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Cite as: AIP Conference Proceedings **1977**, 020019 (2018); https://doi.org/10.1063/1.5042875
Published Online: 26 June 2018

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Designing a Chicken Feed Pellets Machine using Tapered Roller Wheel Model

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Abstract. This study aims to improve the quality and quantity of chicken feed pellets through the development of pellet machines using a taper wheel model. The development of pellet machines using tapered wheel roller model begins by designing machine components, assembling, assembling, testing, and analyzing test result data. The pellet system consists of 4 rollers of tapered wheels that feed the feed ingredients into a molding hole. The working principle of pellet four-wheel drive system is the main axle driven by electric motors with 1 HP power. This shaft rotates a mold plate having holes 4-6 mm in size. The feed mixture is fed into the input funnel. Furthermore, feed mixture is put into the mold hole after being pressed by four wheels roller. The feed mixture will be fused and solidified after passing through a tapered and cylindrical molding hole. The design of the machine pellet four tapered roller wheel system found that the average particle density and bulk density of pellet chicken feed were about 363 kg/m^3 and 726 kg/m^3. The average capacity of the machine was 24.0 kg/hr. The percentage of durability of pellet and broken pellet were about 86.22 % – 89.48 % average 87.77 % and 10.52% – 13.78 % average 8.27 % respectively.

INTRODUCTION

Nowadays, the dependence of poultry breeders on the multi-national feed industry is very strong. This is due to the quality assurance and continuity of the feed supply from the factory, thus enabling the production of large quantities of livestock. Therefore, livestock business and feed pricing will be dominated and determined by large entrepreneurs. Explorative research on the potential of feed ingredients and local technology should continue to be studied and developed. Educated people, practitioners and farmers need to work together in a synergy, sustainable and professional, in which it is expected to grow to be efficient self-sustainable farmers [1].

Currently, the employment opportunities of educated personnel are still limited due to the fact that the share of animal feed is controlled by several large factories that have several branches in each city. The large factories are able to cover all the needs of feed, whether owned by smallholders or companies. A company has one or two nutritionists who are able to provide formulation services for some factories.

The optimization of the potential of large local raw materials, the number of educated staff in the field of animal husbandry, and the high unemployment of productive forces can be done by opening a feed mill as a new company. This effort can reduce the dependence of animal feed from large factories. The production of pellet feed with adaptive technology using local equipment and raw materials should be continuously improved [1].

Making chicken feed in the shape of pellets in large capacity requires a machine. Various kinds of chicken feed pellets machines have been circulating, but the price is still expensive, which make it extremely difficult for chicken breeders to afford. Thus, it is necessary to make a breakthrough by making pellet machine using cheap and light material, small driving force in order to generate pellet machine that could be afforded by most farmer society [2].

The Pellet machines for poultry or chicken feed which are already sold in the market is generally made for large capacity and with quite expensive price. The fundamental problem is the amount of power the machine needs to

Human-Dedicated Sustainable Product and Process Design: Materials, Resources, and Energy
AIP Conf. Proc. 1977, 020019-1–020019-5; https://doi.org/10.1063/1.5042875
Published by AIP Publishing. 978-0-7354-1687-1/$30.00

produce the pellet-shaped feed. In addition, there are some other disadvantages such as drive engines that often die suddenly due to high workload; maintenance and repair is difficult because some machine components are connected permanently. The printing cylinder cannot be opened and closed and produces only one type of pellet feed size.

The pellet machine for fish feed with centrifugal system has been developed by [3, 4]. The working principle of this machine is the dough feed ingredients are fed through the funnel and then feed down into the stir bar. The mixed feed in the tube will come out through the holes in the cylinder wall due to centrifugal force, but this method is still less than optimal. The production capacity of this machine is 1 kg / hour with the percentage of pellets destroyed reaches 60%. Furthermore, Rashid et al. (year) has modified this tool by adding a suppressor system so that the tool can already produce pellet shape feed with a cotton capacity of 3.27 kg/hr has been produced prototype pellet roller wheel system machine for the home industry. The working principle of the pellet roller system machine is a feed material poultice chicken is inserted into the input funnel and then the material into the rotating disk hole by the way pressed by the roller wheel. The capacity of this machine is 26 kg/hour with 800 rpm engine speed. The advantage of this machine is a relatively small motor power of 0.75-1 HP [4].

