Design Build Portable Solar Dryer for Drying Urea Molasses Block with Arduino-based Solar Power Plant

Yuliarman Saragih, Hasna A. Roostiani, and Agatha Elisabet S

***Abstract*— Urea Molasses Block (UMB) is an extra feed or supplement very beneficial for cattle, goats, sheep (ruminants). UMB has an enough protein, energy and minerals content for livestock. Background of the tool design is the UMB drying process is generally still conventionally by breeder of Sekarwangi area in Karawang. Natural drying process usually takes a long time ± 2 days until the UMB is dry and hardened. Portable Solar Dryer controlled by an Arduino Uno micro controller using a 100 Wp solar panel that can produce power which is then stored alocated in battery. The drying method of the appliance is inserting a printed UMB with a size of 200 grams into the drying box. In the drying box there are 3 heaters with power 250 Watts AC and fan to spread the temperature in the box. Then the temperature on the drying box will be displayed on the LCD. This tool uses a solar tracker system so that it can save power of 131 Watt/day. UMB is dry when the UMB drying process has lasted for 5 hours with a 70º-90º C temperature set-point. The dry result of the wet UMB is using a portable solar dryer that is 33 % of the initial weight.**

***Index Terms*— Urea Molasses Block, Portable Solar Dryer, Arduino, Solar Tracker**

I. Introduction

PROVIDING quality feed with an adequate amount of consumption can increase of the weight of livestock [1]. Quality animal feed must contain protein, carbohydrates, mineral fats, vitamin and water. Animal feed consists of forage as the main feed and concentrate as other feed. The types of forage feed are grasses, legumes and straw, while the concentrate in the form of grains and or waste produced by the processing industry of agricultural products [2].

The livestock often eats from rough of feed ingredients. This condition causes a lack of availability of protein, vitamins and minerals for livestock. Initially to meet the need for minerals, farmers breed table salt or urea on straw or grass before giving it to their animals. There are also those who give crushed solid salt which is then stored in perforated bamboo segments and hung or in boxes to be lapped by livestock. In further developments, to make it more practical, feeds made from urea, molasses and other ingredients made by molding into cylindrical solids such as cylinders known as UMB [3].

The UMB drying process is generally still carried out conventionally as done by the breeder of the village of Sekarwangi, Karawang. The conventional drying method carried out in an open area that depends on sunlight. Conventional drying has some several problems, namely fluctuating heat, cleanliness that is not maintained and requires a large place. The natural drying process usually takes omit a long time i.e. ± 2 days until the UMB is dry and hardened because the temperature and energy depend on sunlight [4].

Based on the problems outlined, we need an efficient, effective and effective tool for drying UMB products. Research conducted by Zulfahmi A. Z (2017) [5] using a Portable Solar Dryer source of load supply with Arduino based Solar Power Plants to dry seaweed. The technology-designed tool utilizing electric power and capable of drying seaweed has a high enough efficiency so that this tool has the potential to be implemented in the UMB production process. By modifying the device using the Solar Tracker system can absorb solar radiation optimally. The direction of solar motion can be followed by sensing the change in the direction of the light emitted by the Light Dependent Resistors (LDR) sensor, which integrated with an ATMega328 micro controller and a servo motor to drive the solar panel.

II. Literature

A. Urea Molasses Block

UMB is an extrafeed or supplement that is very useful for cattle, goats, sheep (ruminants). UMB made from the main ingredient of molasses (sugar cane drops) as an energy content, urea fertilizer as a protein, salt, brown sugar, bran, anchovy powder, straw. The use of UMB as supplementary feed ingredients with enoughlevels of protein, energy and minerals can be used for cattle that caged or herded. The UMB benefit for livestock is to avoid the efficiency of vitamins and minerals, malnutrition due to low nutritional value and can also increase livestock production [6].

Manuscript received January 20, 2019.

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Fig. 1. Urea Molasses Block.

B. *Solar Power Plant*

Solar Power Plant is a power generation equipment that converts sunlight into electrical energy. It is often also in the Solar Cell or Solar Photovoltaic. Photovoltaic is a device that can convert solar energy (photons) into direct current electricity. Then direct current electricity converted into alternating current according to the local voltage and frequency system. Installing solar electricity as a power plants system consists of the following important components:

1. Solar Cell
2. Solar Charger Controller (SCC)
3. Battery
4. Inverter

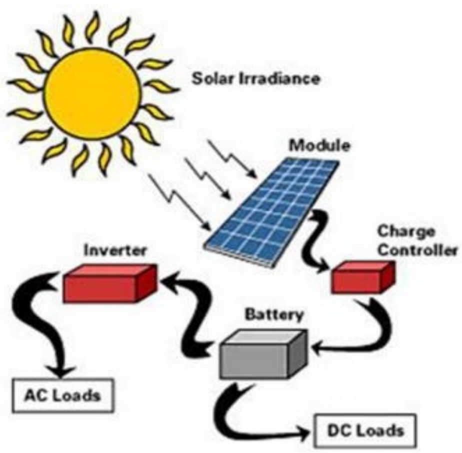

Fig. 2. Solar Cell Work System.

