

Hot Air Circulation Analysis In Tumpeng Dryer Machine With Hole Stage Variation In Every Level Rak

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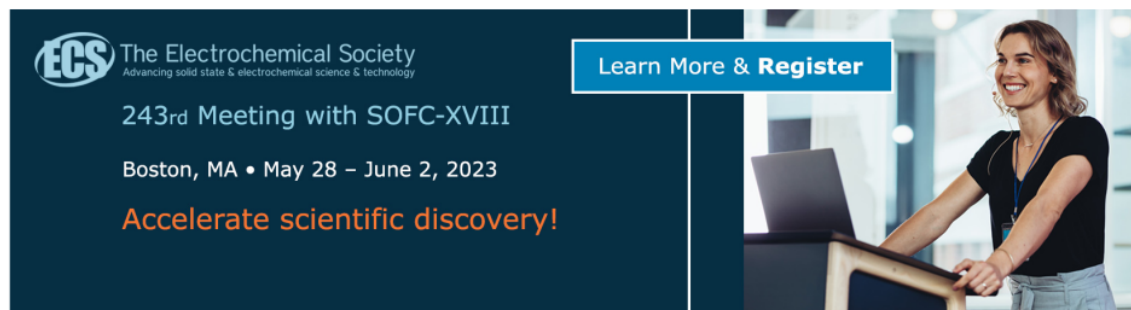
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Hot Air Circulation Analysis In Tumpeng Dryer Machine With Hole Stage Variation In Every Level Rak

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Abstract. Tumpeng is one of the ceremonial facilities used almost in every Hindu religious ceremony. Many people take advantage of these opportunities as a home-based business. At present the craftsmen encounter obstacles in the process of drying the cone. Currently the drying process still uses the manual method, namely by drying it by utilizing direct sunlight. In the previous research, the product planning for cone drying machine has been carried out, where the results obtained from this study are an increase in the productivity of the drying machine from the drying machine which was previously used by the cone maker of 683.33%. Although there is an increase in the productivity of the drying machine, the air distribution at each level of the rack is not evenly distributed, so the drying machine needs to be reviewed so that the air distribution in the drying chamber becomes more evenly distributed between the racks. From the results of studies conducted by the hot air entering the drying chamber from the results of the previous engine design, it is likely that conditions on level 1 shelves and level 2 shelves have temperatures that are quite high compared to other rack levels because this air is circulated at level 3, 4, 5 and 6. To get the air distribution between the level of the rack evenly, it is necessary to do a redesign of the tool. The alternative that can be done is by circulating hot air from rack 1 to rack 6, another alternative is to try variations in air distribution in the drying chamber by varying the cone seat holes.

The redesign method that was carried out was to replace the existing distribution before the air out of the level 3 blower in the rack was changed to the air out of the level 1 rack entry blower, and the cone seat was made varied by random holes, concentric holes and zigzag holes.

From the results of engine redesign after testing the air distribution in the drying chamber with a random hole stacking model, the highest temperature is found in almost all shelf levels, except at the level 1 rack the highest temperature is achieved by a concentric perforated pedestal model that reaches 183 oC. Judging from the hot air distribution, the randomly hollowed cone seat model provides a more even distribution of hot air compared to the concentric and zigzag hollow cone seat model.

Keywords: Drying Machine, Variation of flow models, even drying chamber temperature

1. Introduction

The existence of Balinese society cannot be separated from cultural and religious customs. The religious procession for Balinese people is used as an expression of gratitude to Ida Sangyang Widi Wasa (God Almighty) for the gifts he has given. One of the ceremonial instruments used is a cone, and this cone is needed quite a lot in a series of ceremonies. Many people take advantage of this opportunity as a business that can provide income for the business actor. This tumpeng business is often found in Buruan Village, Belahbatuh District. The craftsmen in this village still face many obstacles in the process of drying the cone. Many innovative efforts have been made by these entrepreneurs to increase their productivity, such as in the drying process which initially only relies on solar heat and is now trying to use energy sources from gas stoves. The drying system by relying solely on solar energy can be carried out in the dry season only, whereas in the rainy season the solar energy is not of the maximum, so that in the drying process many obstacles such as tumpeng will experience fungi, so it is not feasible to be marketed. In the drying process with the equipment designed by the craftsmen themselves still having problems having to move the position of the cone