EXPERIMENTAL METHOD

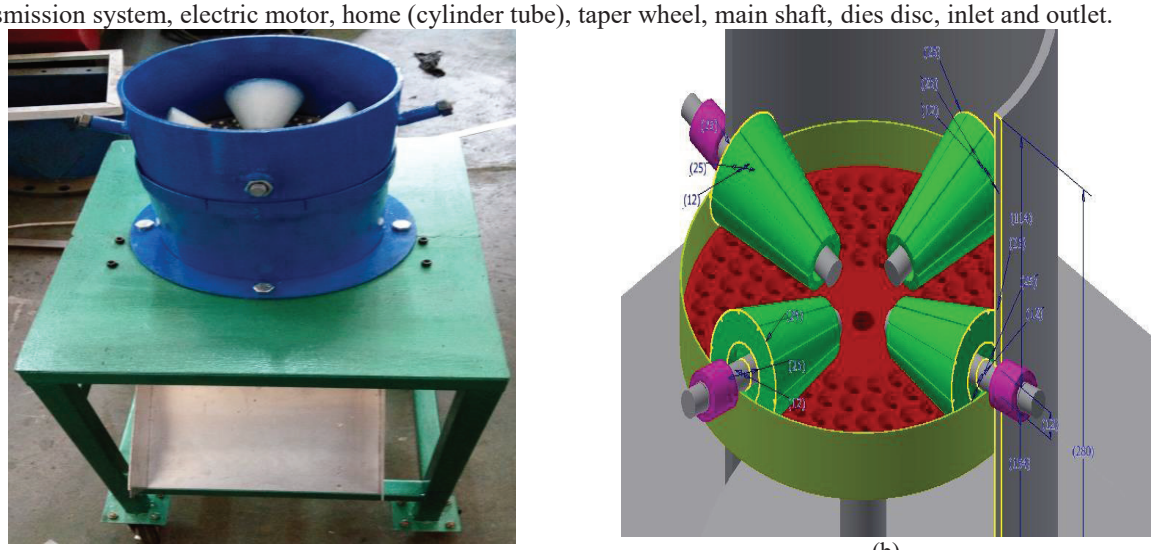
Materials and Equipment

The materials used to make pellet wheel roller machine are s aluminum plate, steel plate, steel pipe, L profile steel, shaft steel, and solid plastic. While the equipment used are electric motor, pulley, V-belt, paint, feed material, and starch. The supporting equipment for pellet machine making are lathe machine, CNC milling machine, plate bending machine, plate cutting machine, welding machine, hand grinding machine, drilling machine, and measuring tools.

Method

The focuses of the pellet feed machine design of the four-wheel turbine grinder are: (a) an ergonomic engine frame, (b) removable tubular wall construction, and (c) the removable and replaceable mold plate. Machine assembly is grouped according to the order of assembly order, either the component made or the component purchased. After assembling, this machine is tested to determine the quality and production capacity of chicken feed pellets.

Figure 1 shows the design results of pellet four-wheel drive system and four models of tapered roller wheel system. Pellet four-wheel system tapered grinding wheel consists of several components, namely main frame, pulley and belt transmission system, electric motor, home (cylinder tube), taper wheel, main shaft, dies disc, inlet and outlet.



(a) (b)

FIGURE 1. (a) Chicken feed pellet machine, (b). Four pieces of tapered roller wheel model

The working principle of pellet four-wheel drive system is the main axle driven by electric motors with 1 HP power. This shaft rotates a mold plate having holes 4-6 mm in size. The feed mixture is fed into the input funnel.