C. *Solar Charge Controller (SCC)*

Solar Charge Controller regulates the voltage and current from the Solar Panel to the battery. Most 12-volt solar panels produce an output voltage of around 16 to 20 volts DC, so if there are no settings, the battery will be damaged from over charging. In general, a 12 volt battery requires a charging voltage of around 13-14.8 volts (depending on battery type) to be fully charged.

Fig. 3. Solar Charge Controller.

D. *Inverter*

Inverter is the "heart" in a Solar Power system. The inverter functions to change the direct current (DC) generated by solar panels into alternating current (AC). The DC voltage from solar panels tends to not constant according to the level of solar radiation. This non-constant DC input voltage will change by the inverter to a constant AC voltage that is ready to used or connected to the existing system [7].

Fig. 4. Inverter.

E. *Accu*

Batteries are devices for storing electrical energy through electrochemical processes. The electrochemical process is that in the battery the chemical changes to electricity (emptying process) and electricity to chemistry by regeneration of the electrodes in the battery by passing an electric current in the opposite polarity direction in the cell [8].

F. *Arduino Uno*

Arduino is an open-source micro single board controller, derived from a wiring platform, designed to help the use of electronics in various fields. The hardware has an Atmel AVR processor and the software has its own programming language. Arduino is now very popular throughout the world so many beginners who learn to know robotics and electronics using Arduino because it is easy to learn. But not only beginners, professional users also like to develop electronic applications using Arduino [9]. Usually Arduino use to control or monitoring a system, such as monitoring a clean water quality with turbidity sensor [10].

Fig. 5. Arduino Uno.

III. Result And Discussion

A. Identification of Problems

Based on the background, it can be identified several problems found in the use of portable solar dryers, as follows:

1. The combination of solar energy and solar power can optimize the performance of the solar dryer.
2. 12V 10A battery specifications are suitable for the load to be used.
3. Indicators used in portable solar dryer show the temperature in the solar dryer area.
4. The temperature sensor used in portable solar dryer is DHT22.
5. UMB product weight is 120 gr / mold and portable solar dryer has a drying capacity of 3kg.

B. Formulation of The Problems

The problem will examine in the design of this tool is as follows:

1. What is the design of a portable solar dryer for UMB drying with an Arduino-based Solar Power Plants?
2. How is the effectiveness of a portable solar dryer for UMB drying by controlling a microcontroller?

C. Research Purposes

The purposes of designing of this tool as follows:

1. Designing a portable solar dryer system that can dry UMB products with Arduino-based Solar Power.
2. Determine the effectiveness of portable solar dryer for drying UMB by controlling a microcontroller.

D. Design of A Portable Solar Dryer

Mechanical design of UMB product dryer with dimensions of length 105 cm, width 70 cm and height 64 cm which can be seen in Fig. 6:

Fig. 6. Design of Portable Solar Dryer.

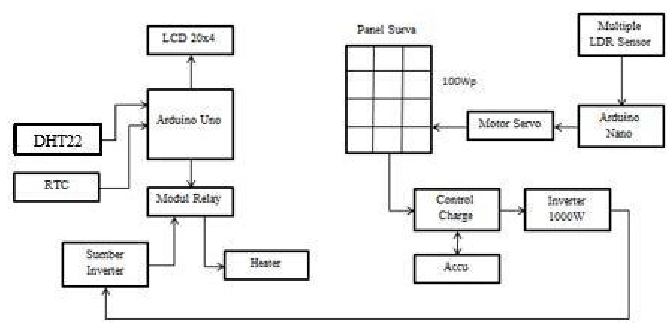

Fig. 7. Block Diagram Portable Solar Dryer Design.

The system designed in this design is an electrical energy derived from solar energy sources that can be usedfor solar electricity generation (Solar Power Plants). The solar panel on a portable solar dryer will planned to follow the direction of the sun's motion. The instrument used to follow the direction of the sun's motion is known as a solar tracker. The direction of motion of the sun can be followed by sensing changes in the direction of the light emitted by using LDR sensors (Light Dependent Resistors).

In the design of a portable solar dryer, the flow of power or voltage generated from the solar cell regulated by a solar charge controller used to control battery charging. After the battery charged, the inverter can be used to convert DC voltage to AC to run the load. The solar cell used has a maximum power capacity of 100 V which designed with a solar tracker system integrated by Arduino Nano that moves in the direction of the sun with a LDR sensor so that it can produce maximum DC voltage.

