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PREFACE

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PREFACE

The International Symposium on Agricultural and Biosystem Engineering (ISABE) has been growing to be one of high-quality international symposiums in Indonesia in the field of Agricultural and Biosystem Engineering. Hence, this year, Department of Agricultural and Biosystems Engineering, Universitas Gadjah Mada in collaboration with Department of Agricultural Technology, Hasanuddin University proudly present **The 3rd ISABE 2019**.

The theme of The 3rd ISABE 2019, The Role of Agricultural and Biosystem Engineering towards Sustainable Development Goals 2030: Food, Water, Energy and Environment, has been carefully chosen to emphasize our role in achieving Sustainable Development Goals 2030. Through this meeting, we provide great opportunities to deliver and discuss your research to broader audiences. Moreover, this symposium offers an occation to extend our network among academia, government and industry which increases the possibilities for collaboration.

Our symposium is rich and varied with 1 keynote speech and 7 invited talks. I am very pleased to welcome the keynote speaker: Dr. Ir. Andi Amran Sulaiman, MP (Minister of Agriculture of the Republic Indonesia) and invited speakers: Prof. Jong Hoon Chung (President of Asian Agricultural and Biological Engineering Association, President of Korean Society for Agricultural Machinery), Assoc. Prof. Dr Rosnah Shamsudin (President of Malaysian Society of Agricultural and Food Engineers), Prof. Bart Nicolai (KU Leuven, Belgium), Prof. Armando Apan (University of Southern Queensland, Australia), Prof. Yu Pin Lin (Associate Dean of College of Bioresources & Agriculture, National Taiwan University, Taiwan), Dr. Katharina Keiblinger (University of Natural Resources and Life Sciences Vienna, Austria), Dr. Bayu Dwi Apri Nugroho (Universitas Gadjah Mada, Indonesia). We thank you for your valuable contribution. I would like also to express my sincere gratitude to Indonesian Society of Agricultural Engineering (ISAE) and Korean Society for Agricultural Machinery (KSAM) for their support in this event.

Prior to the acceptance, all papers submitted were subjected to peer reviews. We would like to appreciate all authors who have contributed to this proceeding. We hope this proceeding will have a significant contribution to the field of Agricultural and Biosystems Engineering.

Arifin Dwi Saputro, Ph.D
Chair of Organizing Committee of The 3rd ISABE 2019.

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The effect of air temperature on rice drying rate using vertical drying machine

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The effect of air temperature on rice drying rate using vertical drying machine

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Abstract. Mechanical dryer usually using heat from combustion and air is blown through heater to the product dried. This study was conducted used a vertical dryer. The purpose of this study was to find out the effect of air temperature to drying rate and drying efficiency. The variation of the temperature used were 50°C, 55°C, and 60°C with a tolerance of ± 1 °C with a constant mass of 20kg. The result of this study showed that the higher the dryer air temperature used, the faster the drying rate and drying time. It was found that the fastest drying rate for 60°C was 0.00033804 kg/s with drying time 70 minutes. While for temperature of 50°C found the longest drying rate of to reach a moisture content of 13.8% of 0.00022571 kg/s with constant air velocity of 5 m/s. The highest dried efficiency occurs at a temperature 60°C.

1. Introduction

One of the post-harvest handling processes is the drying process which is usually carried out in the hot sun. Drying of unhulled rice after harvest is needed for its durability during storage or during distribution. Traditional drying is dried in the sun. The heat intensity of the sun that usually occurs during the dry season (summer), where in Indonesia usually occurs in April to September. During the rainy season, the processing of unhulled rice will be increasingly difficult if you use traditional methods that use sunlight, the more difficult summer than the dry season. Another problem encountered by farmers is the compilation of drying rice unhulled rice in the rainy season is a compilation of rain. Farmers usually store unhulled rice that is still high in water content and dried in the sun's hot compilation there. This makes the drying process relatively long.

For the development of technology, especially in agriculture and food, and the demand for rice up to the time needed by humans to create and use the right technology for unhulled rice processing that is better and more efficient compared to conventional application, which is compatible with artificial dryers or mechanical. The advantages of mechanical dryers when compared to conventional workmanship do not require a lot of humans to work on, do not need to work, work on air dryers, cleaner than contamination of outside objects such as sand, dust, gravel, animal feces and others.

