EFFICIENCY IMPROVEMENT OF RICE POLISHING CYLINDER AXIAL FOR SMALL RICE MILL IN THE COMMUNITY

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Abstract - The objective of this research was to improve the efficiency of rice polishing cylinder axial for small rice mill in the community. From the surveying of problems in the community that use small rice mills with Choltee Subanan rice mill factory at Ubon Ratchathani province in Thailand. It found the axial of rice polishing cylinders have many rust on surface because the axial is made from steel In addition, the binder for casting has magnesium chloride saline. So, it is easy many rust on axial. Therefore, there is an idea to improve this trouble has 2 ways were axial zinc plating and changed axial material by stainless steel instead. When compared the efficiency of rice mill of three types axial that covered original axial in the marketing by Minitab Release 14 Program evaluation. We found the rice polishing cylinder that used stainless steel axial has the best effective and original axial with zinc plating axial have the effective in the following sequence. In addition, we found the type of axial has affected to the wear rate, broken rice percent and rice milling quantity by significant at level 0.05.

Keywords - Axial, rust, effective, rice polishing cylinder

I. INTRODUCTION

In the past until to present, a rice milling machine are used as the agriculture based machinery for Thai agriculturist. Currently, a small rice milling machine which has capacity as 1-2 ton per day is widely used by agriculturists since a small rice milling machine uses less production time and more convenient to use in household. Normally, a small rice milling machine has 2 different types : vertical axle and horizontal axle. Generally, the horizontal axle which are driven by electric motors is extensively used because it has low price and it can easily purchased locally.

The quality of peeled rice depends on several factors such as types of paddy, grain shape and size, paddy moisture content and processes of shelling and polishing [1]. The process of rice polishing is an important step and the percentage of good peeled rice rely on the quality of rice polishing cylinder [2-4]. In general, the rice polishing cylinder consists of two composite materials which are abrasive material and binder material [5]. The abrasive material consists of the emery grain stone and silicon carbide. The binder material comprises of calcined magnesite cement and magnesium chloride that this binder have affect the quality of rice polishing cylinder and milling performance [6-9]. From the surveying of problems in the community that use small rice mills with Choltee Subanan rice mill factory at Ubon Ratchathani province in Thailand.

It found the axial of rice polishing cylinders have many rust on surface because the axial is made from steel in Fig. 1. In addition, the binder for casting of rice polishing cylinder has magnesium chloride saline. So, it is easy many rust on axial.



Fig. 1 The rust on surface of rice polishing cylinder axial

This trouble has affected life time of rice polishing cylinders are short time around 1 year. In addition, it has affected the adhesion effective between abrasive material and binder material is not so good. There are some cases that are brittle cracking occurs during the rice milling as shown in Fig. 2. It is unsafe to use and the rice mill machine is damaged.



Fig. 2 The brittle cracking of rice polishing cylinder

From the above problems, there is an idea to improve the efficiency of rice polishing cylinder axial. The most cost of rice polishing cylinder is axial around

50-70 percent, depending on the quality of steel. The study reviews about rust protection technology has popular method is zinc plating.

This method has prevented corrosion and increase the wear resistance. In addition, there has developed stainless steel for rust protection in the industrial in present.

Therefore, it will be applied the method above to improve the efficiency of rice polishing cylinder axial and the reasonable of this research.

II. EXPERIMENTAL PROCEDURES

A. Material preparation and equipment

1) The axial of rice polishing cylinder has tested to separate 3 types were stainless steel axial, zinc plating axial and original steel axial in the market.
2) The casted specimen and the casted rice polishing cylinder used the same proportion of abrasive material: binder material as 5:1. The horizontal axle rice milling machine was used to test the rice milling.
3) Rice for testing was Jasmine Rice 105 (Industrial standard 888-2532) and paddy moisture content was controlled not to be exceed 14% and all scrap were removed. Each testing batch consisted of 20 kilograms of Jasmine Rice.
4) Minitab Release 14.00 program has licensed was used to evaluate the experimental results and used T-Test function for comparison of each axial type.

B. Design of Experiments

The experiment was separated into 2 parts.

