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Design and Testing of Holagen Incandescent Lamp-Based Corn Drying Cabinet to Improve Efficiency and Cleanliness of the Processing Process

Bagas Prasetyo Purnomo*, A'rasy Fzahruddin
Universitas Muhammadiyah Sidoarjo

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*Correspondence: Bagas Prasetyo Purnomo
Email:
bagasprasetyopurnomo@gmail.com

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Abstract: Indonesia is a tropical country with entrepreneurs engaged in maize cultivation, most of whom live in rural areas. The corn processing process is heavily reliant on sunshine, however owing to the unpredictable environment and sunlight, which is less effective and hygienic in carrying out the corn drying process, the operation is hampered. As a result, a drying cabinet is created that uses heat from electricity and is specifically intended to accelerate the drying process. This corn drying rack employs incandescent lamps, including bulbs and holagen lamps. In addition, the number of drying racks is identified in order to assess the drying cabinet's capacity for work. After testing the tool with various blower speeds (15,000, 10,000, and 5,000 RPM), the electrical power utilized is 120 watts, which includes 50 watts of bulb/halogen lamp power, 40 watts of heated glass, and 30 watts of blower power. So it is known that holagen incandescent lamps are more successful at distributing work evenly on the shelf within 30 minutes, which can save drying time by 20% to 30%.

Keywords: Agriculture, Corn Dryer, Electrical Power, Blower Speed

Introduction

In tropical countries, especially Indonesia, most people live in rural areas, and most Indonesians work as corn entrepreneurs. In uncertain weather conditions, especially during the rainy season, the natural drying process is less than optimal and can result in suboptimal maize production due to humid air (Azalim, 2024; Abhigna, 2023; Gautam, 2023; Sukmawaty, 2023; Çelik, 2022 Bakti, 2006). Sun drying is also unhygienic, as it is placed in an open area that can contaminate the corn (Oria, 2022; Charmongkolpradit, 2021; Hunaefi, 2021; Ononogbo, 2021; Permyakov, 2021). And during the rainy season, drying is less than optimal. To prevent losses experienced by entrepreneurs, drying maize is important, so that it can then become dry maize ready for production (Karyadi, 2021; Nurba, 2021; Sukmawaty, 2021; Ünal, 2021).

Based on the problems that have been raised, it gives an idea to design a (cabinet dryer) by utilizing hot air from an electric heating element, which is considered very helpful for the corn entrepreneur community to reduce production failures (Alit, 2020; da Silva, 2020; Li, 2020). In this stage, we study how to design the drying machine and the drying rate (Bakti, 2006). In addition to the rack-type drying machine (cabinet dryer) there are also those that can be for the success of a business or research is from the mixture of ingredients used for wet corn dough and the length of time used for research besides that the number of shelves also determines the results of the research (Istiadi, 2010).

Methodology

Objects that emit heat or cause other objects to reach higher temperatures are also called heaters. In domestic and household use, heating is usually in the form of equipment whose purpose is to produce heating, namely warmth (Marni, 2016).

The definition of drying is the process of taking relatively small amounts of water from solids or from gas mixtures. And includes heat, mass and momentum transfer processes. Drying occurs in the presence of physical heat, namely the operation of evaporation. In this drying process, a product with one or more desired product goals is obtained, for example in its physical form (powder, flat or granular). The basic types of drying are heat entering through convection, conduction, radiation, and electric heating and combinations of these types of methods (Arhamsyah, 2018).

