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Solar Powered Vulcanizer: An Innovation

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Abstract— *This experimental research design was developed to a Solar Power Vulcanizer (SPV) in all serviceable aspects to save time, investment, manpower and the environment.*

This study is all about the utilization of the nature's power - the SUN'S POWER that means no brownout in vulcanization operation. SPV is designed for greening the world to be lived by from generation to generation.

The result of the three vulcanizer has the best temperature at 60°C in which the gum was bonded exactly to the rubber tire. Solar vulcanizer's rate of energy consumption of 0.0033 and an efficiency of 85.22%, while Class B gum, rate of energy consumption is Php 0.0067 and an efficiency of 85.22%. Portable electronic vulcanizer's rate of energy consumption at Php 0.0757 and an efficiency of 85.22%, while the Class B gum the rate of energy consumption at Php 0.15 and an efficiency of 85.22%.

Conventional vulcanizer's rate of energy consumption at Php 1.08 and efficiency of 43.38%, while Class B gum's rate of energy consumption at Php 1.52 and with an efficiency of 78.08%.

This study concluded that the usage of nature's power resulted to a continuous power supply to the vulcanizer; and the accurate temperature and duration of the vulcanizing process using the SPV which eliminates the problem of gas emission (carbon dioxide) produced by the conventional (gas fired) vulcanizer of about 2.772 kg of carbon dioxide for 1 liter of diesel fuel and/or 2.331 kg of carbon dioxide for 1 liter of petrol into the atmosphere.

Keywords— solar vulcanizer, portable vulcanizer, electronic vulcanizer, electric vulcanizer, conventional vulcanizer.

I. INTRODUCTION

This study is all about the utilization of the nature's power - the SUN'S POWER that means no brownout in vulcanization operation. This solar power operated vulcanizer is a green machine and environmentally-friendly equipment. Its design is considered for greening the world to be lived by from generation to generation. The modernization of this gadget is introduced for the benefit of mankind.

Renewable energy dramatically lowers pollution emissions, reduces environmental health risks, and slows the depletion of finite natural resources. Renewable energy is derived from sun, wind, water, or the earth's core. It can also be derived from biomass—or plant matter—which is grown, harvested, and transferred into energy by one of a number of processes.

Therefore, as a green machine, it is an "environment friendly" product. The radiant light and heat from the sun, has been harnessed by humans since ancient times using a range of ever-evolving technologies.

A. Rationale

This electronic vulcanizer and the conventional vulcanizer (carbon dioxide emitting apparatus) have a common problem. In electric vulcanizer, if power supply is cut down during vulcanization, the process is not completed and will result to damage and an uncured vulcanization results. To solve the aforementioned problems and for environmental concern, (gas emission), this innovative technology (solar power vulcanizer) is studied which is expected to be applied over time as technology changes.

B. Flow Chart of the Study

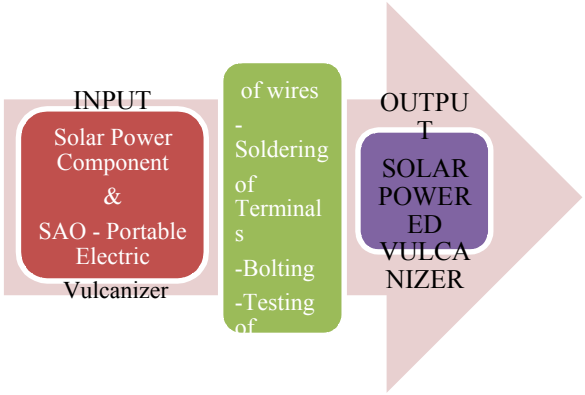

Fig. 1: Flow Chart of the Study

Fig. 1 shows the construction methods of this solar power machine in three steps.

