

Modified Vacuum Sealer for Rice Packing

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Abstract— This paper aims to develop the vacuum-packed rice sealer for community business in Si Prachan district in Suphanburi province, Thailand. It can pack organic rice for one kilogram per packet. This invention emphasizes on two forms of rice sealing packet: square-shaped and flat-shaped rice sealing packet. This is because these two forms are attractive among the consumers. Additionally, this vacuum-packed rice sealer can identify the electric parameters such as voltage, current and power by data recorder. The findings indicate that, regarding the rice-packed duration packet, the square-shaped rice sealer takes 26 seconds per packet. The electrical energy used is averagely 2.91 watt-hour per packet. On the contrary, the flat-shaped rice sealer takes 19.5 seconds per packet. The average used of electrical energy is 2.21 watt-hour per packet.

Keywords— Vacuum, sealer, packing machine, organic rice

1. INTRODUCTION

Vacuum sealer in this article is used to contain the organic rice in packaging bag with vacuum system for rice distribution. Moreover, vacuum container can keep rice without insect infestation and microbial infection. Vacuum machine are composed of two parts, vacuum pump for taking the air out of the rice bag and sealer part for sealing an organic rice bag by heater to prevent the air leak into rice bag.

There is requirement from farmer who grow the organic rice in Si Prachan district in Suphanburi which is close to Rajamangala University of Technology Suvarnabhumi (RMUTSB), Suphanburi Campus. This farmer group needs to use vacuum sealer for packing their rice. This farmer group grows the organic rice and mills paddy to brown rice by themselves. For marketing demand of organic rice, most customers want to buy the rice in vacuum and shaving bags.

For electrical engineering student project, vacuum sealer is designed and created for helping farmer group to conveniently produce the rice packaging bags. This project wants to promote local knowledge with lifestyle and culture including marketing and health.

2. Theory and Design

For finding problem in community, the authors are interested in organic rice packaging. Then vacuum technique and sealing process are studied to design a simple machine for vacuum and shaving rice packaging. Furthermore, electrical energy and duration of machine

operating are measured to consider about energy economy. Data logger from microcontroller is added to collect electrical parameters of this machine together with power meter. There are several parameters like current, voltage, real power and power factor. Then machine testing are prepared to vacuum and seal many of bags containing the organic rice. The sealer process is shown in figure 1.

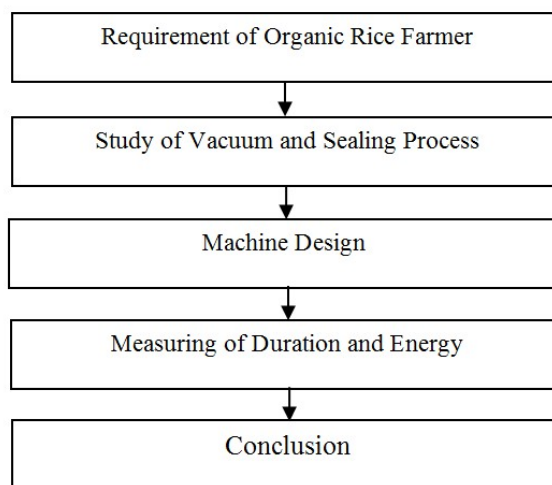


Fig.1. Project Concept

Volume of Air

Air Volume is a multiple of length, width and height in centimeter of vacuum chamber for containing the rice bag. The formula is shown in equation (1).

$$\text{Air Volume} = \text{length} \times \text{width} \times \text{height} \quad (1)$$

Electrical Energy

Electrical power and energy of vacuum sealer are calculated by equation (2) and equation (3) in kilowatt (kW) and kilowatt-hour (kWh).

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$$Power (P) = V.I.\cos\theta \quad (2)$$

$$Energy = Power \times DurationTime \quad (3)$$

Machine Design

In figure 2, mechanical drawings show the objects as side view, front view and top view of vacuum sealer in millimeter. Three dimensional design of machine are presented in figure 3.

