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RESEARCH ARTICLE OPEN ACCESS

Solar Powered Turmeric Pulverizer

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ABSTRACT:

Turmeric or luyangdilaw is very abundant in our country .Turmerics were usually used as herbal medicine, it serves a cure for different illnesses, and also as a condiment in spicing foods. The problem is the producer only conducts manual operation in pulverizing the turmeric using mortar and pestle but it is not enough in making a well-powdered product, another round of pounding should be done in order to perfectly pulverized the turmeric. Pulverizing is done manually by their members and requires much time and effort to perfect the required texture of the product to be commercially competitive to other same product in the market.

The researchers came up with the idea of making a solar powered turmeric pulverizer machine as a solution to the problem of the producer with the high electric energy consumption and quality output product. The Solar Powered Turmeric Pulverizer applies the use of renewable resources such as photovoltaic for the operation of the pulverizing machine. Different design layouts of machine with components was collected in order to construct a newer and better design of the desired machine. The machine was composed of a solar panel, battery, DC motor, grinding machine and feeder where the cooked turmeric will be fed to reduce its size and a grinder to ensure that the output will be well-powdered. This prototype pulverizes pre-cooked solidified turmeric extract created by the process of cooking the turmeric extract, sugar and other herbal plants. The project is designed to use renewable source of energy to make it economical and energy efficient. It requires one person to operate the machine which makes it easy to use. The Solar Powered Turmeric Pulverizer consists of one 200 Watts solar panel which converts sunlight into electricity and then stores to 2 units of 12V 100Ah battery which are connected in series. The 20A, 24V charge controller acts as a filter of excessive current and voltage entering the batteries which prevents overloading and prolonging the batteries lifespan.

Keywords: Pulverizer, Photovoltaic, Solar Panel, Charge Controler

Introduction

Herbal medicines are very efficient to human , even on the ancient times. Roots, leaves and fruits are used in making herbal medicines. Eating or drinking any of those herbal medicines is a simple way to gain its nutrients. One of root crops used in making herbal medicine is turmeric. It is a spice derived from the rhizomes and came from the family of ginger.

Turmeric is widely used today as herbal medicine because of its active biological components which have the ability of reducing cholesterol in the body; warm the body to liberate stagnant fluids; aids digestion; quickens the body of general weakness; ensure easy menstrual flow; reduces high blood pressure, among others. It is also being used by many cooperatives and livelihood programs as the main ingredient of their projects. Because of its characteristic, turmeric is being produce as drinks, food supplement, spices, tea, peppermint, beer, wine, biscuits, breads, etc.

Salabat or turmeric tea is one of the products of turmeric. Salabat is the extracted one from the turmeric. But some other people or cooperative produces powdered turmeric which can be an instant salabat after adding water in it.

Pulverizing machines or grinder are widely used today for various kinds of industrial and residential applications. It is a mechanical device for grinding different types of materials. Some machines are pulverizing vegetables and fruits which used in the production of herbal medicines. Most pulverizer or grinder are electric, which requires less effort than their manual counterparts.

There are a lot of research studies that show the healing power of salabat . In line with this, turmeric was considered as the main ingredient due to its availability and its health benefits.

Mrs. Sarah Alea, a pioneer in the production of instant salabat in Wawa, Batangas City, manages and makes powdered turmeric.This business makes a huge impact in the business industry nowadays. The business of Mrs.Alea helps their neighborhood to have an income even if they are in their home.

Pulverizing is done manually by their members and requires much time and effort to perfect the required texture of the product. The work can produce 3 to 5 kilograms a day. The production varies with its demand, availability of turmeric and the members available during production time. If there are only few members, their time of pulverizing would last longer compared with the greater number of members pulverizing the turmeric.

In line with these, the researchers conducted a study on turmeric pulverizer powered by solar energy to minimize effort and time of the members in producing powdered turmeric with better and greater output. The research project is a solar powered turmeric pulverizer that is composed of solar panel, battery, DC motor, grinding machine and feeder.