Mechanical drying is basically done using heating from the combustion results. The air media is blown through heating or direct contact to the dried product. Air heating can be done directly and indirect. The advanced drying technology that is currently being applied by many rice mills in Indonesia is the flat bed dryer and vertical continuous dryer [1]. Vertical continuous dryers include high-tech dryers. This machine is one of the circulation type dryers, where air is exhaled from under the drying chamber and the material will flow continuously from the bucket elevator to the drying chamber and back to the bucket elevator then it will repeat until the water content limit is reached.

Some of the factors that influence the time of the drying process include, air velocity, the mass of the dried material, drying air temperature and others [2-5]. Based on the description above, it is necessary to conduct further research on continuous vertical type mechanical dryers for the unhulled rice drying process. In this study, the drying air temperature will be varied with the drying rate in continuous vertical type unhulled rice drying machines.

2. Methodology

The schematic diagram of the experimental facility is shown in figure 1. The major parts of the test bed are dryer room, blower, elevator, heater and hot air pipeline.

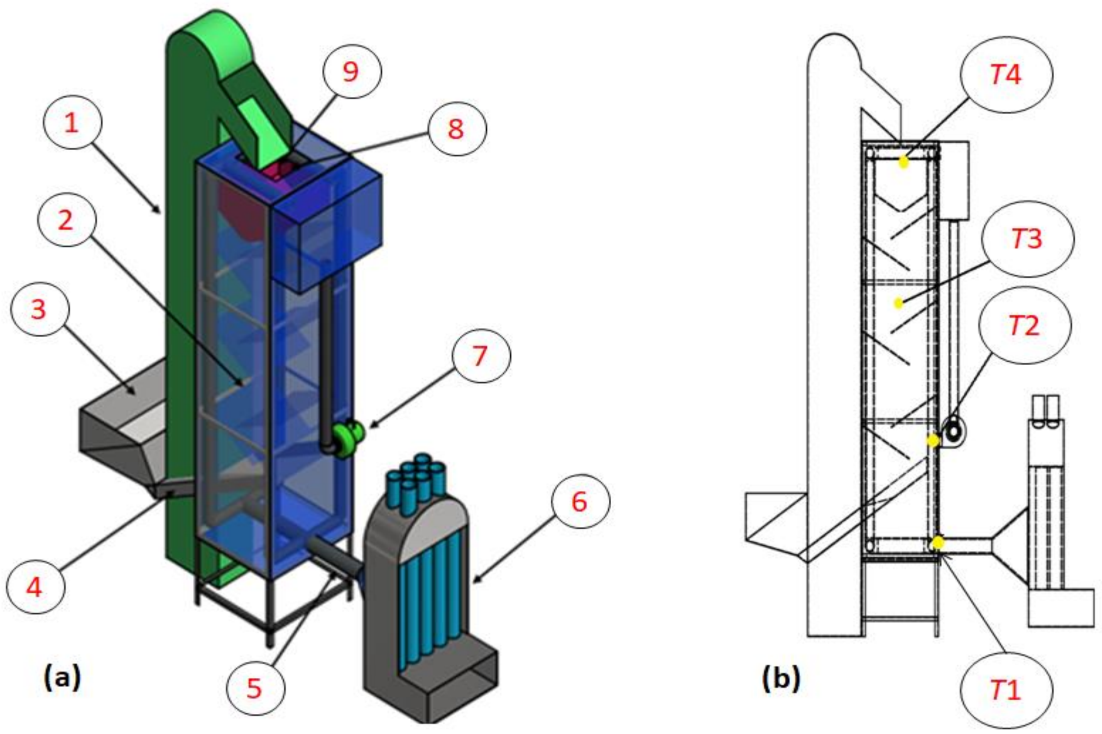

Figure 1 Schematic diagram of the test bed; (a) showing the part of the test bed and (b) showing the thermocouple position; 1. Elevator, 2. Dryer room, 3. Material storage hole, 4. Material outlet, 5. Inlet of hot air, 6. Air heater, 7. Blower, 8. Outlet air, 9. Dryer room inlet, T_1 is inlet temperature of hot air, T_2 is the temperature of air flowing into the dryer room, T_3 is the dryer room temperature, T_4 is the outlet temperature of the air.