C. Objectives

Specifically, this study was conducted to:

1. identify the design of a solar power vulcanizer (SPV);
2. determine the material component for the solar power electronic vulcanizer (SPV);

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3. find out the efficiency solar power vulcanizer (SPV) in terms of vulcanization operation; and
4. find out the economic feasibility of the solar power electronic vulcanizer.

II. REVIEW OF RELATED LITERATURE

The work environment refers to the aggregate of surrounding things and conditions that affect the quality of work, life and the individual itself being an employee or an entrepreneur.

The Technical Education Skills Development Authority (TESDA) reported the government's quest to realign technician education program to be of paramount importance. Mismatch problems of the education sector and industry are vital issues as regards the graduates of colleges and universities, wherein most of them cannot find jobs because of lack of skills needed by the industry. Hence, graduates of technical courses have wider range of employment compared to those graduates of white collar profession[1].

The technological development begins with basic research when a scientist discovers some new phenomena or advances new theory. Other reaches to examine the breakthrough for its potential utility. If further development leads to a prototype and engineering refinement makes commercial exploitation practical. Then, the technology that is finally put to use and may be widely adopted[2].

Technological changes take place in many directions at once; that is, it is multi-lineal. Bar codes, for example, are used to track items not only in grocery stores but also in warehouses, assembly lines, shipping docks, libraries, even in the Department of Defense. Technological changes are also nonlinear; developments take irregular directions. There are many dead ends, and each highly visible advance may depend on a host of small developments (including failures)[3].

Renewable technologies are designed to capture and store this energy. They include:

- Photovoltaic solar panels convert sunlight directly into electricity.
- Wind turbines capture wind to turn rotors, which turn a generator and creates electricity.
- Transpired solar collectors use sunlight to preheat air for heating purposes.
- Solar hot water heaters use the sun to heat water for domestic applications.
- Small-scale hydroelectric power plants flow water over turbines, which turn a generator and create electricity.
- Fuel cells combine hydrogen and oxygen to produce electricity and heat.
- Ground source heat pumps transfer heat to the ground in summer and extract heat from the ground in winter.
- Green power is electricity generated from renewable sources such as wind, solar, geothermal, biomass, and landfill gas.

Solar Power Tower Design (also known as 'central tower' power plants or 'heliostat' power plants) capture and focus the sun's thermal energy with thousands of tracking mirrors (called heliostats) in roughly a two square mile field. A cost/performance comparison between power tower and parabolic trough concentrators was made by the NREL which estimated that by 2020 electricity could be produced from power towers for 5.47 ₡/kWh and for 6.21 ₡/kWh from parabolic troughs. The capacity factor for power towers was estimated to be 72.9% and 56.2% for parabolic troughs[4].

Levelised Cost. Given the fact that solar thermal power is reliable, can deliver peak load and does not cause pollution, a price of US$0.10 per kWh starts to become competitive. Although a price of US$0.06 has been claimed[5]. With some operational cost a simple target is 1 dollar (or lower) investment for 1 kWh production in a year.

Related Studies

The Philippines today must recognize the present educational technologies status that these may be used whenever possible to enhance and equalize the opportunities in this field of technical education, like in the engineering field, considering that license professional engineers undermine the people who graduated technical education only, even though that these people are sometime more skillful than them. The problem of mismatch does not only embrace from technology graduates but they are included for some do not carry practical skills.

Former President Fidel V. Ramos [6], stressed that the living condition of the people in every sector of society can be improved by initiating family investment or group. He wanted the Philippines to be a New Industrialized Country (NIC) in Asia and the Pacific by 2000 and beyond. Thus, Executive Order No. 318, s. 1991, was passed to reinforce functional program in the implementation toward industrial reform and development.

Vulcanization Methods[7]

A variety of methods exist for vulcanization. The economically most important method (vulcanization of tires) uses high pressure and temperature. A typical vulcanization temperature for a passenger tire is 10 minutes at 170 °C.