OBJECTIVES OF THE STUDY

The main thrust of this study was to design and develop a solar powered turmeric pulverizer for instant salabat making to be used in the livelihood program of Barangay Wawa, Batangas City , the study sought to attain the following objectives:

1. To evaluate the existing turmeric pulverizer in terms of the following:
   1.1 Design
   1.2 Construction
   1.3 Operation
   1.4 Areas for Improvement
2. To determine the project's design requirements and

considerations based on thefollowing standards and provisions:

2.1 Philippine Electrical Code (PEC)

2.2 Institute of Electrical and Electronics Engineers (IEEE)

2.3. National Electrical Manufacturing Association (NEMA)

2.4 Wire Size

3. To prepare the design plans:
   3.1 General Description
   3.2 Construction Layout
   3.3 Design Computation and Analysis
   3.4 Schematic Circuit Diagram
   3.5 Bills of Materials and Specifications
4. To determine the methods of fabrication and assembly:
   4.1 Machine and Tools
   4.2 Methods
5. To present the financial feasibility of the project in terms of:
   5.1 Total Project cost
   5.2 Project Evaluation
6. To determine the methods of testing in terms of:
   6.1 Procedure
      6.1.1Battery Charging
      6.1.2Pulverizing Rate
   6.2 Results and Discussion
7. To discuss the effects of the project to the society and the economy as a whole.
   7.1 Socio-Economics

RESEARCH DESIGN

This study was provided a specific outline in designing and plan analysis to attainthe objectives of the research. The information was collected from certain related studies,dissertations, books and from the internet where the design can be based for thepreliminary draft. A thorough evaluation and analysis of other relevant concept are takeninto consideration in designing because it was served as the basis of the project study.

The gathered collection of information was used by the researchers in structuringthe ideas for the study. Researched materials gave the knowledge for the development ofthe design of the prototype. The study focused mainly on the development of the solarpowered turmeric pulverizer which aims to powder the turmeric after cutting, drying andcooking separately. The researched related studies was a reliance in determining thefeatures of the past prototypes related which can be improved within the study.

The compiled printout materials for related studies from different books and otherdissertations in the libraries was used to gather ideas for the design of the prototype thatthe proponents desired to fabricate. Different design layouts of machine with componentswas collected in order to construct a newer and better design of the desired machine. Theproponents used the gathered materials to make use of the recommendations of the pastresearches which are related to the study.

Another source of information is the internet, this is where the concepts on solarenergy and prototype development was gathered. Electrical components used for theconstruction of prototype were fetched from online sources on the internet, the selectionsof components were properly specified as of the design.

Consultation to the adviser and knowledgeable individuals about the project is amethod to be used in constructing the prototype of the study. The planning comes withdifferent stages which is the step in the development of the solar powered turmericpulverizer output. The cost with respect to the materials and components were computedfor the estimation of the expenditure of the whole project.

In assuring the capacity and effectiveness of the design of the prototype, someseries of trials was conducted in establishing the performance of the pulverizer.Measuring of components such as the battery was conducted to ensure the capabilityand limitations of it, considering the charging and discharging

capability of the wholeproject with respect to the attaining the features specified for the solar panel.

The researcher undergoes a proper processing of inquiry and interviews about theexisting renewable energy equipment, as for having a new design of a new efficientprototype.

Some considerations towards the appropriate provisions from the Institute of

Electrical and Electronic Engineering (IEEE), National Electrical Manufacturer's

Association (NEMA) and Philippine Electrical Code (PEC) is taken as a standard ofeverything that is done within the study.

RESULTS AND DISCUSSION

1.1 Evaluation of the existing tomato powdering machine.

1.1.1 Design. In the design of an existing tomato powdering machine it operates by using the disk plate pulverizer and an alternating current motor. The motor has a capacity of 1.5 hp, 1.119kW, 1740rpm, and 60 Hz based on the input process. The electric motor has a high speed, so in order to fit that speed in the powdering process, a speed reducer is used and it is designed for the shafting of screw were the belt is also the controller of the speed of the motor with respect to the part of the pulley system. The existing design used only aluminum bars and plates in the feed hopper and in powder catchment tray and that it is also a problem whereas food is considered in overall process.

1.1.2 Construction. Figure 1.1 shows the existing Tomato Powdering Machine. It has a height of approximately 2.5ft, length of 2.5ft and width of 1ft respectively.

