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Performance Of A Tray Type Dryer With Variations In Air Speed Against Drying Rate

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Abstract— Corn is a crop that plays the second most important role after rice as a food raw material. Corn has no less nutritional value than rice. Production losses during post-harvest handling are still very large due to improper handling. One aspect of post-harvest handling is drying, which aims to ensure that the corn consumed can be stored for a long period of time. An artificial drying system is needed as an alternative to overcome this problem, so the drying process with a Tray Drayer can be done at any time or not depending on the weather and location. The operating conditions in this study were drying air speeds of 2 m/s, 3 m/s, and 4 m/s and a heating temperature of 65 ºC. The dryer in this study used four stacking shelves. Each shelf is filled with 500 grams of corn. This research aims to determine the effect of variations in air speed on the drying rate of a dryer. The results of this research are that the greater the air speed used to dry corn kernels, the greater the drying rate. The average drying rate increases by 1.5% for each change in drying air speed variation.

Keywords— Dryer, Air Speed, Drying Rate, Corn.

I. INTRODUCTION

Indonesia is the largest corn producer in Southeast Asia, Indonesian corn production reached 18.5 million tons in 2013, followed by the Philippines in second place with total production of 7.4 million tons. The Indonesian government continues to strive to increase productivity in the agricultural sector by optimizing limited resources such as land, labor and other inputs. This is done with the hope of producing more food and increasing the household income of farmers [1]. Corn is a plant that plays the second most important role after rice as a food raw material, corn has no less nutritional value compared to rice, production losses during post-harvest handling in Indonesia are still very large due to inappropriate post-harvest handling itself, one of the aspects Post-harvest handling, namely drying, is intended so that corn consumed by humans can be stored for a long time [2].

Post-harvest handling, namely drying, is an important stage to maintain the quality of corn during the storage period. Currently, corn drying is carried out in two ways, namely with direct sunlight and artificial heating. Direct sun drying is hampered by dependence on the season, namely if the intensity of sunlight is sufficient and the day does not rain. Apart from that, the results of the drying process have a non-uniform water content depending on the relative humidity of the surrounding air during the

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drying process. Meanwhile, artificial drying is hampered by low efficiency which is still below 60% and degradation of the protein content in corn, especially if the air temperature for the drying process is more than 60°C [3].

An artificial drying system is needed as an alternative to overcome this problem. There are various forms of drying equipment, including the rack type dryer, which is one type of dryer that is often used in the drying process. Drying using a rack type dryer is an effective drying method, the rack type drying process can be done at any time or not depending on the weather and space. Apart from that, drying with a rack type does not require a lot of labor, based on the problems that have been raised, this gives an idea to study the drying method using a rack type dryer. In this research, the drying characteristics of corn were studied under various drying operating conditions, namely at various predetermined air velocities and tested the performance of the dryer using a rack type dryer.

Fast drying times are obtained at high air temperatures, whereas long drying times are obtained at low air temperatures. Research on variations in drying air temperature showed that an air temperature of 65°C produced the fastest drying time compared to drying at temperatures of 55°C and 60°C. Meanwhile, the longest drying time was obtained at an air temperature of 55°C [4]. Fast drying times were obtained at high air velocities, whereas long drying times were obtained at low air velocities. In this study, variations in air velocities of 5 m/s, 6 m/s, and 7 m/s were used to obtain results that at an air speed of 7 m/s produces a faster drying time compared to drying at an air speed of 5 m/s and 6 m/s, while a longer drying time is obtained at an air speed of 5 m/s [4].

Drying is one of the most important factors in determining the quality of corn kernels, in addition to the harvesting process. The quality of corn kernels is determined by its water content. Drying aims to reduce the water content in the corn kernels to a condition where the water content in the corn kernels cannot reduce the quality of the corn kernels and the corn kernels do not grow mold. Based on the energy source, corn drying can be divided into natural drying and artificial drying [5].

Drying corn seeds (zea mays. sp) using a rack type dryer found that drying corn seeds affected the drying rate and changes in the water content of the corn seeds or caused the water content to decrease. The higher the temperature and the longer the drying process, the faster the drying rate will be and the decrease in water content will be smaller or slower [3].