Vulcanization is the chemical process by which the physical properties of natural or synthetic rubber are

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improved; finished rubber has higher strength and resistance to swelling and abrasion, and elastic over a greater range of temperature. In its simplest form, heating rubber with sulfur brings about vulcanization.

The Discovery of Vulcanization

Vulcanizing gum is a ready-made natural rubber that is vulcanized to bond the rubber tire. Therefore, vulcanization of rubber is a curing process of rubber that involves high heat and the addition of sulfur or other equivalent curatives[8].

Rubber

Vulcanizing gum is classified according to its texture, bonding temperature and the content of accelerators. The three classes of the gum are as follows[9]:

Class A – usual bonds on the rubber 30°C-70°C and is smooth;
- Use for small punctured and cracks in the inner tube rubber tire.

Class B – usual bonds on the rubber 35°C-80°C and is moderately rough;
- Use for medium or punctured holes and cracks/scars in the inner tube rubber tire.

Class C – usually bonds on the rubber 45°C to 90°C and is very rough;
- Seldom available in the market and is used in tire repairing big and busted with cracks/scars in the inner tube rubber tire and mostly used for tire recapping.

In modern practice, temperature of about $140^0 – 180^0$ C is deployed, and in addition to sulfur and accelerations, carbon black oxides are usually added, not merely as an extender, but improve further the qualities of the rubber. Vulcanizing gum, which is a classified "ready to heat" rubber, is now utilized to repair worn out interior/exterior rubber tires with the help of vulcanizing equipment. Certain problems such as inaccuracy of the product are evident to third-world countries as the first-world never used some[10].

Other Related Studies

Solar power uses the sun's energy to produce electricity. A number of solar technologies are currently available or under development, like a Solar PV is the most familiar solar technology. Photovoltaic's use semiconductor materials—most frequently silicon—to convert sunlight directly into electricity.

The use of fossil fuels like coal and oil cause long term damage to our world. They not only cause air pollution, but reduce the ozone layer and contribute to the greenhouse effect which is causing global warming. They also cause untold damage to the environment.

Solar energy is clean and free of side effects to the environment. Solar panels require little maintenance and usually last 25 or 30 years. Solar panels are made to withstand the elements of the northern climate, such as snow, sleet and hail. Solar increases the value of one's property[11].

The technological development begins with basic research, when a scientist discovers some new phenomenon or advances new theory. Others reach and examine the breakthrough for its potential utility. If further development leads to a prototype, and engineering refinement makes commercial exploitation practical's, then, the technology is finally put to, use may be widely adopted[12].

Engineering and Technology Education goes hand in hand to the rapid pace of globalization which pressures nations to be competitive in order to survive. In this field of education its ushers the freer permeability of human resources among countries. While it poses as a huge challenge to the survival of Filipino workforce in the global market, it yields various opportunities. This challenge pushes for the continuing development and replenishment of manpower through this field of education in order to ensure that there are workers of the right quality and right quantity for jobs that are made available at any given instance. Further, it urges for a stronger labor market intelligence and technology development. Lastly, it encourages transformation of the Filipino workforce to be knowledge-based and adaptable to shifting skills or even occupations [13].

The Philippines today must recognize the present educational technologies status that these may be used whenever possible to enhance and equalize the opportunities in this field of technical education, like in the engineering field, considering that license professional engineers undermine the people who graduated technical education only, even though that these people are sometime more skillful than them. The problem of mismatch does not only embrace from technology graduates but they are included for some do not carry practical skills.

III. MATERIAL AND METHODS

This chapter discusses the processes that were done during the experiment and the tools that were used during the experiment.

A. Rationale

The study utilized experimental research method which includes the new design, selection and identification of materials, assemblage or fabrication, and testing process.

B. Materials

The materials to be used in the assemblage of the SPV for construction were the following:

A. Materials:

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Solar panels, charge controllers, storage batteries, wires and cables, system meters and monitors, solar array disconnect, battery charge controller, deep cycle batteries, solar power converter/inverters, backup power, angle bars, steel bars, and bolts and nuts.

