Career Episode 3

Solar Operated Sprayer Design

A) Introduction

[CE 3.1] The work was done at the University of Tolima, Colombia.

Title of Project: Solar Operated Sprayer Design

Duration: [Date] – [Date]

Location: University of Tolima, Colombia

Position: Agricultural Engineering Student

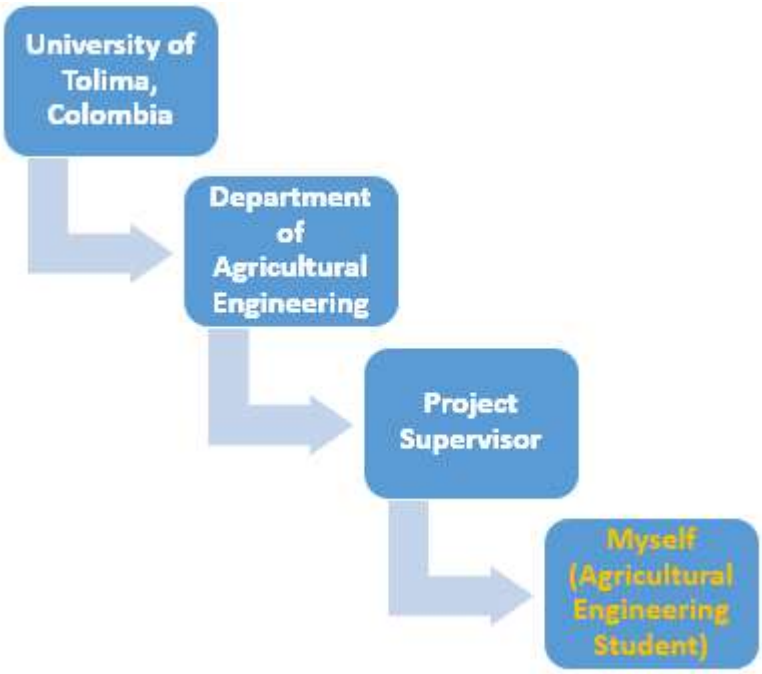
B) Background

[CE 3.2] Meeting increasing energy demand in today's world is an adequate challenge in society. Nuclear energy, coal along with other conventional energy widely utilized in the country and it results in the exhaust which came out after pollutant levels impacting the environment. Thus, in these situations, there is the need for moving forward towards the usage of the non-conventional energy sources which include wind, solar and tidal energy. In all development types, the non-conventional energy sources are becoming popular like in the drying agriculture process, spraying purpose and irrigation purpose.

[CE 3.3] The project's main motive was the designing of the solar operated sprayer which was done with the unique equipment proposal for the users of cultivation. I contributed to the project in a way to conduct research and collect data related to spraying and the issues which farmers were facing during spraying. During the research, I realized that the farmers were using hand-operated technique and it causes user fatigue because of the heavy construction and excessive bulkiness. Thus, I worked on the designing and fabrication of the model which was related to the trolley based solar sprayer and eliminated the sprayer back mounting which was not an adequate technique for farmers. The proposed technique worked well in the user's fatigue level reduction.

[CE 3.4] The work split into sections during the project execution which resulted in getting the needed results in terms of designing the solar operated sprayer within the specified project timeline.

[CE 3.5]



[CE 3.6] My work duties:

- I worked on the selection of the components and it included elements such as DC battery, DC motor, and other components.
- I utilized the plug for carrying out the charging operation using my technical knowledge.
- I made components selection of the solar panel with the 40 watts capacity of the panel which was included in the defined size of the panel.
- I worked on using the charge controller which was mainly for limiting the rate of current needed to be added to the battery.