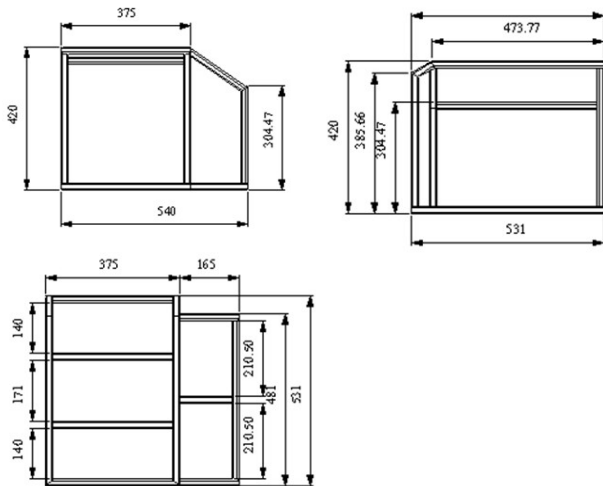


Fig.2. Structure Design

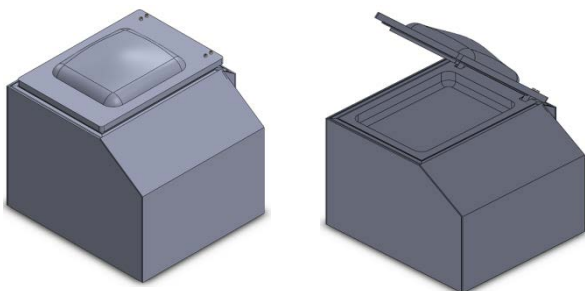


Fig.3. Three Dimensional Structure Design

Data loggers

Data collection equipment is microcontroller Aduino applied to keep electrical parameters such as voltage, current and power of vacuum sealer. The data are recorded in microSD card memory. Data logger set comprises voltage and current sensors, counter and display screen as presented in figure 4.

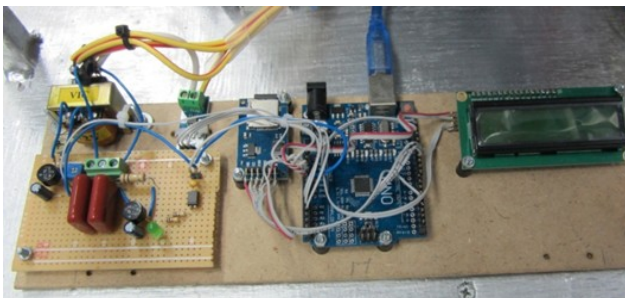












Fig.4. Microcontroller for Data Logging



Fig.5. Vacuum Sealer

3. Results

Table 1. Sealing on Rice Bags

No.	Sealing Testing
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

After the sealer machine is built already as shown in figure 5, vacuum sealer testing is needed to validate and verify the experimental results such as sealing on rice bags that the plastic bag is sealed as presented in table 1. Each pictures of sealing on rice bag in table 1 represent the duration time which is suitable to seal bag tightly. These duration time is added every 0.5 minute until 4.5 minutes to consider the sealing on plastic bag. There are two types of rice bags consist of square shape and flat shape. For square shaped bag, the appropriate duration is 3 seconds and 2.5 seconds for flat shaped bag.

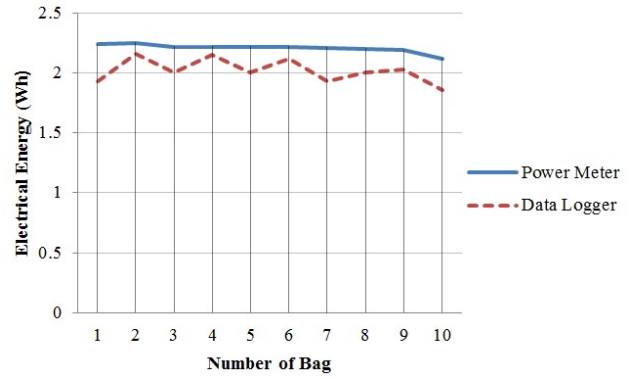


Fig.6. Electrical Energy of Vacuum System for Square Shaped Bags

Measuring of electrical energy of vacuum system that exclude sealing system, the average energy for square shape is 2.21 watt-hours by power meter and 2.02 watt-hours by data logger in duration time 21 second as shown in figure 6. Average error of energy measuring from data logger compare with power meter is 8.66 percent.

Table 2. Electrical Parameters of Vacuum System

Number of bags	Voltage (V)	Current (A)	Power)W(Power Factor ($\cos \theta$)	Vacuum Pressure)Pa(
1	217.7	2.10	379	0.821	-0.098
2	217.6	2.05	367	0.816	-0.098
3	217.6	2.07	370	0.817	-0.098
4	217.9	2.02	361	0.812	-0.099
5	218	2.06	369	0.816	-0.098
6	218.2	2.06	371	0.818	-0.098
7	218.0	2.06	371	0.818	-0.098
8	217.7	2.04	367	0.818	-0.098
9	218.0	2.06	371	0.818	-0.098
10	218.0	2.05	369	0.818	-0.098
Average	217.8	2.05	369	0.817	-0.098