B. Tools & Equipment

Portable electric drill, electric soldering rod, soldering lead, multi tester(digital/analog), welding machine, hacksaw, and ball-pen hammer.

These are the materials to be used to shape up the Solar Power Vulcanizer. The parts is to be collected, measured and welded, boring of holes for bolt and spring placement and assembled as the new semi-auto-open portable electronic vulcanizer.

Fig. 2 shows the schematic diagram of the solar power electronic vulcanizing equipment.

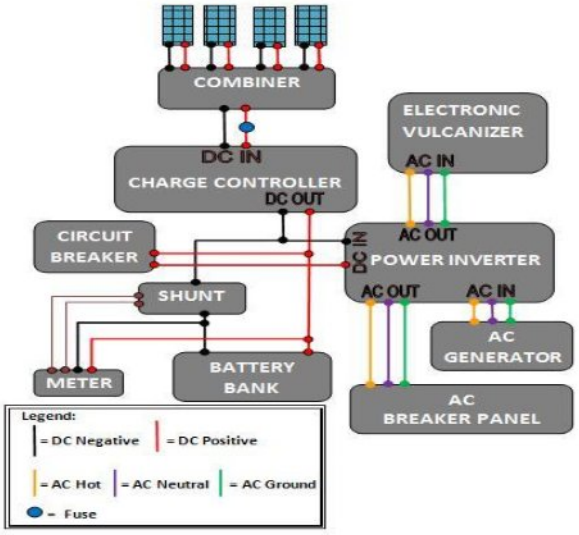

Fig. 2: Schematic diagram of solar power electronic vulcanizing equipment

C. Timetable of Research

This study was conducted during the school year 2013 - 2015 in the Technology Department, College of Engineering, University of Eastern Philippines, University Town, Northern Samar.

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IV. RESULTS AND CONCLUSIONS

The study utilized experimental research method which included the new design, selection and identification of materials, assemblage or fabrication, and testing process:

1. ***New design.*** The new design of the solar power vulcanizer (SPV) vulcanizing equipment was based on the power supply shortage that hampers the vulcanization operation. The following features of this SPV machine are as follows:

1. Vulcanizing Machine

a. The vulcanizing machine weighs 9.25 kilograms; total length of 49 cm, height of 33.5 cm, back width (panel board) of 22 cm with front width (front base) of 14 cm, and environment-friendly.

b. Its body configuration is like a letter L configuration. A movable arm is like a letter J appearance is bolted at the top of the base, that is made of GI pipe schedule, 40 x 49cm in length x 6,3cm in diameter, and attached to it is a detachable vulcanizer head of 15.5cm in length x 6.5cm in width x 1.5cm in thickness.

c. The base was made of channel bar with dimension of 47cm in length x 9cm in width x 6.5cm in height and thickness of 0.30cm that served as foundation of the equipment;

d. A flat type 300 watts mica heating element is attached to the vulcanizer head and a box type panel board of 22 cm in length x 27cm in width x 8cm in thickness.

e. Cost of the vulcanizer machine is Php 8, 786.00

2. **Solar panel components:**

i. Solar panel 250 watts @P15,000/set
-3 sets ---------- Php 45,000.00

ii. Deep Cycle Battery 12volts 150 AH
@ P9,600/unit – 3 units---------- 28,000.00

Industrial inverter 1,500 watts
-1 set (pure sine wave) ---------- 7,200.00

iii. Controller 30 ampere ---------- 2,500.00

iv. Accessories (wiring, switches,
Holders bolt and nuts, etc.) -------- 8,900.00

Total --------- Php 91,600.00

Total Project Cost ---------- Php 100,386.00

3. ***Selection and identification of materials.*** Selection and identification of materials was seriously considered for this study.

4. ***Fabrication.*** Based on the plans and design,

5. ***Testing process.*** Testing of the machine was undertaken to determine the workability of the machine.