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container alternately towards the bottom near the stove and sometimes the cone can be scorched by forgetting to move the position of the cone and this process requires operators waiting for the drying process to end. The results obtained from the previous study were an increase in the productivity of the drying machine from the drying machine which had previously been used by the cone maker of 683.33%. Although there is an increase in the productivity of the drying machine, the air distribution at each level of the rack is not evenly distributed, so the drying machine needs to be reviewed so that the air distribution in the drying chamber becomes more evenly distributed between the racks. From the results of the study, the hot air entering the drying chamber from the previous engine design tends to be on level 1 shelves and level 2 shelves, because the air that is circulated is air at the rack position 3,4,5 and 6, so a redesign tool is needed to get better results. An alternative that can be done is by circulating hot air from rack 1 to rack 6, another alternative is to try out variations in air distribution in the drying chamber by varying the hole of the seat holder on each shelf level.

1.1. Problem

The problem in this study is the air distribution in the drying chamber is not evenly distributed at each level of the rack, so it is necessary to do a machine redesign that was made in previous studies.

1.2. Purpose

The purpose of this research is to get a drying machine product that has a temperature in the drying chamber evenly at each rack level

2. Literature Review

2.1. Heat Transfer

Heat transfer can be defined as the transfer of energy from one region to another as a result of temperature differences between these regions. The matter of heat flow is universal which is related to the pull of gravity. In general there are three different ways of heat transfer, namely: conduction (conduction; known as conduct), radiation (radiation) and convection (convection; known as ilian). If we speak correctly, only conduction and radiation can be classified as heat transfer processes, because only these two mechanisms depend on the temperature difference. Being convection, does not exactly meet the definition of heat transfer, because it depends on mechanical mass transport as well. But because convection also results in the transfer of energy from higher temperature regions to lower temperature areas, the term "convection heat transfer" has been generally accepted.

2.1.1 Conduction

Conduction is the process by which heat flows from a high-temperature area to a lower temperature region in one medium (solid, liquid or gas) or between different mediums which intersect directly without the transfer of large enough molecules according to kinetic theory. The temperature of the element of a substance is proportional to the kinetic energy of the average molecules that make up the element. The energy possessed by an element of a substance caused by the speed and relative position of its molecules is called inner energy. The transfer of energy can take place with collisions of elastic (elastic impact), for example in a fluid or by mixing (diffusion / diffusion) electrons - electrons that move quickly from high-temperature areas to areas with lower temperatures (such as metals). Conduction is the only mechanism by which heat can flow in an opaque solid.

2.1.2 Radiation

Radiation is the process by which heat flows from a high-temperature object to a low-temperature object, if the objects are separated in space, even if there is vacuum between the objects. All objects emit radiation heat continuously. The intensity of the beam depends on the temperature and surface properties. Radiation energy travels at the speed of light (3×10^8 m / s) and symptoms - the symptoms resemble light radiation. According to electromagnetic theory, light radiation and thermal radiation differ only in each wavelength.

2.1.3 Convection

Convection is an energy transport process with the combined work of heat conduction, energy storage and mixing movements. Convection is very important as a mechanism of energy transfer between the surface of a solid, liquid or gas object. Convection heat transfer is classified as free convection and forced convection according to how to move the flow. When the mixing motion takes place solely as a result of differences in density caused by temperature gradients, it is called natural or free convection. If the mixing motion is caused by an external device such as a pump or fan, the process is called forced convection. The effectiveness of heat transfer by means of convection depends in large part on fluid mixing movements. consequently the study of convection heat transfer is based on knowledge of the characteristics of fluid flow.

3. Research Methods

3.1. Research design

This study was designed by designing a cone drying machine as a result of previous research designs, where the design of this study was made as in Figure 3.1.