The drying mechanism can be explained by mass transfer theory. Where the event of the release of water molecules from the surface depends on the shape and surface area of the wet material or the water layer that covers the material is so thick, so that the surface of the material is flat, when the drying air is flowed between the material it will attract water molecules on the surface of the uneven granules which will expand the surface of the material so that in drying there are two types of mechanisms (Putro, 2016), namely:

1. Evaporation mechanism with a fixed speed (constant rate period)
2. Evaporation mechanism with changing speed (period of decreasing rate)

Materials used

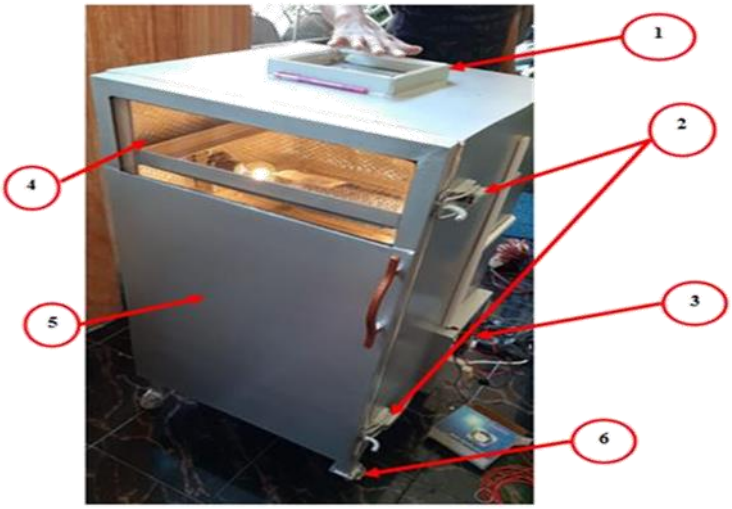

Figure 1. Research test equipment

Description:

1. Ventilation As evaporation air circulation
2. Door lock
3. Electrical panel
4. 3mm glass to observe the condition of the machine room
5. Tool door
6. Iron wheel

In the constant rate period, generally during drying, the material will always be wet with liquid to the critical point. The point is the point at which the surface of the material is not completely wet with liquid, once the critical point is reached, start with a period of decreasing speed until the liquid completely evaporates (Wibowo & Rahayuningsih, 2016). In this process the relationship between moisture content and drying rate can be either a straight line or a broken curved line. The speed of evaporation in the non-permanent period depends on the solid as well as the liquid. On the surface of a solid, a rougher drying will be faster when compared to a smoother surface (Summarecon, 2016).

The design of the drying process in principle to be more precise and determine the size of the equipment, it is necessary to know in advance the time required to dry the material from a certain moisture content to the desired moisture content under certain conditions (Taufik, 2004).

Drying is the process of removing the moisture content of the material so as to achieve the desired moisture content so that the speed of material damage can be slowed. In drying too fast can damage the material, because the surface of the material dries too quickly so

that it can not be balanced with the speed of movement of water from the material towards the surface. In this case it can cause hardening on the surface of the material so that the water in the material can no longer evaporate because it is inhibited (Tika, 2010).

Result and Discussion

The test results that have been obtained make the calculation results which are then analyzed for the efficiency that occurs in the efficiency parameters of the drying machine based on changes in time and rack capacity. The analysis is explained in the form of a graph below:

1. Data Analysis of Efficiency against Corn Capacity Using Bulbs and Halogen Lamps

Efficient tests are analyzed in the form of graphs, this graph shows the highest efficiency is at a corn capacity of 100 gr with a blower speed of 10,000 rpm using a bulb lamp, while the lowest efficiency occurs at a blower speed of 15,000 rpm with a capacity of 50 gr. For more complete data can be seen in graph 2 below:

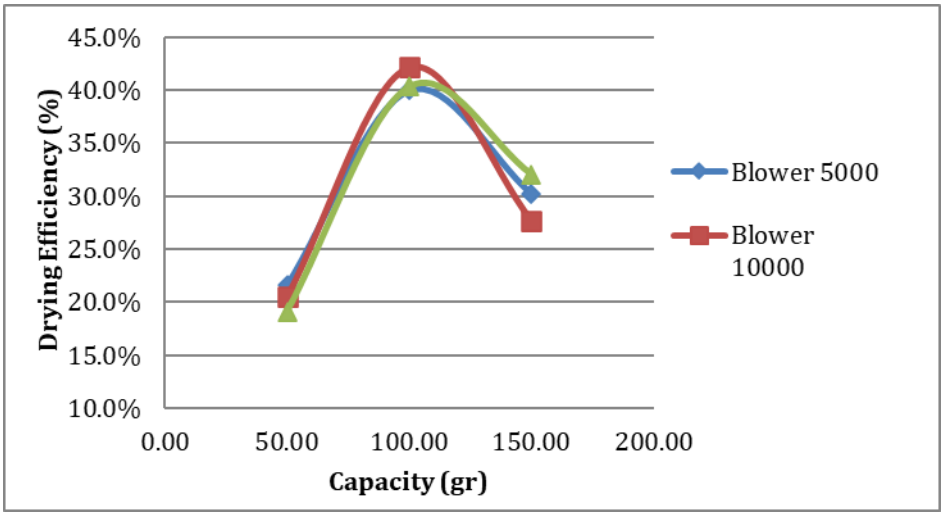

Figure 2. Graph of Drying Efficiency at Variations of Corn Capacity with Bulb Lamps

Efficient tests are analyzed in the form of graphs, this graph shows the highest efficiency is found in 150 gr corn capacity with a blower speed of 10,000 rpm using halogen lamps, while the lowest efficiency occurs at a blower speed of 5,000 rpm with a capacity of 50 gr. For more complete data can be seen in graph 3 below.

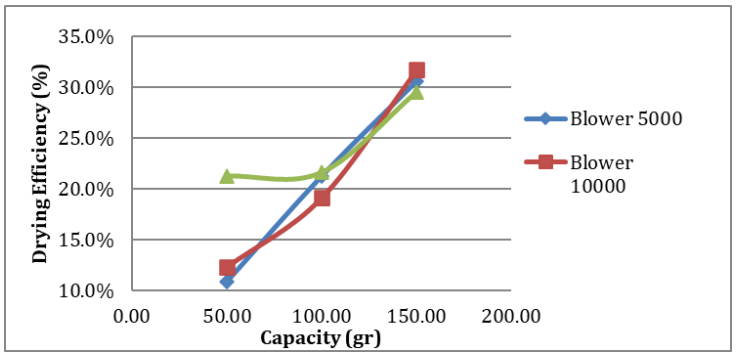

Figure 3. Graph of Drying Efficiency at Variations of Corn Capacity with Halogen Lamps

In figures 2 and d it can be seen that variations in blower speed can affect the size of the efficiency obtained. The highest efficiency is obtained at a blower speed of 10,000 rpm with a capacity of 100 grams of corn, while the lowest efficiency is obtained at a blower speed of 5,000 rpm with a capacity of 50 grams of corn. This is because the smaller the capacity, the lower the efficiency obtained, while the larger the capacity will get a high efficiency because of the greater amount of corn dried.

2. Comparison of Bulb and Halogen Lamps

From the overall results of testing corn dryers using bulb and halogen lamps, it can be seen that the comparison according to the data obtained that testing using bulb lamps is better because it can reduce more water content and get better efficiency. As for testing using halogen lamps, the drying results and efficiency are lower, but drying using halogen lamps can get dry results that are more evenly distributed between shelves I to shelf III.

Conclusion

In the variation of the bulb lamp with a blower speed variation of 15,000, 10,000, 5,000 rpm, the highest drying rate was obtained at a blower speed of 5000 rpm, namely at shelf position I, while the lowest drying rate was obtained at a blower speed of 15000 rpm, namely at shelf position III, at shelf position no. I got the highest value because the hot vapor from the bulb was pushed up by the blower, so shelf position no. I got the most hot air. The drying rate in the time variation test obtained results of 9.04 mg/min to 13.56 mg/min. So the longer the test time, the lower the efficiency obtained.

In the variation of halogen lamps with rack positions 1 to 3, the drying results are more evenly distributed with different blower speeds of 15000, 10000, and 5000 rpm at the same time of 30 minutes. Drying using halogen lamps is more evenly distributed than bulb lamps because halogen radiant power is wider than bulbs, besides drying using halogen lamps can get a stable heat temperature and better circulation. From the above information, it can be concluded that variations in time and number of shelves can affect the drying rate between 20% and 30%.

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