The design of this solar power electronic vulcanizer is due to intermittent brownout in the province.

The function of the component parts of the SPV machine comprises seven (7) basic main components, namely:

1. **Solar Panels** - One can order discount photovoltaic cells online, and assemble these into complete 80W, 200W, or 500W solar panels.

2. **Solar Array Disconnect** - This is basically just an electrical switch but is an important part of the system. It allows disconnection and cutting off the DC power output from solar panels and array should any repairs be required or if there is a problem with the solar system.

3. **Battery Charge Controller** - The battery charge controller ensures that a consistent amount of electrical

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power is sent to the batteries so that they are not over charged, and to ensure that the backup batteries do not discharge back through the system at night.

4. **Deep Cycle Batteries** - Deep cycle storage batteries for solar systems are more robust and are designed for the type of charging and discharging cycles they need to endure.

5. **System Power Meter** - Help improve the system to gain the maximum efficiency from solar installation as well as having the advantage of letting neighbors know how much money a solar system saves.

6. **Solar Power Converter** - The solar power converter converts the solar energy from the panels into usable energy in the home by providing the DC to AC conversion using electronic switching techniques.

7. **Backup Power** - This is used when the sun does not shine and the batteries are empty. Most systems will include some sort of backup power. In a stand-alone installation this would generally be a diesel generator. In a grid-tied system the utility grid itself would provide the backup power through the converter.

Data on TABLE 1 & 2 shows that the three vulcanizers had the best temperature at 60°C in which the gum was bonded exactly to the rubber tire. For solar vulcanizer the rate of energy consumption of 0.0033 and an efficiency of 85.22%, while the Class B gum, the efficiency of 85.22%. For electronic vulcanizer the rate of energy consumption at Php 0.15 and an efficiency of 85.22%.

For the conventional vulcanizer, the rate of energy consumption at Php 1.08 and an efficiency of 43.38%, while the Class B gum, the rate of energy consumption at Php 1.52 and with an efficiency of 78.08%.

Table.1: Time/Temperature/Power/Fuel Consumption/ Solar Power/Electronic/Conventional Vulcanizer

Type of Vulcanizer	**Table Column Head**					
	Time in Minutes		***Temperature in °C***		***Power/Fuel Consumed***	
	Class					
	A	B	A	B	A	B
Solar	1	2	60	60	0.005kw-hr	0.10 kw-hr
Electronic[a]	1	2	60	60	0.005kw-hr	0.10 kw-hr
Conventional[a]	5	10	60	60	20ml	30ml

a. Ramis. E.Z. Efficiency of Portable Electronic Vulcanizer, World Journal of Engineering and Technology, Volume 3, No. 1. February 2015. ISBN: 2331- 4222.

Table.2: Efficiency and Rate of Energy Consumed of Solar Power/Electronic/Conventional Vulcanizer

Type of Vulcanizer	***Cost in Kw-hr/ Gas-ml***		***Rate of Energy Consumption***		***Results***		***Efficiency (%)***	
	Class							
	A	B	A	B	A	B	A	B
Solar	Php 0.0067		Php 0.0033	Php 0.0067	Best bonding		85.22%	
Electronic[a]	Php 0.0067		Php 0.0757	Php 0.15	Best bonding		85.22%	
Conventional[a]	Php 0.054		Php 1.08	Php 1.52	Good bonding		43.38%	78.08%

a. Ramis. E.Z. Efficiency of Portable Electronic Vulcanizer, World Journal of Engineering and Technology, Volume 3, No. 1. February 2015. ISBN: 2331- 4222.

Fig. 3 shows that the conventional vulcanizer is also five (5) times behind the operation compared to the solar and electric vulcanizer for both Class A vulcanizing gum. It consumed 20ml of fuel for class A. The efficiency of 43.38% for Class A gum. The solar power vulcanizer was five (5) times efficient Class A and B gum compared to the conventional vulcanizer. It shows also that the cost per kw-hr was only Php 0.0067 for both gums and an efficiency of 85.22% for Class A gum.