1) Cast the rice polishing cylinders have 3 types were stainless steel axial, zinc plating axial and original steel axial in the market. The quantity of rice polishing cylinder per type was 3 pieces.
2) Test the rice mill efficiency of each rice polishing cylinder axial based on the broken rice percent, the wear rate and the quantity rice milling values. All cylinders used the proportion of abrasive materials: binder material as 5:1.

III. IMPLEMENTATION AND RESULTS

A. Results of wear rate evaluation from 3 axial types

When we brought rice polished cylinder axial 3 types that tested as showed in Fig. 3 for casting as below

1) rice polishing cylinder that zinc plating axial
2) rice polishing cylinder that used stainless steel axial
3) rice polishing cylinder that used original steel axial

After the casting finished, we led the wear rate of rice polishing cylinder from experimental to evaluate by T-Test function in Minitab Release 14, the results are show in Fig.4 and Fig.5.



Fig. 3 rice polished cylinder axial 3 types

Variable	N	Mean	StDev	T	P
Stainless Steel AC	3	4.70333	0.69974	-223.51	**0.000**
Original Steel AC	3	4.74000	0.75425	-207.27	**0.000**
Zinc Coat AC	3	6.62000	0.96659	-158.37	**0.000**

Fig. 4 Wear rate mean of 3 axial types from T –Test

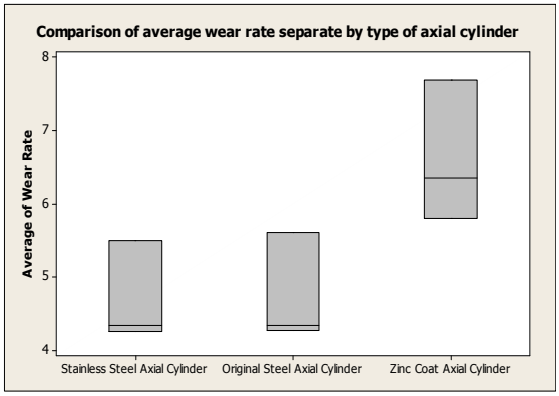


Fig.5 Comparison of average wear rate of 3 axial types

From the evaluation T-Test of wear rate mean from 3 axial types that showed in Fig.4, we found type of axial has affected the wear rate of rice polishing cylinder by significant because P-Value less than 0.05. In addition, we found the average wear rate of rice polishing cylinder that used stainless steel axial was lowest as 4.703 g/hr. In subsequent, the rice polishing cylinder that used original steel in the market and the rice polishing cylinder that zinc plating were 4.74 g/hr and 6.62 g/hr in respectively as shows in Fig.5.

B. Results of broken rice percent evaluation from 3 axial types

From the evaluation T-Test of broken rice percent mean from 3 axial types that showed in Fig.6 , we found type of axial has affected the broken rice percent of rice polishing cylinder by significant because P-Value less than 0.05.

In addition, we found the average broken rice percent of rice polishing cylinder that used stainless steel axial was lowest as 32.22%. In subsequent, the rice polishing cylinder that used original steel in the market and the rice polishing cylinder that zinc plating were 33.00% and 37.67% in respectively as shows in Fig.7.

Variable	N	Mean	StDev	T	P
Stainless Steel AC	3	32.2233	1.0722	-101.41	**0.000**
Original Steel AC	3	33.0000	1.1995	--89.52	**0.000**
Zinc Coat AC	3	37.6700	1.0000	-99.30	**0.000**

Fig. 6 Broken rice percent mean of 3 axial types from T-Test

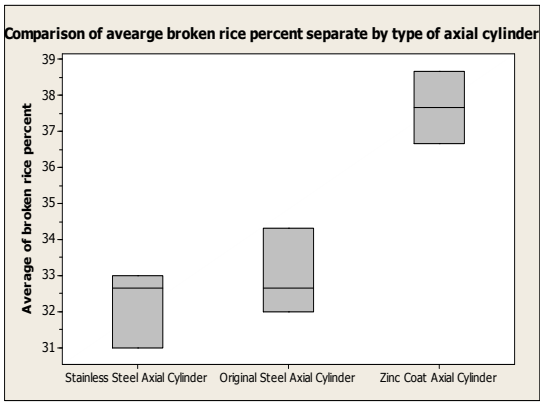


Fig.7 Comparison of broken rice percent from 3 axial types

C. Results of rice mill percent evaluation from 3 axial types

From the evaluation T-Test of rice mill percent mean from 3 axial types that showed in Fig.8 , we found type of axial has affected the rice mill percent of rice polishing cylinder by significant because P-Value less than 0.05. In addition, we found the average rice milling quantity of rice polishing cylinder that used stainless steel axial was highest as 63.55. In subsequent, the rice polishing cylinder that used original steel in the market and the rice polishing cylinder that zinc plating were 62.22 and 61.88 in respectively as shows in Fig.9.