Drying is defined as a way to remove some of the water from a food item by evaporating some of the water contained in it, through the provision of heat energy which will involve increasing the temperature with the aim of obtaining a high drying rate. The drying principle involves two phenomena, namely heat transfer and mass transfer. The heat transfer process occurs because the temperature of the material is lower than the temperature of the air flowing around it. This is related to the application of heat to the material to be dried. Meanwhile, the mass transfer process is related to the release of a certain amount of liquid from the material into the environment. The heat from the drying air will increase the temperature of the material, causing the water vapor pressure in the material to be higher than the water vapor pressure in the air, resulting in the transfer of water vapor from the material to the air [5].

II. RESEARCH METHODS

This research is experimental research with a scheme as shown in the following figure.

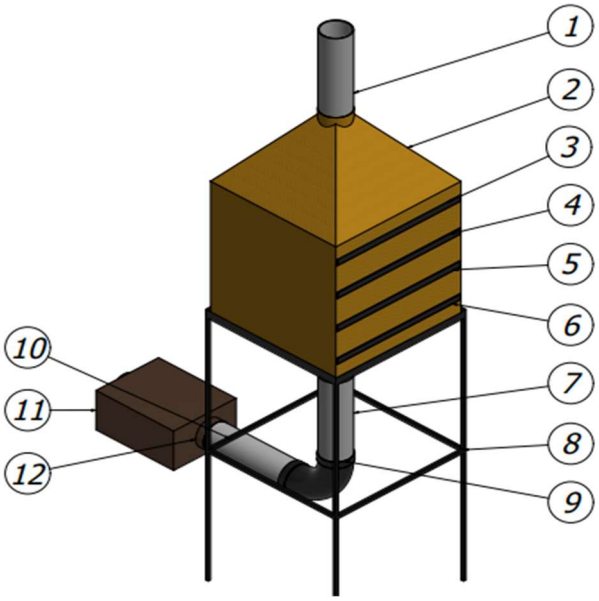

Figure 1. Dryer installation. 1. output pipe, 2. dryer box, 3. rack 4, 4. rack 3, 5. rack 2, 6. rack 1, 7. input pipe, 8. frame, 9. keni, 10. blower pipe, 11. box heater, 12. sensor controller.

In this study, two types of variables were used, namely the dependent variable and the independent variable. The dependent variable is a variable that is influenced by other variables such as the power used. By analyzing the dependent variable, it is hoped that an answer or explanation can be found regarding the problem being tested. The dependent variables in this research are obtaining the maximum capacity of the dryer, drying rate and cost of drying with the tool. Independent variables are variables that can be adjusted and determined according to testing needs. The independent variables used in this research are variations in air speed of 2 m/s, 3 m/s, and 4 m/s, and a heating temperature of 65ºC during drying.

III. Results And Discussion

During the research, data were collected every half hour after putting the corn into the dryer, then waited another half hour to let the corn dry in the dryer.

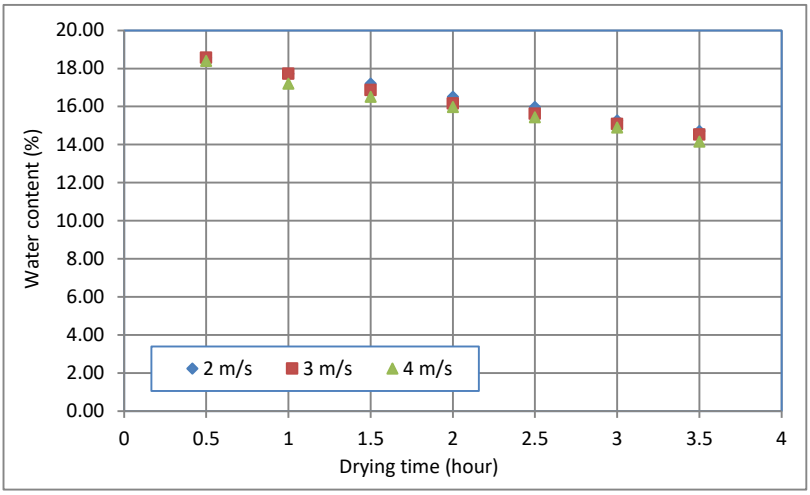

Figure 2. Graph of the relationship between the water content of the test material (corn) and drying time

Based on Figure 2, it can be seen that the water content of dried corn is directly proportional to the time used to dry the corn itself. The longer the time used for the drying process of corn kernels, the less water content the corn kernels contain. Likewise, the less time used to dry the corn kernels, the greater the water content contained in the corn kernels. The longer the drying time, the more difficult it is for water to be removed from corn kernels [6]. because the water content in dried corn will decrease

as drying time goes by.