Before starting the test, first assemble the research tool and measuring instrument, then check the condition of the research tool and the measuring instrument, calibrate the measuring instrument that needs to be calibrated. The testing steps are as follows:

1. Prepare the unhulled rice with a standard water content of 20% with a tolerance of ± 0.5%, if the water content in the material does not meet the standards in testing, then the treatment is done such as drying if the water content of the material exceeds 20% and soaking with water if the water content of the material less than 20% ± 0.5%, until it reaches the standard water content used.
2. Weighing Unhulled rice using a scale to obtain a mass of 20 kg of unhulled rice
3. Turn on the stove and measure the temperature in the drying chamber to a constant temperature of 50 ºC ± 1 ºC then wait until the temperature is completely constant for ± 10 minutes
4. Turn on the blower and set the air speed to 5 m / s
5. Turn on the electric motor on the bucket elevator
6. Inserting the unhulled rice into the material reservoir at the bucket elevator

7. Measure unhulled rice moisture content every 10 minutes
8. Measuring the moisture content of the unhulled rice if it reaches the water content of 13% -14%, the unhulled rice is removed from the material reservoir
9. Repeat the steps in points 1-8 above for temperatures of 55 ºC and 60 ºC.

Each test with dryer air temperature variation was repeated twice to obtain accurate research data

The stages of data collection in this study were carried out as follows:
1. Initial data taken before drying, namely:
a. The mass of unhulled rice that will be dried
b. Speed of air flow into the drying chamber
c. Initial moisture content of the rice
d. Initial temperature (drying chamber and environment).
e. Wet ball temperature in the drying chamber and environment.

2. After the tool is run, the following data is taken every 10 minutes, namely:
a. Record the temperature of the wet ball in the drying chamber and the environment
b. Measuring the moisture content of the material
c. Considering the mass of material samples.

3. Retrieval of data after the drying process
a. Considering the final weight of the unhulled rice sample
b. Record the time taken until the unhulled rice water content reaches the desired moisture content.

3. Results and Discussion

The results of the study on the effect of drying air temperature variations on the rate of drying of unhulled rice using a continuous vertical drying machine showed various results according to the variation in temperature of the drying air entering the drying chamber. In the results of this study, with the mass of material and the velocity of the incoming air constant the variation in low temperatures requires a relatively long drying time. Whereas at high temperature variations it requires a relatively shorter drying time. This is caused by the rate of evaporation of the water content of a material which is directly proportional to the size of the temperature, but inversely proportional to the mass of the material. High temperatures certainly have a large energy to evaporate the water content in the material, the greater the energy used to vaporize the content of water content in the material, the greater the amount of water that is evaporated at the same time so that the evaporation time of water content become shorter [2].

The table below is the average obtained from the results of the drying study using a continuous vertical type drying machine with temperature variations of 50 ° C, 55 ° C and 60 ° C with a constant mass of material of 20 kg and a constant speed of 5 m / s.

Table 1. Data on average research results.

T_{in} (ºC)	Ka1 (%)	Ka 2 (%)	T_{out} (ºC)	Δt (s)
50	19,62	13,72	39,5409	6000
55	20,07	13,85	41,3833	4800
60	19,85	13,80	43,9250	4200

Table 2. Drying efficiency for each variation.

T_m (°C)	Q (kJ)	q (kJ)	Q_{loss} (KJ)	P (kW)	$\dot{m}$ (kg/s)	η (%)
50	3568,19	124306,28	120738,09	0,59470	0,00022571	2,8705
55	3726,11	128103,52	124377,41	0,77627	0,00030187	2,9087
60	3801,89	129471,76	125669,87	0,90521	0,00033804	2,9365

4. Conclusion

Variations in air temperature will affect the drying process of unhulled rice. The higher the temperature of the drying air used, the faster the drying rate and drying time. The fastest drying time occurs at a temperature variation of 60 °C with a constant unhulled rice mass of 20 kg requiring 70 minutes to reach the moisture content of 13.80% and the fastest drying rate of 0,00033804 kg/s. While the slowest time occurs at a temperature variation of 50 °C, it takes 100 minutes to reach the water content of 13.72% and the drying rate of 0.00022571 kg/s.

5. References

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