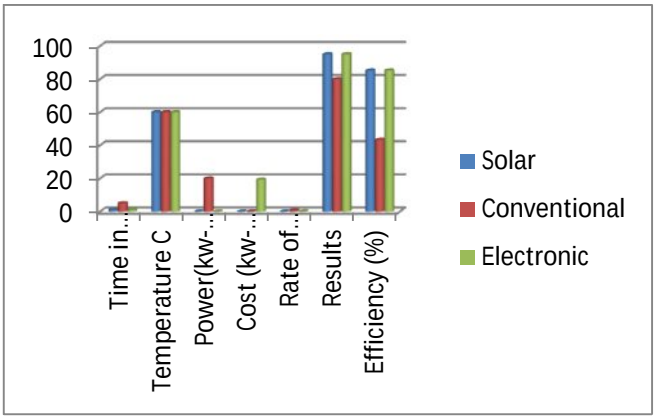

Fig.3:The Solar, Conventional, & Electronics vulcanizers using Class A vulcanizing gum

Fig. 4 shows that the electronic vulcanizer was also five (5) times efficient for Class A and B gum compared to the conventional vulcanizer. It shows also that the power consumed at Php 0.010 kw-hr for Class B gum and cost per kw-hr was only Php 0.0067 for Class B gum. The

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rate of energy was Php 0.15 for class B gum with an efficiency of 85.22%

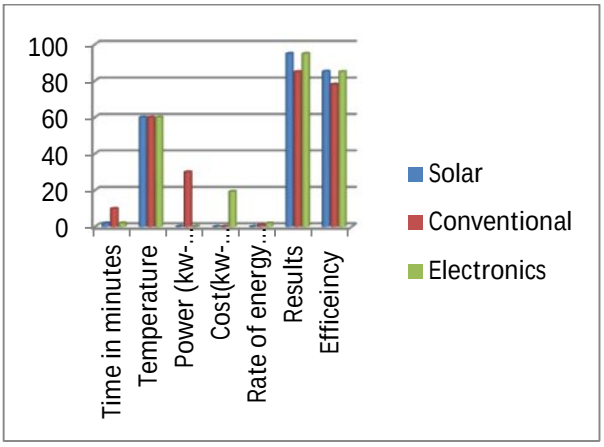

Fig.4: The Solar, Conventional, & Electronics vulcanizers using Class B vulcanizing gum

This study concluded that the usage of nature's power resulted a continuous power supply to the vulcanizer and the accurate temperature and duration of the vulcanizing process using the electronic vulcanizer which eliminates the problem of gas emission[14] (carbon dioxide) produced by the conventional (gas fired) vulcanizer of about 2.772 kg of carbon dioxide for 1 liter of diesel fuel and/or 2.331 kg of carbon dioxide for 1 liter of petrol into the atmosphere.

V. CONCLUSION

This study concluded that the usage of nature's power resulted a continuous power supply to the vulcanizer and the accurate temperature and duration of the vulcanizing process using the electronic vulcanizer which eliminates the problem of gas emission[14] (carbon dioxide) produced by the conventional (gas fired) vulcanizer of about 2.772 kg of carbon dioxide for 1 liter of diesel fuel and/or 2.331 kg of carbon dioxide for 1 liter of petrol into the atmosphere.

The findings of this study have an important implication for future enhancement and improvement of the study. More tires can be vulcanized in a short period of time; therefore increase income over time.

It is suggested that this solar power vulcanizer should be adopted in welding, automotive and machine shops to save time and investment in their operations;

Small time businesses like vulcanizing shops in the Philippines are encouraged to provide this solar power vulcanizing machine so that they can save money and labor in their operation;

It is suggested also that this study be innovated thru additional features like automatic release of vulcanizer head after the vulcanization process.

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