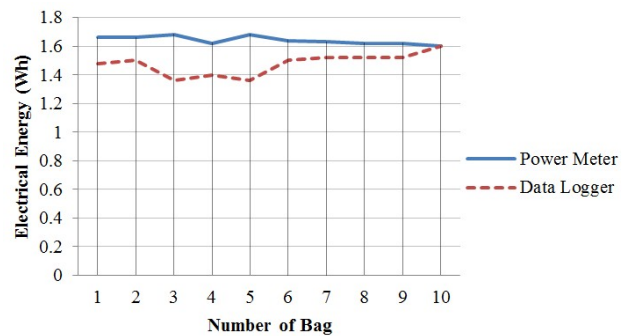


Fig.7. Electrical Energy of Vacuum System for Flat Shaped Bags

Measuring of electrical energy of vacuum system

that exclude sealing system, the average energy for square shape is 1.64 watt-hours by power meter and 1.48 watt-hours by data logger in duration time 21 second as shown in figure 7. Average error of energy measuring from data logger compare with power meter is 9.98 percent.

Table 3. Electrical Parameters of Sealing System

Number of bags	Voltage (V)	Current (A)	Power (W)	Power Factor ($\cos \theta$)
1	216.8	3.77	821	0.999
2	216.5	3.83	833	0.999
3	216.7	3.80	828	0.999
4	217.0	3.71	818	0.999
5	216.9	3.78	824	0.999
6	217.7	3.75	818	0.999
7	216.8	3.72	811	0.999
8	216.5	3.70	805	0.999
9	218.6	3.67	802	0.999
10	216.9	3.73	814	0.999
Average	217.0	3.74	817	0.999

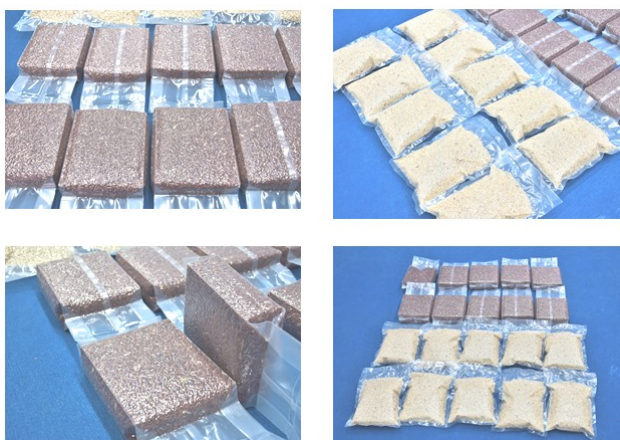


Fig.8. Organic Rice Packaging Bags

For the results in table 2 and table 3 show the measured values of ten bag are voltage, current, power, power factor and vacuum pressure. The average power of vacuum system is 372 watts and the average power of sealing system is 817 watts. Packaging bags containing the organic rice for one kilogram per bags are shown in figure 8. Experimental measuring of rice bags, duration time for square shaped bag for vacuum and sealing consists of vacuum time 21 seconds, sealing time 3 seconds and the open and close time of the air 2 seconds that the total time is 26 second. The duration time for flat shaped bag for vacuum and sealing consists of vacuum time 15 seconds, sealing time 2.5 seconds and the open and close time of the air 2 second that the total time is 19.5 seconds.

However, skill of users can help for speed of packaging, for example the first user is from farmer group who has more experience about sealing of rice, she can pack for 30 bags per hour. Our student who has no skill for rice packaging undertake to pack for 22 bags per hour.

4. CONCLUSION

The experimental results of vacuum sealer shows that the machine can be used to package the square shape and flat shape of rice bags for one kilogram contained organic rice. The square shape of rice bag are vacuumed with pressure -0.1 pascal. Average duration time for one bag packaging is equal 26 seconds. Average electrical energy is consumed about 2.9 watt-hours. The flat shape of rice bag are vacuumed with pressure -0.091 pascal. Average duration time for one bag packaging is equal 19.5 second. Average electrical energy is consumed about 2.21 watt-hours.

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REFERENCES

- [1] M. Sidik, The quality changes of rice stored under vacuum condition, Journal of Agricultural Technology, Vol.1 No.3, December, 2000

- [2] C. Ketkaew, J. Klankham, T. Choowong, A. Phuchuay and W. Wuthi-Udom, Organic Rices Vacuum Packing Machine, In *Proceedings of The RMUTCON conference: Phranakhon Si Ayutthaya, Thailand, 2015*
- [3] J. Boonmak and J. Utti, Packaging Development for Chiangmai Organic Agricultural Coop's Organic Brown Rice, online: <http://journal.rmutp.ac.th/wp-content/uploads/2014/08/Special-Business-Administration-06.pdf>
- [4] C. K. Alexander and M. N. O. Sadiku. 2004. *Fundamental of Electric Circuit Analysis*. second edition. McGraw-Hill.