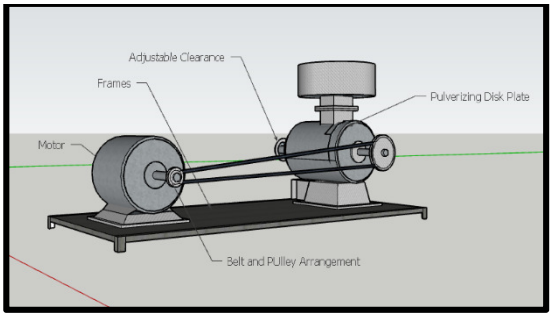

Figure 1.1 Existing Tomato PowderingMachine

In the construction or fabrication of the "Tomato Powdering Machine", the machine constructed by the use of aluminum bars and plates. The aluminum plate used in a feed hopper and in powder catchment tray and the aluminum bars is assembled for the equipment and instruments like the speed reducer, screw, and the belt as well as its motor. The feed hopper and the powder catchment tray is very important part of the project because it is the container where the tomato is powdered. Since a machine used an AC motor it has a belt to connect the functions of the electric motor, screw, and the speed reducer. The machine was too small with its maximum capacity of only 3kg. Considering food is involved in this project, materials that are easily prone to corrosion must be avoided. The feed hopper of the existing tomato powdering machine is fixed that is why after operation cleaning of the machine became a big problem. The frame of the prototype was painted to become more presentable and to prevent from rust and corrosion. The bolts and nuts are also used to make sure that some parts of the machine are secured from collapse and damage and secure to tighten the parts of the tomato powdering machine. And lastly, the angle bar is used to support the whole machine when powdering is in process and also the wiring of the electrical components is done in the machine.

1.1.3 Principles of Operation. The project has different components that are involve to its operation. The AC motor which is 1.5hp is used to run the machine in powdering process. The belt and pulley arrangement were used to support the rotating shaft of

the machine with the help of compatible bearings and accessories. It makes the shaft to have a smooth rotation. The stainless shafting is used to hold and support the screw when it is rotating. The pulley is used to hold and connect the belts that help to move the rotating parts of the project. The speed reducer is used to slower the rotation of AC motor. Since the motor has a higher speed, the rotation of the work piece needs to be slower down for the powdering to be effective. The electric motor that converts electricity to the mechanical work enables the machine to function and to powder tomato. Since the machine used aluminum bars and plates for the fabrication of feed hopper and powder catchment tray it gives greater impact for the operation of the project and also for the processing of tomato.

1.1.4 Areas for Improvement. Based on the gathered information about the existing tomato powdering machine, the researchers present a summary on the areas for improvement.

In line with the areas of improvements on the existing design, the proponents constructed a plan for improvement. The plan included the design of a turmeric pulverizer with all the components to be used and the motor was operated in direct current (DC). In terms of its construction, the body and the frame of the machine was built using stainless steel. Stainless steel was used since food is involved in the project. The machine has a height of around 4ft. The machine was constructed to pulverized turmeric with a maximum capacity of 1kg for every pulverizing of turmeric. The powder catchment tub or the powder catchment along with the burr mill is also made with stainless steel to prevent the turmeric in contamination. All the materials that were used in the fabrication of the machine were new to ensure that the turmeric would not get contaminated. All the components are all tested and ensured and used DC motor so that it could operate using the energy harnessed from the sun through solar panels. The energy generated by the solar panels could be stored in batteries so that the machine could operate for a longer time and for the continuity of production. The use of solar panels in operating the machine promote clean and reliable source of energy.

1.2 Design Considerations and Requirements

1.2.1 Philippine Electrical Code (PEC). Some provisions of the Philippine Electrical Code were cited and considered as guides for the development of design and operation of the solar-powered turmeric pulverizer in order to be certain on the quality of the products to be used within the study.

1.2.2 Institute of Electrical and Electronics Engineer (IEEE). Some provisions of the Institute of Integrated Electrical Engineers (IIEE) were cited and considered as guides for the development of the project and to ensure the quality of the device.

According to IEEE Guide for Array and Battery Sizing in Stand-Alone Photovoltaic (PV) System, 9 PV Array Sizing, 9.2 System Losses, system losses need to be estimated and included in the calculation. These losses may include dust on the array, battery coulombic efficiency, parasitic losses (from a charge controller or inverter if not included inthe average daily load Ah), etc. These losses are typically expressed as a percentage of the system load.