Variable	N	Mean	StDev	T	P
Stainless Steel AC	3	63.5500	0.7000	-77.82	**0.000**
Original Steel AC	3	62.2167	0.7654	-74.19	**0.000**
Zinc Coat AC	3	61.8833	0.6252	-91.75	**0.000**

Fig.8 Rice mill percent mean of 3 axial types from T-Test

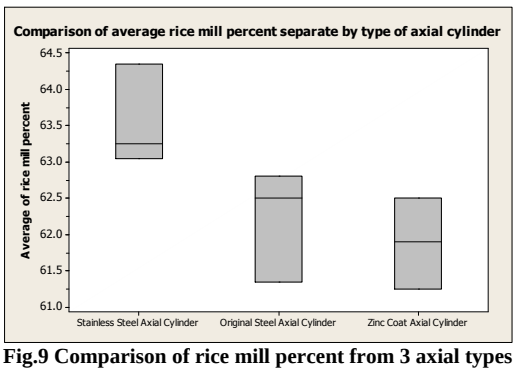


Fig.9 Comparison of rice mill percent from 3 axial types

D.Testing Result of rice mill efficiency

The rice mill efficiency of each axial types were compared based on the broken rice percent and rice mill percent after rice milling and the wear rate of the cylinder. T-test function was used to analysis and evaluate the efficiency of each cylinder at the significance level of 0.05. When we compared the cost of axial types and above items are show in Table.I

Detail	stainless steel axial Cylinder	zinc plating axial Cylinder	original steel axial Cylinder
Average broken rice percent	32.22	37.67	33.00
Average wear rate	4.703	6.620	4.740
Average mill rice percent	63.55	62.22	61.88
Cost of axial material (baht)	1,065	1,000	700

Table I: Efficiency Evaluation of Rice Polishing Cylinder

When we compared between cost of stainless steel axial as 1,075 baht which similar to the steel axial that zinc plated as 1,000 baht. These axial condition above have higher than the original steel axial in the market price as 700 baht. However, the original steel can be used no more than 3 times because it has many rust was eroded on steel.

When compared with zinc plating axial and stainless steel axial, we found this axial can be used more than 3 times and reduced cost of replacement axial around 300 baht/time. The axial no rust is a good selection for farmers who are customers.

IV. CONCLUSION

1. The average wear rate of rice polishing cylinder that used stainless steel axial was lowest as 4.703 g/hr. In subsequent, the rice polishing cylinder that used original steel in the market and the rice polishing cylinder that zinc plating were 4.74 g/hr and 6.62 g / hr in respectively.
2. The average broken rice percent of rice polishing cylinder that used stainless steel axial was lowest as 32.22%. In subsequent, the rice polishing cylinder that used original steel in the market and the rice polishing cylinder that zinc plating were 33.00% and 37.67% in respectively.
3. The average rice milling quantity of rice polishing cylinder that used stainless steel axial was highest as 63.55. In subsequent, the rice polishing cylinder that used original steel in the market and the rice polishing cylinder that zinc plating were 62.22 and 61.88 in respectively.
4. The axial of rice polishing cylinder has affected the wear rate, broken rice percent and rice milling quantity because it was an important equipment and affected the balance of rice polishing cylinder in the rice milling. The rust was eroded on axial can effect to the balance of rice polishing and rice milling.

5. The research in future for reduction cost can use pozzolan material binder in domestic to replace instead import binder by apply with improvement axial cylinder

V. ACKNOWLEDGEMENT

Thank to Scinece Park Ubon Ratchathani University (Spark UBU) and Choltee Subanan rice mill factory for research fund support. Thank you Faculty of Engineering (UBU) for research equipment and conference budget support.

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