Modification of Dryer Cabinet Based on Automation System

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Abstract. Dryer cabinets based on automation systems are able to carry out and organize work so that they do not require human supervision. The automation system is able to reduce the role of humans in the operation of the tool, improve production quality, avoid human errors and for the safety and security of users. In this paper, the automation system in question is the addition of an automatic setting facility on the device by utilizing a temperature sensor, and a timer to adjust the temperature automatically. The heat source in the dryer cabinet will turn on and off automatically according to the pre-set temperature and timer settings. The results of the drying test of materials and tools using a cabinet dryer based on an automation system using an upper temperature variation of 50 °C to 60 °C and a lower temperature range of 47 °C to 57 °C in a drying time range of 1–3 h obtained a moisture content of $<5\%$. The research and development method was used to complete this paper. The process in product modification and product testing is presented in this paper to demonstrate the strengthening of the proposed concept.

Keywords: Dryer Cabinet · Drying · Automation System

1 Introduction

In today's modern era, technological developments are increasingly rapid which aims to help human activities to be lighter and easier. A wide variety of technologies have been invented so that humans are able to adapt to the ever-changing nature [1]. One of the forms of technology that humans invented to reduce dependence with nature was the invention of the Dryer Cabinet. Kabinet drying is a tool that functions to dry various kinds of food ingredients Kabinet drying using the method of drying a closed room (chamber) with hot air [2]. Cabinet drying is classified as a rack-type dryer, because of the shape of a square unit with shelves arranged as a place for the material to be dried. The rack or tray is made of metal and has holes that serve to drain hot air on the material to be dried [3, 4]. The basic principle in its use is with hot air flowing and drying using low temperatures. The food to be dried is placed on a tray with a thin layer that aims to speed up the drying process and then left in the drying cabinet within the specified time. The circulation fan will flow hot air vertically through the column. The resulting

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air flow is fresh air brought to the cabinet and humid air that runs out using heat. The perforated plywood floor under the drying cabinet is useful for distributing air in the drying machine. The dryer tray is made according to the size *of the cabinet* to prevent the transfer of air to the material to be dried [5].

The Dryer Cabinet is one of the drying equipment units in the Food Technology Laboratory of the Family Welfare Education Department with a severely damaged condition. As a result, practicum activities are hampered. This research intends to find the best solution to the limited availability of dryer cabinet tools in food technology laboratories by re-functioning the tools and modifying the dryer cabinet based on the automation system. The automation system in question is the addition of an automatic setting facility on the device by utilizing a temperature sensor, and a timer to adjust the temperature automatically. The heat source in the dryer cabinet will turn on and off automatically according to the pre-set temperature and timer settings. The dryer cabinet based on the automation system has the advantage of being able to carry out and organize work so that it does not require human supervision. Automation systems are able to reduce the role of human in the operation of tools, improve the quality of production, avoid human error and for the safety and security of users [6, 7].

2 Methods

The Methods for this research is R & D Methode (Research and Development). Place and time of this research is in Surabaya State of University which located on A8 Building at food technology laboratory Family Welfare Education Department from June until November 2022. The *Research and Development* (R&D) research procedure begins with the pre-research stage and the research stage [8]. For more details, it is found in the flow chart of the research design as in Fig. 1.

At the performance testing stage of the dryer cabinet, tests were carried out on the drying of foodstuffs including watermelon, pineapple, spinach leaves, turmeric, chicken meat and fish meat. While the tool that will be tested for drying is beaker glass. The drying temperature is generally used to dry a material and tool, which uses a temperature of 50 °C to 60 °C with an air flow speed of 0.5 m/s. The drying time used is about 1 to 3 h. After going through the tool testing procedure, then a water content analysis will be carried out on the results of the trial. Data analysis of the moisture content in foodstuffs is calculated by weighing the material at the initial weight, then dried and then weighed the final weight. Here is the formula for calculating the moisture content in the material

$$M\,(\%bb) = \frac{initial\ weight - final\ weight}{initial\ weight} \times 100\% \quad (1)$$