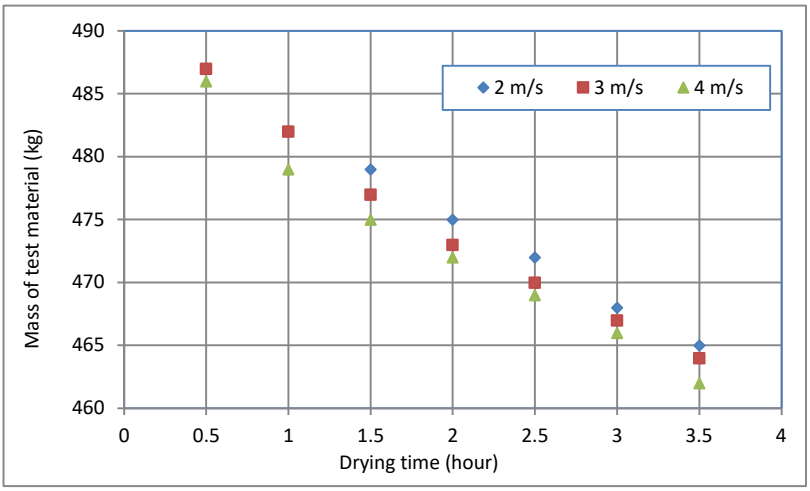

Figure 3. Graph of the relationship between the mass of the test material (corn) and drying time

The results showed that the mass of dried corn was directly proportional to the time used to dry the corn itself. The longer the time used for the drying process, the less corn mass will be left behind (figure 3). This happens because the longer the drying time, the greater the water content contained in the corn that is evaporated. This has the effect that the longer the drying process takes, the less water content the corn contains. The results of the research showed that the water content contained in corn decreased by 1.5% for each change in drying air speed variation.

Based on Figure 4, the results are in accordance with research [4] which found that the higher the air speed, the faster the corn drying time. Figure 4 shows that the longer the drying process, the smaller the drying rate and the slower the water content in the corn decreases.

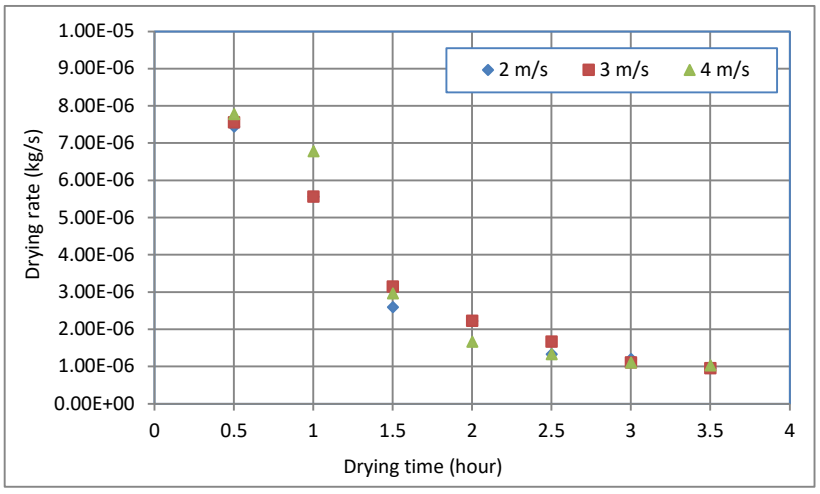

Figure 4. Graph of the relationship between the drying rate of the test material (corn) and the drying time

IV. CONCLUSION

Based on data analysis of the drying process with air speeds of 2 m/s, 3 m/s, 4 m/s, and a temperature of 65ºC, it shows that the greater the air speed used to dry corn, the greater the drying rate. In this study, the highest drying rate was obtained at The air speed of 4 m/s was 0.0000778 kg/s in the first 30 minutes, while the smallest drying rate at an air speed of 2 m/s in 3 hours was 0.000000112 kg/s.

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