937-2007 – IEEE Recommended Practice for Installation and Maintenance of Lead-Acid Batteries for Photovoltaic (PV) Systems, Article 937-2007 provides design considerations and procedures for storage, location, mounting, ventilation, assembly,and maintenance of lead-acid batteries for photovoltaic (PV) power system. Safety precaution and instrumentation consideration are also included. Even though general recommended practices are covered, battery manufacturers may be provided specific instruction for battery installation and maintenance.

Article 1013-2000 describes a method for sizing both vented and valve-regulated lead-acid batteries used in terrestrial photovoltaic (PV) systems is described. Installation, maintenance, safety, testing procedures, and consideration of battery types other than lead-acid are beyond the scope of this document. Recommended practices for the remainder of the electrical systems associated with PV installations are also beyond the scope of this document.

1013-2000 – IEEE Recommended

Practice for Sizing Lead-Acid Batteries for Photovoltaic (PV) Systems.

Considering the IEEE standards, the proponents considered the recommendation practice for installation and maintenance of lead-acid battery for photovoltaic system. This article provides design considerations and procedures for storage, location, mounting, ventilation, assembly, and maintenance of lead-acid batteries for photovoltaic (PV) power. Safety precaution and instrumentation consideration are also included.

1.2.3 National Electrical Manufacturers Association (NEMA). NEMA is the association of electrical equipment manufacturers in USA. Its approximately 450 members, including the Philippines, manufacture products used in generation, transmission, distribution and use of electricity. These products are industrial, commercial, institutional, and residential applications. The NEMA has published revisions to two standards within the ANSI C18 series of standards for batteries. The researchers referred to NEMA in accordance with construction of the prototype.

ANSI C18.3 1M, Part 2-2011 American Standard for Portable Primary Cells and batteries with Aqueous Electrolyte-Safety Standards.

ANSI C18.3, Part 2-2011 American National Standards for Portable Lithium Primary Cells and Batteries-Safety Standards.

As the NEMA implies, each standard specifies tests and requirements for specific types of batteries to ensure their safe operation under their normal use and normally foreseeable misuse. In ANSI C18.3M, Part 2, the committee highlighted the importance of designing battery compartments with mechanical tension devices to prevent swallowing and ingestion of batteries of children. Annex A, through informative, provides guidance for device designers when considering the proper use of batteries electrical devices.

1.2.3.1 Wire Size. NEMA ICS 7.1, Section 2.8.2 states that the conductors for panel wiring should be no smaller than No. 18 AWG and those for electronic and solid-state controls sub-assemblies no smaller than No. 30 AWG.

The proponents considered the NEMA standards for the connection of the auxiliaries inside the casing to be free from short circuits and grounding. The use of cable ties and terminal ring was considered to ensure the fixed connections of the batteries, charge controller and the DC motor. Furthermore, the NEMA types of enclosure standards were taken into consideration for the type of location for the installation of the project.

1.3 Design Plans and Specifications

1.3.1 General Description of the Project

.This prototype pulverizes pre-cooked solidified turmeric extract created by the process of cooking the turmeric extract, sugar and other herbal plants. The project is designed to use renewable source of energy to make it economical and energy efficient. It requires one person to operate the machine which makes it easy to use.

The pulverizer is composed of screw feeder and burr mill. The controller box is just located at the right side and it includes the emergency stop push button, with on/off switch and solar charge controller.The batteries are separated in a rack below the prototype.

The Solar Powered Turmeric Pulverizer consists of one 200 Watts solar panel which converts sunlight into electricity and then stores to 2 units of 12V 100Ah battery which are connected in series. The 20A, 24V charge controller acts as a filter of excessive current and voltage entering the batteries which prevents overloading and prolonging the batteries lifespan.

The Solar Powered Turmeric Pulverizer applies the use of renewable resources such as photovoltaic for the operation of the pulverizing machine. The solar system uses one 200 Watts solar

panel facing south inclined by 11.2 degrees from the horizontal to the direction of the sun. The solar panel is connected to the solar charge controller and batteries. The Solar Powered turmeric Pulverizer is a project that aims to pulverize turmeric in a more efficient and faster way. The 2 units of 12V 100Ah batteries are connected in series which supplies the 0.5 HP DC gear motor. The digital voltmeter is included in order to monitor the voltage produced by the solar panel.

