to connect to the servo motor for rotation purpose.

3. STEAM COOKING FEATURE

We are constantly tweaking and improving our commercial steam cooker. One of the biggest advantages with Advanced that our engineers can think outside the box to come up with innovate solutions. For example: Every once in a while a new customer has a one of a kind problem with a unique food product they want to produce. Odds are our engineers can solve their unique food process challenges with creative modifications and innovative solutions. Advanced is the 'Go To Company' in our industry for companies that need a solution to their unique problem**.**

Here are just some standard features of the advanced spiral steam cooker:

- Continuous in-line-belt freezer design assures both quality and gentle handling during the cooking process AND minimum weight loss.
- Products are fed evenly from the production line directly onto the loading cooker belt**.** The belt quickly transports the

product on to the high steam temperature cooking zone. The belt travels in spirals up along the rotating drum, until it reaches the top, the belt runs out of the cooker discharge port where the cooked product is gently discharged.

- Due to the large belt surface available, the product can be cooked in single layers or individually for I.Q.C. (Individually Quick Cooking) quality**.** The product can maintain the original load in position throughout the cooking process.
- Simultaneous cooking of different products with mixing, which simplifies product sorting, after cooking**.** This can result in major time and labor savings.
- Stainless steel heavy-duty spiral telescopic belting**.** The belt can be telescoped and extended to change the pitch of the links. During operations, the extended belt approaches the rotating drum and one side telescopes in causing it to turn around the drum, as it travels in a spiral up the rotating.

4. PROBLEM DEFINITION

All combustion equipment must be operated properly to prevent dangerous conditions or disasters from occurring, causing personal injury and property loss. The basic cause of boiler explosions is the ignition of a combustible gas that has accumulated within the boiler. This situation could arise in a number of ways, for example, fuel, air, or ignition is interrupted for some reason, the flame extinguishes, and combustible gas accumulates and is reignited. Another example is when a number of unsuccessful attempts at ignition occur without the appropriate purging of accumulated combustible gas. There is a tremendous amount of stored energy within a boiler. The state change of superheated water from a hot liquid to a vapour (steam) releases an enormous amount of energy. For example, 1 ft 3 of water will expand to 1600 ft3when it turns to steam. Therefore, "if you could capture all the energy released when a 30 gallon home hot water tank flashes into explosive failure at332oF, you would have enough force to send the average car (weighing 2,500 lbs) to a height of nearly 125 feet. This is equivalent to more than the height of a 14 story apartment building, starting with a lift-off the velocity of 85 miles per hour. Boiler safety is a key objective of the National Board of Boiler and Pressure Vessel Inspectors. This organization reports and tracks boiler safety and the number of incidents related to boilers and pressure vessels each year. Their work has found that the number one incident category resulting in injury was poor maintenance and operator error. This stresses the importance of proper maintenance and operator training. Boilers must be inspected regularly based on manufacturer's recommendations. Pressure vessel integrity, checking of safety relief valves, water cut off devices and proper float operation, gauges and water level indicators should all be inspected. The boiler's fuel and burner system requires proper inspection and maintenance to ensure efficient operation, heat transfer and correct flame detection. The Federal Energy Management Project (FEMP) Oand M Best Practices Guide to Achieving Operation Efficiency

5. METHODOLOGY

Steam boiler or simply a boiler is basically a closed vessel into which water is heated until the water is converted into steam at required pressure. This is the most basic definition of a boiler.

5.1 Direct method

Direct method of boiler efficiency test is more usable or more common boiler efficiency =Q*(HgHf)/q*GCV *100 Q =Total steam flow, Hg= Enthalpy of saturated steam in kcal/kg, Hf =Enthalpy of feed water in kcal/kg, q= quantity of fuel use in kg/hr, GCV =gross calorific value in Kcal/kg ,like pet coke (8200 KCAL/KG).

5.2 Indirect method

To measure the boiler efficiency in the indirect method we need a following parameter like:

(a) Ultimate analysis of fuel (H_2, S_2, S, C moisture constraint, ash constraint)
(b) Percentage of O_2 or CO_2 at flue gas
(c) Flue gas temperature at the outlet
(d) Ambient temperature in deg c and humidity of air in kg/kg
(e) GCV of a flue in Kcal/kg
(f) Ash percentage in combustible fuel
(g) GCV of ash in Kcal/kg

6. DESIGN AND CALCULATION

6.1 Steam boilers for textile

The textile industry is suffering from energy crisis especially Gas, Low pressure and high demand among residence in winter cause a complete breakdown. So, it's a high requirement to shift on alternate energy resources e.g. Coal. The country is very rich with its coal reserves and it can serve for quite long. In this post, we will discuss possible energy alternates for the textile industry, Economical aspect (Costing), Merits and demerits involved. A major focus is on costing to evaluate the efficiency of different

International Journal of Current Trends in Engineering and Research (IJCTER) Volume 02, Issue 04; April – 2016 [Online ISSN 2455–1392] @IJCTER-2016, All Rights Reserved 469 energy resources. The industry utilizes a different kind of boilers with varying pressure and of different capacities as per unit requirement.

Let's assume a boiler working at pressure 5Bar and producing steam of Two Tons per hour. The efficiency of this boiler is approx. 80%. What would be the cost of producing 2Tons of steam per hour on Natural Gas, Coal and Furnace Oil? Our solution to this scenario is a simple formula which says: Efficiency (n) = Output Quantity of Steam(Qs) X Energy in Steam(hf) Input Qt of Fuel (Qf) X Gross Cal. Val. (GCV) X Sp. The gravity of fuel Omitting Specific Gravity of fuels to simplify and shifting variables of formula from here to there and vice versa. So, that Final shape becomes. Qf = Qs X hf GCV X n So, Here what these are Qf = Quantity of fuel needed to produce 2Tons steam per hour at 5 Bar Qs = Quantity of steam. This is fixed value 2000Kg per hour Hf = Enthalpy of evaporation which is Fix Value is taken from Steam table, 2757KJ/Kg of Steam. (Means One Kilogram of steam has this much energy at Pressure 5 Bar) GCV = Gross caloric value, Different for each combustible material. N = Efficiency of Boiler, the Fixed quantity taken as 80%, we will put 0.8 in the formula. Sample References Section

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