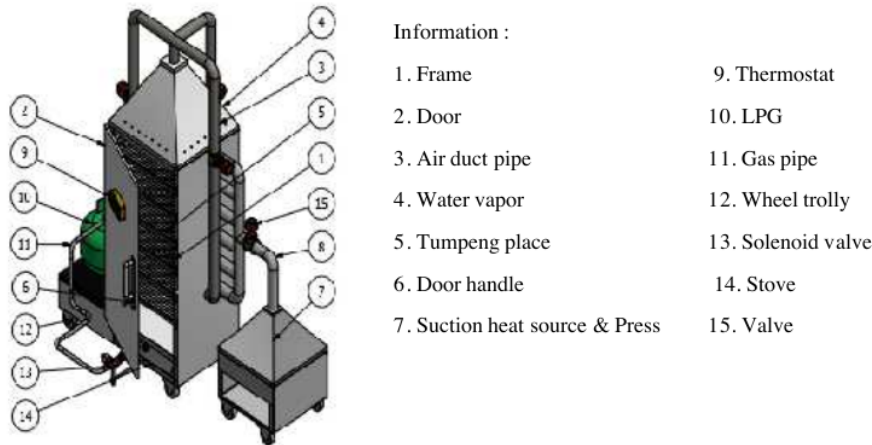


Figure 3.1 Model of Tumpeng Drying Machine

3.2. Variables that are measured and how they are measured

The variables measured in this study are temperature, where the temperature of the heat source entering the drying system and the temperature in the drying chamber at 30 different place positions. The temperature measurement at 30 positions will be examined from several variations in air distribution in the drying chamber by replacing the cone holder on each rack.

4. Results and Analysis of Research Data

4.1 Data of Research Results

4.1.1 Data on the results of temperature testing of the drying chamber with a cone stand model in a random hole drying rack.

From the measurement data, it can be seen that the distribution of hot air with a cone seat model in a random hole drying rack on the shelf level closest to the heat source reaches 154 °C at 50 minutes, on

rack level 2 reaches 154 °C at 60 minutes, on a shelf level 3 128 °C at 100 minutes, at rack level 4 reaching 115 °C at 90 minutes, at rack level 5 reaching 109 °C at 100 minutes, and at rack level 6 reaching 107 °C at 110 minutes. Measurement of temperature data was measured up to 120 minutes, assuming at that time the temperature of each rack was stable. Judging from the level 1 rack temperature distribution and level 2 racks still have the highest temperature reaching 154 °C and for temperature, 3, 4, 5 and 6 rack ranges around 107-115 with a difference of around 7 °C. More can be seen in Figure 4.1.

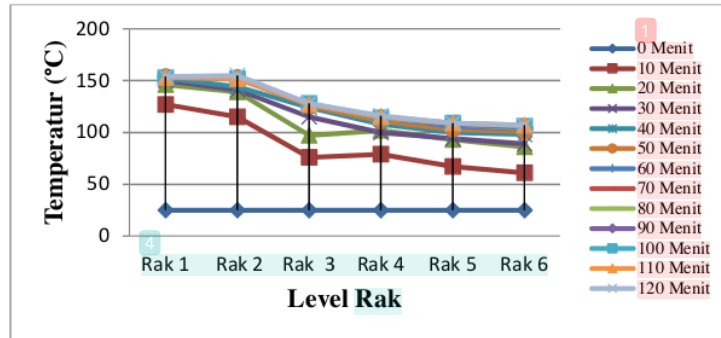


Figure 4.1 Condition of the drying chamber in the cone stand model in the drying rack random hole.

4.1.2 Data from the temperature test results of the drying chamber with the model of the cone seat in the Concentric hollow drying rack

Figure 4.2 shows the temperature achieved on a level 1 rack, reaching 183 °C at 110 minutes, while the rack level 2 temperature reached 128 °C at 120 minutes, rack level 3 reached 102 °C at 120 minutes, rack level 4 reached 94 °C at time is 90 minutes, rack level 5 reaches 85 °C at 60 minutes and rack level 6 reaches 77°C at 90 minutes. Here it can be seen that the concentric perforated flow model between the shelves can provide a quite high temperature difference between the shelves where between shelf 1 and 2 the difference reaches 55 °C, for shelves 3,4,5 and 6 the difference reaches 25 °C. More information is presented in Figure 5.4.

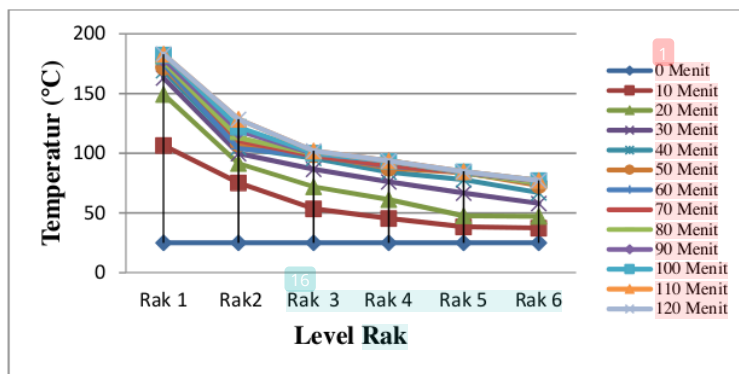


Figure 4.2 Condition of the drying chamber in the cone stand model in the drying rack Concentric holes.