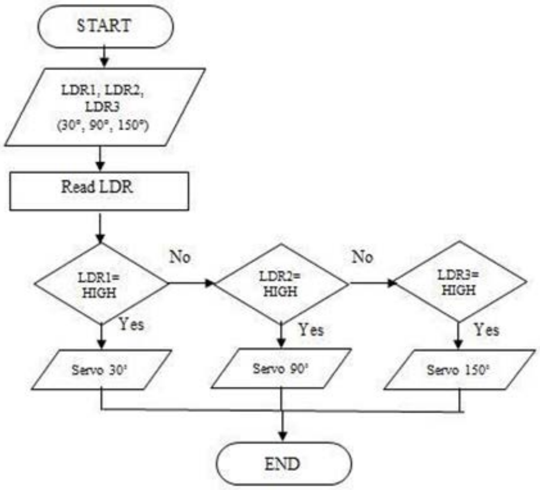

Fig. 8. Flowchart LDR Sensor.

The solar panel on a portable solar dryer planned to follow the direction of the sun's motion. The instrument used to follow the direction of the sun's motion is known as a solar tracker. The direction of motion of the sun can be followed by sensing changes in the direction of the light emitted by using LDR sensors (Light Dependent Resistors). This LDR sensor automatically detects the highest light intensity.

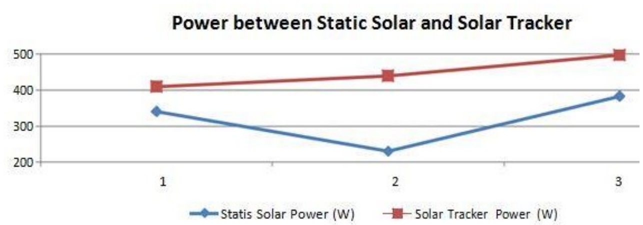

Figure. 9. Power Comparison Chart.

If the LDR1 value is greater than the value of sunlight intensity, the servo motor will move to 30 degrees, if the LDR2 value is greater than the value of light intensity, the servo motor will move to 90 degrees and if the LDR3 value greater than the light intensity will move to 180 degrees.

E. Comparison of Power Between Solar Static and Solar Tracker

The following is the data of the results of power testing between the static solar system and the solar tracker.

TABLE I
COMPARISON OF BETWEEN SOLAR STATIC AND SOLAR TRACKER

Sample	**Static Solar Power (W)**	**Solar Tracker Power (W)**
1	340,02	409,50
2	230,47	438,59
3	382,83	496,13
Total Power	953,32	1344,22
Average Power	317	448
Power Difference		131 Watt

Based on Table 1, it can be concluded that portable solar dryer with solar tracker system is more efficient to be used for drying Urea Molasses Block compared to static solar systems with the following calculation:

Solar Tracker:

$$P = I.V = 3.90 \times 13.9 = 54.21\ watt$$

Static Solar:

$$P = I.V = 2.45 \times 14.4 = 35.28\ watt$$

The percentage increase in an electric current and power generated between the solar tracker systems by a static solar panel are:

$$Power = \frac{Solar\ Tracker\ Power - Static\ Solar\ Power}{Static\ Solar\ Power} 100$$

$$Power = \frac{1344.22 - 953.32}{953.32} 100\%$$

$$Power = 41\%$$

F. UMB Weight and Water Testing with Portable Solar Dryer

The following are the results of UMB weight and moisture test results with a portable solar dryer.

TABLE II
TESTING THE UMB WEIGHT AND WATER CONTENT WITH A PORTABLE SOLAR DRYER

Sample	**Weight (gr)**		**Water Content (%)**	
	Static	**Tracker**	**Static**	**Tracker**
1.	128	121	41	35
2.	152	123	44	34
3.	139	120	39	32
Total	419	364	124	101
Average	139	121	41	33

From the testing of UMB portable solar dryer with an initial weight of 200 grams of UMB using the solar tracker system further reduces the weight and water content of UMB that is 121 grams and 33% compared to the static solar system which only produces weight and water content of 139 grams and 41%. Based on the Brebes Regency Animal Husbandry Service, 1990 [14]. UMB dry standard which has a water content of 35-45% with a weight of 120 grams, the UMB dry yield with the solar tracker system better meets the existing UMB dry standard.

IV. CONCLUSION

Heater/Heating Element used in portable solar dryer for drying UMB produces a temperature that is in accordance with the set point that has been set. Fan worked to spread the temperature in the drying box so that the temperature evenly distributed and achieved the temperature set point faster. The effectiveness of a solar dryer for drying UMB using the solar tracker system saved power by 131 W per day and produced UMB with a water content of 33%.

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