The gear motor is connected to the screw feeder and burr mill. The screw feeder pushed the turmeric coming from the feeder into the burr mill. The burr mill will then pulverize the solidified turmeric.

The emergency stop push button will perform the emergency shutdown operation on the machine. Another switch is connected and once it is pressed, the motor operation will start.

1.3.2 Design Computation and Analysis

Computations are made to determine the components and design specifications in order to build the project. Different factors are considered and used to design the project.

Mechanical Power

$P=(2\pi NT) / 44760$

P=((2π)x 63rpm x 5.980176 Nm) / 44760

P=0.529 Hp = **0.5 Hp**

Solar Panel Sizing Computation

*Total Energy = (Wattage of DC Gear Motor) * Time of operation*

Total Energy = 373W x 1.5 hrs = 560Wh/day

The 0.5 hp DC gear motor rating is equivalent to 373W. One hour and thirty minutes is said to be the minimum number of hours that a machine can withstand if used continuously.

Solar Panel

*Panel Rating = (Watt-hours per day) * 1.3*

= 560Wh/day *1.3

Solar Panel Energy Needed = 728Wh/day

Size of the Panels Needed

$$Total\ Wp\ of\ Panel\ Capacity\ Needed = \frac{Wh}{day} / (Panel\ Generation\ Factor)$$

Total Wp of Panel Capacity Needed = 728 / 4.8625

Total Wp of Panel Capacity Needed = 149. 7172237 Wp

$$Number\ of\ PV\ Panels\ needed = \frac{TotalWpofP anelCapaci tyNeeded}{Ratingofth ePaneltobe\ used}$$

The type of solar panel the proponents used is monocrystalline silicon type with the following specifications:

Max. Power = 200W; Vmp = 37.4V Vdc; Imp = 5.35A; Voc = 45.7V; Isc = 5.72A

$$\text{Number of PV Panels needed} = \frac{149.7172237\ \text{Wp}}{200\ \text{Wp}}$$

Number of PV Panels needed = 0.7486 = **1 unit**

Battery Sizing

$$Battery\ Capacity\ (Ah) = \frac{\text{Total Watt - hours per day x Days of Autonomy}}{0.85 \text{ x } 0.6 \text{ x Nominal Battery Voltage}}$$

$$\text{Battery Capacity (Ah)} = \frac{\frac{560Wh}{day} x1day}{0.85x0.6x12}$$

Total Ampere - Hours required = 91.5033 Ah

$$Units\ of\ battery = \frac{\text{Total Ampere - Hours required}}{\text{Ah rating of the battery to be used}}$$

Units of Battery = 91.5033 Ah / 100 Ah

Units of Battery = 0.9150 = 1 unit

= 2 units ; 2 series battery connections

Solar Charge Controller Sizing

Charge Controller Rating = Total Short Circuit Current of PV Array x 1.3 Solar Charge Controller = 5.72 A x 1.3

Solar Charge Controller = 7.436 A

Circuit Breaker Sizing

Load Current of the Breaker = (Imp of the Solar Panel x) x 1.25

= 5.35A x 1.25 = 6.6875 A

1.3.3 Construction Layout . The perspective view of the project is shown in Figure 4.2 along with the components' label. The construction layout provides the accomplishment of the Solar Turmeric Pulverizer. This layout provided for the proper installation and connection of the components for the complete operation of the project.

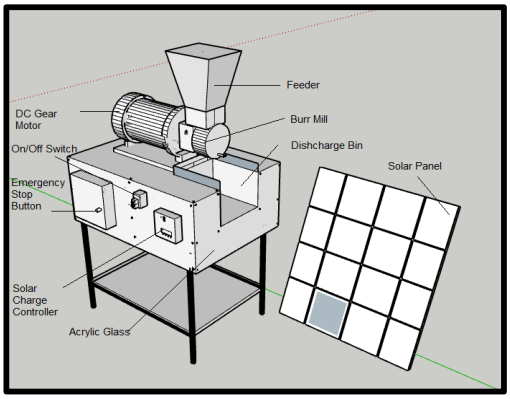

Figure 1.2 Perspective View Along with its Components

The main components of the Solar Powered Turmeric Pulverizer are the solar energy system, the DC gear motor, the burr mill and the feeder.