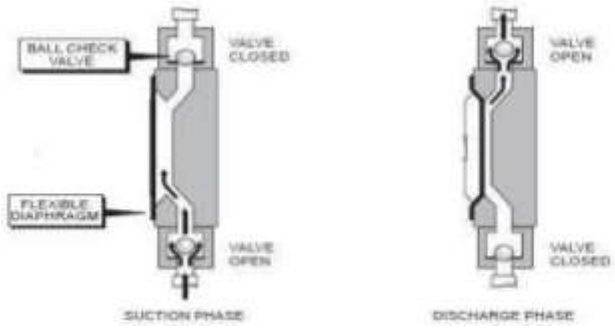
C) Personal Engineering Activity

[CE 3.7] I executed the activities in the design and fabrication of the solar-powered operated dryer with the components of selection according to the set requirements. I selected the components which included DC motor, solar panel, tank, DC battery, DC motor, pipe, nozzle, mounting element, and trolley assembly. I used the tank which had the 25 liters capacity with the PVC material tank utilized for it. I selected the components of the solar panel with the 40 watts panel capacity and it included the defined panel size with the 1.4 kg panel weight. I set the 10W maximum power with a panel weight of 1.4kg. I worked on the set voltage with the 16V and with the 0.5A current rating.

[CE 3.8] I obtained the solar energy which converted into electrical energy with the usage of the photovoltaic effect along with the solar panel. I converted the energy conversion output to the charge which included the lead-acid battery of deep cycle and it worked well with the charge

controller. I used the charge controller which limits the current rate required to be added to the battery. It thus assisted well in the prevention of the overcharging along with providing the overvoltage protection. I applied the PWM technique which resulted in stopping the battery charging with the main benefit of the PWM in terms of lesser power loss for carrying out the switching operation. I provided the charge controller output from the charge controller which was provided to the battery with the 3 pin socket via an electrical network.

[CE 3.9] I analyzed the circuit which had 3 states and these were initiated with the O state in which the switch was off. I kept the current in the dead state but the battery was charged using the plug. I then switched on the second part of the circuit which fell in the second state and calculated the 12V voltage when the circuit was on. Thus, there was no current flow via the connecting wire and I used the plug for charging the battery but there was no operation of the motor. I then carried out the third state in which the switch was turned to 'I'. In this way, the complete circuit was switched 'ON' and the motor-operated while the simultaneous charging was going on via the plug. I controlled the motor's RPM with the variable resistance controlling and the dc motor output was utilized for the diaphragm pump actuation for the fluid pumping. The water diaphragm pump working is underneath in the figure:



[CE 3.10] I selected the DC motor which was for lifting the pesticide form the tank and it worked well in delivering it using the spray gun. I selected the DC motor which had 500gm weight with the operational power set at 10W and the operating voltage was 12V. I worked on the operating current which was at the value of 0.8A with the 1500 rpm worked as the motor speed. I obtained the battery weight which was 2.5 kg with the 12V worked as the operational voltage. I selected an adequate nozzle type with a discharge rate of 0.5 Lt/min. I selected and executed the centrifugal pump with the 0.5 lit/min worked as the liquid discharge and the speed was set at the 1500 rpm value. I worked on setting the suction head and it was fixed at 0.5m with the discharge head of 3m. I then evaluated the diameter of the discharge pipe and the pump output efficiency can be calculated as:

$$\eta = \frac{W * Hm}{1000} / \text{S.P.}$$

[CE 3.11] I selected the battery of the pump according to the set specifications with the lead-acid battery with the 12V voltage and 7A current. I obtained the power which was 84 watts. This was

the power when the circuit was open and as soon as it got shorted, the voltage of 12V with the current of 1.5A was noted which resulted in getting 18 watts power. I attained the battery cost which was Rs. 1200 and the 20 watts solar panel was selected according to the battery output. I then worked on the dimensions with the open-circuit voltage of 22 volts and the short circuit current of 0.9 amperes. I connected the battery to the solar panel via charge controller which led to applying to the load with the calculation of the total power and it resulted to be 18 watts. I also conducted the current theoretical calculations with the battery charging time. I worked on getting the current produced from the solar panel which was based on the maximum current time charging and it was computed well with obtaining the battery ratio in ampere-hours to the full current supplied by the solar panel. I calculated the ampere rating of the battery which was in hour/total current and it was 4 hours.

D) Summary

[CE 3.12] I fabricated the solar-powered sprayer which was for the pesticide and it met the design parameters with the usage of adequate agricultural engineering skills. I executed the project which was for conforming the farm to the spraying technique and it was in the trolley based structure which resulted in the elimination of the sprayer back mounting. The design proposed was decent for farmers' health viewpoint which resulted well in the reduction of the overall fatigue.