Furthermore, feed mixture into the mold hole after being pressed by four wheels roller. The feed mixture will be fused and solidified after passing through a tapered and cylindrical molding hole.

The prepared feed mixture includes 500 grams of feed, 100 grams of starch, and 400 grams of warm water [4], was inserted into mixer and then the weight to be 1 kg per tank, 5 tanks for testing five times. The density is measured before compression; timing of chicken feed pellets and then takes the feed chicken pellets to reduce the moisture by using solar energy. Then, weigh the total of feed mixture and sampling of chicken feed pellets to find the particle density and bulk density of pellet, and the capacity of machine molds. The test parameters are variations in the hole diameters (4, 5, 6 mm) and engine rotation (300, 400, 500, 600 rpm).

The wheel diameter, ratio, and length of conveyor belt can be calculated using the equation as follows [5]:

$$n_2 = n_1 \times d_1/d_2 \quad (1)$$

$$i = d_1/d_2 \quad (2)$$

$$L = 2C + 1.57\,(d_1+d_2) + (d_1-d_2)/4C \quad (3)$$

RESULTS AND DISCUSSION

A feed mixture of 1000 grams is inserted into a pellet machine with 300 rpm of rotation. It will produce pellets through a disc hole with 4 mm diameter. The time required to produce chicken feed pellet is 205 second with an average weight of 789 grams. The average of operation time is 13.9 kg/h. The experimental result is shown in Table 1 and Table 2. In Table 1 it can be seen that the fixed diameter of the hole with the higher engine rotation variation indicates an increase in production capacity. The highest pellet production capacity of 31.8 Kg / h occurs at 600 rpm engine speed and mold hole with diameter of 6 mm. This can occur because of the intensity of the pressing and extrusion processes in the feed material into the higher molding holes. This result is in accordance with research conducted by Rashid [3] that the higher the engine rotation the greater the production capacity.

Compared to previous research conducted by Rasyid [3-4], the use of 4 grinders in this study could increase the production capacity from 26 Kg / hr. to 31.8 Kg / hr. This can happen because of the difference in the number and shape of the rollers.

The average particle density and bulk density of pellet feed chicken are about 363 kg/m^3 and 726 kg/m^3. An increase in the mass density of chicken feed pellets may occur due to the compaction process occurring in the molding holes. Where the mold hole has a tapered shape (countersink) at a depth of 0.5 from the thickness of the disc mold resulting in volume reduction in the molding hole. This is in accordance with the results of research conducted by Rashid [4] which states the shape of the molding hole affects the compaction rate on the printed feed material.

TABLE 1. The experimental result of the machine

No	Hole Diameter (mm)	Rotation Speed (rpm)	Average Weight (gram)	Time (s)	Capacity (Kg/hr.)
1	4	300	789	205	13.9
		400	842	164	18.5
		500	813	136	21.5
		600	820	125	23.6
2	5	300	876	157	20.1
		400	893	139	23.1
		500	891	128	25.1
		600	890	116	27.6
3	6	300	883	125	25.4
		400	897	117	27.6
		500	917	113	29.2
		600	936	106	31.8

The percentage of durability pellet and broken pellet were about 86.22% – 89.48% (87.77 % average) and 10.52% – 13.78% (12.23% average) respectively. These results have difference for percentage of durability in the Lawong's

research. Lawong et al. develop pellet organic fertilizer compression machine. The percentage pellet of durability and broken are 91.73% and 8.27% respectively [6].