The solar energy system consists of the solar panel, charge controller, and batteries. Meanwhile, the pulverizing machine is composed of the DC gear motor, screw feeder, and the burr mill.

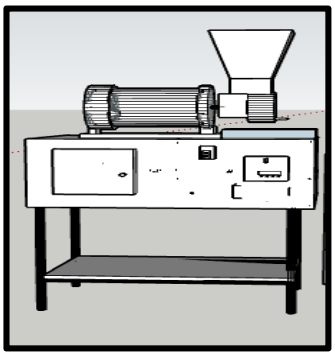

Figure 1.3 Right Side View of the Prototype

Figure 1.3 shows the right side of the Solar Powered Turmeric Pulverizer. The rightside is where the circuit breaker, emergency stop button, on/off switch and charge controllerare located.

1.4 Methods of Testing

Testing was done after all the components have been assembled and connected according to the circuit diagram to determine the efficiency of the device. Testing was done on the location of the beneficiary. Two tests were performed for the prototype's power generation and its functionality test.

Battery Charging. This section presents the data gathered from the charging of the battery in seven (7) trials from 6:00 AM to 6:00 PM. The generated voltages and currents were also recoded along with the status of the battery from time to time.

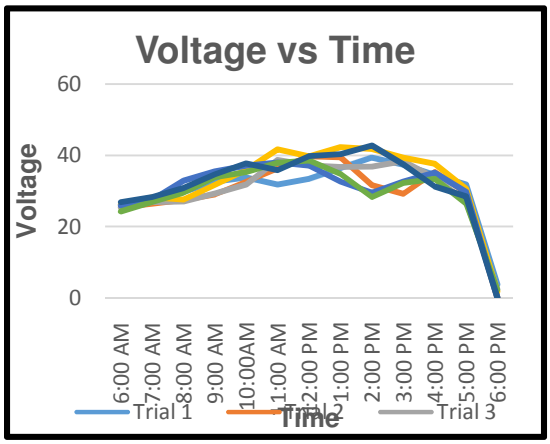

Figure 4.35 Graph Analysis of Voltage in Seven Trials

From the data obtained though the charging test, it can be observed that the initial charge of the battery in every trial ranges from 63% to 53%. The initial charges of the battery depended on the last percentage obtained from the previous discharging of the battery.

During the initial part of the trial at 6:00 AM, the current generated by the panel were at low values and were increasing as the time approaches its peak hour where there is higher level of irradiance. The battery is charging at approximately 4 hours per day, in trial 1, the battery became fully charged at 2:00 PM. In trials 3,4 and 7, it reached 100% at 3:00 PM, while the remaining trials 2, 5 and 6 did not reached 100% due to the weather.

The researchers found out that the charging rate decreases when the sun was not around or it is not too radiant, resulting into a lower duration of charging time. Figure 4.35 shows the graph of voltage versus time of the charging test conducted by the researchers. The y-axis presents the values of voltage generated and, on the x-axis, represents the time that the proponents conducted the test.

The graph presented on Figure 4.35 shows the values of voltage in every hour of each trial. The highest voltage obtained appeared on trial 7 with a value of 41.7 at 2:00 PM, while trial 4 also had the highest value of voltage generated at 2:00 PM which is 41.1 V.

Shown in figure 4.36 was the graph analysis of current at 7 trials conducted by the proponents. Presented on the y-axis were the values of current generated and on the x-axis were the time the researchers conducted the test in every trial.