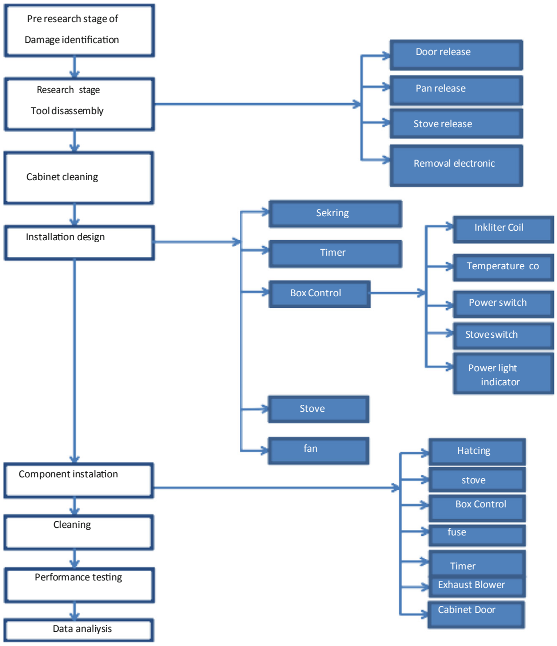

Fig. 1. Flowchart of the Research.

3 Result and Discussions

The result of this study is an automation-based dryer cabinet. Automation-based dryer cabinets have the advantage of being able to perform and manage work automatically so that they do not require human supervision. Whereas in the previous dryer cabinet, the tool operating system was still manual. Modification of the automation-based dryer cabinet was changed and added several important components to carry out the function of the tool optimally. Some of the changes made include a manual stove being replaced with an automation system, namely a furnace stove connected by a fire sensor and lighter as well as an inkliter and timer so that it can live the stove automatically. In addition, the addition of a control box to the device as an electronic circuit safety device. The circuit in the control box consists of an inkliter coil, temperature control, power switch, stove switch and power indicator light. Other components that were replaced were the solenoid valve and fan. Solenoid valve as a regulator of the flow of gas entering the furnace [9]. The next change is the location of the fan and the fan model. The location of the fan or blower was previously at the bottom of the rack close to the fire furnace so that it melts easily due to the hot temperature of the fire. While in this design, the type of blower used is an AC type blower which is placed on the top of the rack to flow hot air in the tool and maximize in attracting hot air [10]. Temperature control has also undergone a change that was originally manual to digital. The addition of other components is the installation of a fuse as a safety tool in case of trouble shooting and also the addition of a timer component as a timer. Here is the look of the dryer cabinet design based automation system (Fig. 2).

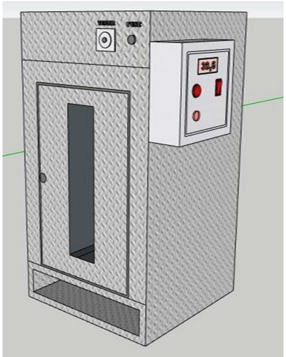

Fig. 2. Automation-Based Dryer Cabinet Design

Fig. 3. Dryer Cabinet Before Modification

Here is the appearance of the dryer cabinet before modification (Fig. 3).

After going through the modification process, the appearance of the dryer cabinet underwent some changes. Here is what the automation-based dryer cabinet looks like after modification (Fig. 4).

The display of the automation-based dryer cabinet tool control box is as Fig. 5.