TABLE 2. The durability of pellet

No	Hole Diameter (mm)	Rotation Speed (rpm)	Average Weight (gram)	Weight of durability pellet (gram)	Weight of broken pellet (grams)	Percentage of durability pellet (%)	Percentage of broken pellet (%)
1	4	300	789	706	83	89.48	10.52
		400	842	754	88	89.55	10.45
		500	813	705	108	86.72	13.28
		600	820	706	114	86.10	13.90
2	5	300	876	787	89	89.84	10.16
		400	893	798	95	89.36	10.64
		500	891	779	112	87.43	12.57
		600	890	778	112	87.42	12.58
3	6	300	883	770	113	87.20	12.80
		400	897	780	117	86.96	13.04
		500	917	797	120	86.91	13.09
		600	936	807	129	86.22	13.78

The increased durability of the feed material after the molding process is not only influenced by the compaction process in the molding hole, but also influenced by the composition ratio of feed mixture (feed material, adhesives, and warm water). This is in accordance with the results of a study conducted by Fairfield [7-10] which states that the factors affecting the durability of pellets are the characteristics of the raw material, in this case the factors in question are protein, fat, fiber, starch, density (density), texture, and water and the stability of material characteristics, which will produce good pellet quality. The particle size of the raw material greatly affects the quality of the pellets and the resulting pellet production. The particle size of the feedstock is influenced by the fineness content of the raw materials used in the manufacture of pellets [7-10]. Dosier [11] states that the quality of pellets is seen from the value of the durability of pellets, which is indicated by the physical integrity of the pellets after handling and transporting with the least amount being fine or damaged.

CONCLUSION

The design of the machine pellet four tapered roller wheel system found that the average particle density and bulk density of pellet chicken feed were about 363 kg/m^3 and 726 kg/m^3. The average capacity of the machine was 24.0 kg/hr. The percentage of durability of pellet and broken pellet were about 86.22 % – 89.48 % average 87.77 % and 10.52 % – 13.78 % average 12.23 % respectively.

ACKNOWLEDGMENT

This paper based on work supported by DIKTI grant. I would like to thank The Ministry of Research, Technology and Higher Education of the Republic of Indonesia and Politeknik Negeri Ujung Pandang for funding and supporting.

REFERENCES

1. D. Glover, and K. Kusterer, 2016. Small farmers, big business: contract farming and rural development. Springer.
2. M. Tanaka, Katsu Manufacturing Co., Ltd., 1993. Pellet making machine for producing pellets from a strand. U.S. Patent 5,186,959.

3. Rasyid, Syaharuddin and Tri Agus Susanto. 2015. Design of Machine Pellets for Animal Feed Chicken with roller Wheel System. Proceedings of the National Seminar Industrial Technology III, ISBN 978-602-14822-2-3. Politeknik ATI Makassar, Ministry of Industry of the Republic of Indonesia.
4. S. Rasyid, T. A. Susanto and R. Nur, 2017, March. The Influence of Mixed Composition and Hole Mould on the Quality of Chicken Feed. In IOP Conference Series: Materials Science and Engineering (Vol. 180, No. 1, p. 012026). IOP Publishing.
5. W. Lawong, P. Hwangdee, S. Thumma and C. Lawong, 2011. Development of two pellet die organic fertilizer compression machine. Procedia Engineering, 8, pp.266-269.
6. M. F. Spotts, T. E. Shoup and L. E. Hornberger, 2004. Design of machine elements (Vol. 1). Prentice Hall.
7. D. Fairfield, 1994. Pelleting cost center. In: Feed Manufacturing Technology IV, R. Mc Ellhiney, ed. pp. 121-122.
8. F. Fairchild and D. Greer. 1999. Pelleting with precise mixer moisture control. Feed International, Aug: 32-36.
9. Khalil. 1999a. Effect of water content and particle size on changes in physical behavior of local feed ingredients: pile density, pile compaction density, and specific gravity. Livestock Media 22 (1):1-11.
10. Khalil. 1999b. Effect of water content and particle size on changes in physical behavior of local feed ingredients: pile angle, threshold and hygroscopic factors. Livestock Media 22 (1): 33–42.
11. W. A. Dozier, 2001. Pellet quality for most economical poultry meat. J. Feed Int. 52: 40-42.