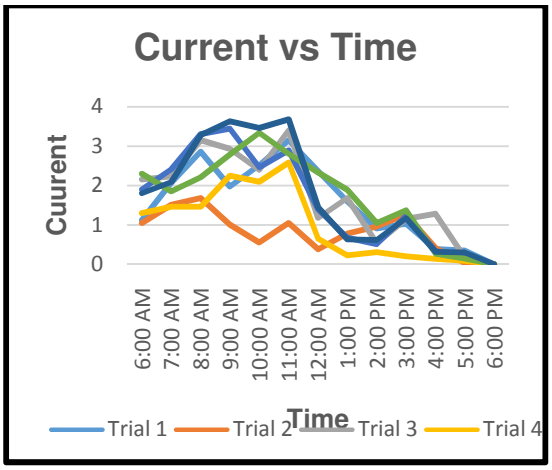

Figure 4.36 Graph Analysis of Current in Seven Trials

The graph in Figure 4.36 indicates that the value of current also depended on the amount of energy that the sun is emitting. The current will increase and/or decrease depending on the degree of sunlight that the sun is producing. The highest generated current appears 11:00am of the seventh trial which is 3.68 A, while the lowest value of current is 0 A which appeared on 6:00 PM of all of trials.

Pulverizing Rate. This section presents the recorded data in pulverizing the precooked solidified turmeric extract. The time of pulverizing were also gathered together with the initial and final status of the battery.

Seven trials were made to test the discharging capacity of the batteries. The first kilo of the input in the first trial consumed 7 minutes of pulverizing time and the battery discharged to 97% from 100%. The first input of one kilogram of the precooked solidified turmeric extract indicated that the battery can produce more than a kilo in every trial. The first trial was

tested with 10 kilos of the of the input that discharged to 59 percent of the battery which consumed a total of 71 minutes.

It was recorded that the pulverizing time of each kilo has different time which ranges from 6 to 8 minutes. As observed, the time depended on the output of cooking of solidified turmeric extract fed per kilo. The input amount with 6 minutes of time recorded contained most parts of the product which were already crushed due to the process of mixing the extract in the part of cooking. The time of pulverizing that had reached 8 minutes contained the most amount of the larger compacted precooked solidified turmeric extract.

The second trial also took 10 kilos that discharged to 60% that consumed 72 minutes of pulverizing. Third trial has an initial battery status of 95% and discharged to 55% after 10 kilos was pulverized in 70 minutes. The fourth trial discharged to 63% for 67 minutes and the fifth trial to 61% in 69 minutes. On the sixth trial, the initial status of the battery was 91% and have discharged to 53% for 68 minutes. The last trial is observed to discharged from 93% to 54% consuming 69 minutes of pulverizing of the turmeric.

CONCLUSIONS

Based on the findings obtained after designing and constructing the project, the following conclusions were made:

The reason why the existing design used belt and pulley in order for the motor of the machine to powdered well and accurate ,instead of direct installed of the disk plate which affects the speed of the motor in the powdering process. The materials used in the fabrication of the existing design came from aluminum in the construction of the feed hopper. The risk of contaminating the rust and dirt for the food can become

isdischargeable.

2. The standards provided by the PEC took a big role in assuring the sizes of the materials used in the prototype properly with the consideration of each part.

IEC plays an important role in assuring quality of the solar panel. By this standard, the proponent were able to check the defects of the solar panel to make sure it will function well during operation.

The proponents used provisions from NEMA that ensures safety standards of the battery to be used. This provision guarantees continuous operation of the prototype.

3.The desire layout of the project as well as the materials to be used were accomplished which made it possible for the operation of the system. Circuit diagram, design computations and analysis area the main fundamentals of the project in preparing the design. The ratings used based on the computations are applicable for the whole design of the project. The total cost of the project is too large because of the components used are expensive.

4. The materials and tools used were in good quality and working condition. The components of the prototype used in the construction are suitable for it to work properly. Considering the accomplishment of the fabrication, assembly and installation were important

5. The reason why the total cost of project amounted to Php51,533.50 is becausethe materials used and fabrication cost were expensive. Most of the parts of the machine were fabricated using stainless steel to ensure that the turmeric will not get contaminated. Based on the computation on overall financial aspect of the project, it would take 1 year and 2 months for the project to recover its investment.

6. The charging of the battery consumes 4 hours per trial, the capability of thebattery was observed. The machine was capable to produce 10 kilos of turmeric powderin 68 to 71 minutes per day. The input of the solidified extract affects the time ofpulverizing in terms of how small or big the solid particle was.

7. The prototype encourages the use of renewable source thathas more environmental benefits as compared to the conventional energy sources.Even if the demand of each customer is increasing, the pulverizing is done in a short period of time with less human endurance.

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