4.1.3 Data on the results of temperature testing of the drying chamber with the model of the cone stand in a zigzag hollow drying rack.

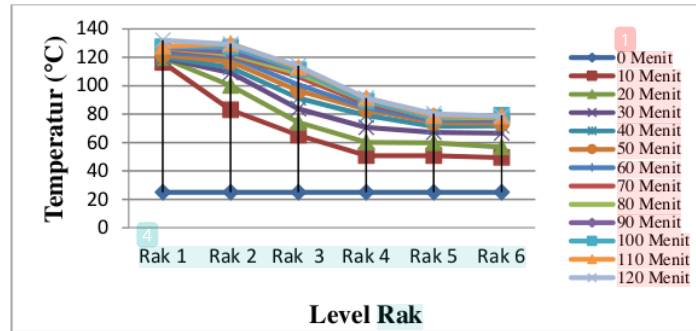


Figure 4.3 Condition of the drying chamber in the cone stand model in the drying rack zigzag hole.

The model of a pedestal holder in a zigzag perforated rack is the highest temperature still on level 1 rack with a temperature of 132 °C at 120 minutes, on rack level 2 the temperature reaches 130 °C at 110 minutes, rack level 3 temperature reaches 114 °C at 120 minutes, rack level 4 temperature reaches 91 °C at 110 minutes, rack level 5 temperature reaches 80 °C at 120 minutes, and rack level 6 temperature reaches 79 °C at 90 minutes. More information is presented in Figure 4.3.

5. Data Analysis

From the three models of cone stand tested on the cone drying machine, it can be seen that the highest temperature achieved by a random hollowed pedestal holder model, even though there is a temperature achievement on the rack level 1 the highest temperature is achieved by concentric hollow cone seat model which reaches 183 °C. Judging from the heating time starting from 50 minutes to 120 minutes there has been no significant change in temperature in the drying chamber. For this reason, analysis of data from temperature test results in the drying chamber between the cone stand model was analyzed at 60 minutes drying time. At 60 minutes drying can be seen the temperature difference between level 1 shelves and the lowest level 2 shelves is achieved by a random perforated pedestal model with a difference of 1 °C and a zigzag perforated pedestal model reaching 3 °C and a concentric hollow cone seat model reaching 71 °C.

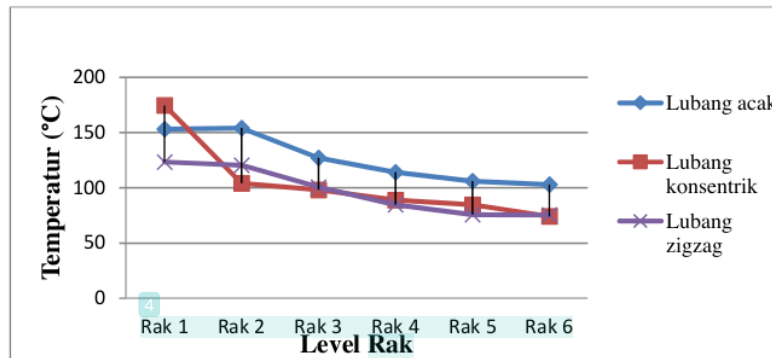


Figure 4.4 Graph of Temperature Comparison in Each Rack Model With 60 Minutes Heating Time

From Figure 4.4, it can be seen that the distribution of hot air is best distributed in a random hole cone seat model, this is due to the hot air random holes that are sourced at the bottom of the rack can move randomly to the top level rack (rack level) so that hot air flows the turbulent in the drying room. Theoretically turbulent flow is the most effective flow for convection heat transfer.

6. Conclusion

From the results of the research that has been done, it can be concluded that for the cone drying model with a rack with heat source at the bottom of the rack, a randomly hollowed pedestal stand model can provide the highest drying space compared to the concentric and zigzag perforated pedestal model, as well as the distribution of hot air whose heat source is located at the bottom of the rack with a random perforated pedestal holder provides the most effective effect of hot air distribution to each rack, as evidenced by the difference in temperature between the shelves of this model is the lowest.

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