3.1 Test Results of Drying Tools and Materials and Water Content Analysis

Drying tools and materials using *a* dryer cabinet is influenced by several factors including, type of material, material thickness or cross-sectional area, high low temperature, fan speed, size of the fire, position of the baking sheet and drying time. After going through the drying trial process with the dryer cabinet, the moisture content analysis of the material is then carried out. Drying watermelon and pineapple fruits weighed an initial weight of 1 kg with a thickness of 0.2 mm pieces using a temperature above 60 °C and a lower temperature of 57 °C within 3 h 30 min the result was the final weight of the material 120 gr with a moisture content of 0.88%bb. The trial of drying spinach and turmeric leaves with an initial weight of 285 gr of spinach leaves and 350 gr of turmeric was dried with a temperature of up 60 °C and a lower temperature of 57 °C

Fig. 4. Insulated Dryer Cabinets Automation

Fig. 5. Box Control Cabinet Dryer Based Automation

for 1 to 2 h the final weight ofspinach leaves was 20 gr while turmeric was 85 gr with a moisture content of 0.9% bb and turmeric 0.75% bb. While the drying of chicken and fish meat with an initial weight of 300 gr is dried at an upper temperature of 60 °C and a temperature below 57 °C for 2 h the result is the final weight of chicken meat is 165 gr and the final weight of fish meat is 170 gr with a water content of chicken meat and fish meat 0.45% bb. The moisture content in good dry food ingredients is below 5% (Elizabeth, 2018). On drying beaker glass tools with a temperature above 60 °C and a lower temperature of 57 °C for 25–30 min the result is dry tools. While the appearance of drying foodstuffs using an automation-based dryer cabinet is as in Fig. 6.

For data on the results of trials of drying tools and materials as well as water content analysis, they are contained in Table 1. Drying using a cabinet dryer based on an automation system is faster, saves power and has good product results. The Dryer Cabinet is based on a simple and easy- to-use automation system to support practical practicum activities while still prioritizing user safety.

Fig. 6. Drying Pineapple and Watermelon Fruits.

Table 1. Test Results of Drying Tools, Materials and Moisture Content Analysis

No	Temperature	Time	Tools or Materials	Result	Air Up
1	Upper Temperature 60 °C Bottom Temperature 57 °C	3 h 30 min	Watermelon Cut Thickness 0.2 mm	Initial Weight: 1 kg Final Weight: 120 gr	0.88%bb
2	Upper Temperature 60 °C Bottom Temperature 57 °C	3 h 15 min	Chicks Cut Thickness 0.2 mm	Initial Weight: 1 kg Final Weight: 250 gr	0.75%bb
3	Upper Temperature 60 °C Bottom Temperature 57 °C	1 h 30 min	Spinach Leaves	Initial Weight: 285 gr Final Weight: 25 gr	0.9%bb
4	Upper Temperature 60 °C Bottom Temperature 57 °C	2 h 30 min	Turmeric Cut Thickness 0.2 mm	Initial Weight: 350 gr Final Weight: 85 gr	0.75%bb
5	Upper Temperature 60 °C Bottom Temperature 57 °C	2 h 00 min	Chicken Meat Cut Thickness 0.2 mm	Initial Weight: 300 gr Final Weight: 165 gr	0.45%bb
6	Upper Temperature 60 °C Bottom Temperature 57 °C	2 h 00 min	Mujair fish Cut Thickness 0.2 mm	Initial Weight: 310 gr Final Weight:170 gr	0.45%bb
7	Upper Temperature 60 °C Bottom Temperature 57 °C	25 min	Beaker Glass	Dry	Dry

4 Conclusions and Suggestions

Automation System Based Dryer Cabinet creates a sterile, controlled drying chamber. And easy to use. This is proven by several test results of drying tools and materials with an upper temperature of 60 °C and a lower temperature of 57 °C in a drying time of less than 4 h to obtain a moisture content of $<5\%$. The moisture content in good dry food ingredients is below 5%. Dryer cabinets based on automation systems are capable of operating in drying materials, but trials are still needed regarding variations in materials, temperatures and drying times to obtain more accurate data. Drying using a cabinet dryer based on an automation system is influenced by several factors that must be further investigated, such as external factors such as cross-sectional area or thickness of pieces of material or tools, placement of shelves or pans, fan speed, temperature range and others. In addition, it is hoped that the development of fire and gas heating sources in the future can be converted into electricity- saving energy, and changes to components that are still manual to digital. Drying using a cabinet dryer based on an automation system is faster, saves power and has good product results.

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