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Performance Analysis of Intermittent Dryer

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ABSTRACT: The intermittent drying system utilizes electrical energy to heat and dry any food substance loaded, which is beneficial in reducing wastage of agricultural products and helps in the preservation of the agricultural product. Based on the limitations of natural sun drying e.g. exposure to direct sunlight, liability to pests and rodents lack of proper monitoring,[1] and the escalated cost of the mechanical dryer, an intermittent dryer is therefore developed to cater to this limitation. This project presents the design, construction, and performance of an intermittent dryer for food preservation. The fruits slices were placed in trays. In the dryer, the heating coil utilizes the electrical energy to produce a heat and passed to the drying cabinet, heat transfer through the trays. The results obtained during the test period revealed that the temperatures inside the dryer were much higher than the ambient temperature. And dried at temperatures of 55 degrees Celsius in a drying cabinet. Samples were removed at various intervals and weighed, before returning to the oven to continue drying. The weight loss of samples was determined using weighing machine. A weighing interval of 30min was used during drying until the calculated final moisture content of the fruit reached approximately 20%(w.b). Each run was performed in an identical manner.

KEYWORDS: Dryer, Thermometer, Heating Coil, Weighing machine.

I. INTRODUCTION

The intermittent drying process in which the drying time of the fruits is varied for better utilization of electrical energy. Intermittent drying can be accomplished by controlling the supply of thermal energy, which can be achieved by varying the heat flow rate, and temperature[2]. One can also vary the mode of energy input to achieve intermittence. In continuous heating same amount of energy supplied throughout the drying process, results in quality degradation and heat damage to the surface hence a waste of energy. This is because in the later stage of drying, the drying rate reduces as fruits or crops do not contain sufficient moisture to be removed[3]. The strategy of using intermittency allows time to transfer the moisture from the center to the surface of the sample during the temperature period. Therefore, the quality degradation and heat damage can be minimized by applying intermittent drying.

II. LITERATURE REVIEW

Crop drying is the most energy consuming process in all processes on the farm. The purpose of drying is to remove moisture from the agricultural produce so that it can be processed safely and stored for increased periods of time. Crops are also dried before storage or, during storage, by forced circulation of air, to prevent spontaneous combustion by inhibiting fermentation. It is estimated that 20% of the world's grain production is lost after harvest because of inefficient handling and poor implementation[4]. These must be dried to a level of 13% to 17% of its solid weight depending on application and market need. Once a cereal crop is harvested, it may have to be stored for a period of time before it can be marketed or used as feed. The length of time a cereal can be safely stored will depend on the condition it was harvested and the type of storage facility being utilized[5]

III. METHODOLOGY

Guava samples were cut vertically into quarters and their core white seeds removed. Each fruit slice was then cut horizontally to its axis into a thickness of 5mm with a top surface area of 20*20mm, using a vernier calliper from the white fleshy part of guava fruit. The guava slices were placed in trays and dried at temperatures of 55 degrees Celsius in a drying cabinet. Samples were removed at various intervals and weighed, before returning to the oven to continue drying. The weight loss of samples was determined using weighing machine. A weighing interval of 30min was used during drying until the calculated final moisture content of the guava reached approximately 20%(w.b). Each run was performed in an identical manner

IV. SCHEMATIC DIAGRAM

The design, construction, and performance of an intermittent dryer for food preservation. The fruits slices were placed in trays. In the dryer, the heating coil utilizes the electrical energy to produce a heat and passed to the drying cabinet, heat transfer through the trays. The results obtained during the test period revealed that the temperatures inside the dryer were much higher than the ambient temperature. and dried at temperatures of 55 degrees Celsius in a drying cabinet. Samples were removed at various intervals and weighed, before returning to the oven to continue drying. The weight loss of samples was determined using weighing machine. A weighing interval of 30min was used during drying until the calculated final moisture content of the fruit reached approximately 20%(w.b). Each run was performed in an identical manner.



Fig1: Intermittent dryer cabinet

OBJECTIVES

1. To help local farmers to get high profit in the drying of crops by designing a intermittent fruit dryer/thermal fruit dryer.
2. For Preserving of fruits, vegetables, and food and to keep them for a long time without further deterioration in the quality of the product.
3. By integrating dryer to remove moisture content of product without compromising on its nutrition value.
4. to design and develop the cabinet dryer with intermideat heat application method.

REQUIREMENT OF COMPONENTS

1) Mini LCD thermometer

Mini LCD thermometer Type: Digital Applications: Aquarium, Fridge, Outdoor, etc. Sensor cable length: 1 meter Batteries: LR44 coin cell (Easily available) (2 x Batteries are included in this product) Feature: A-Set probe to display the temperature at the location of the probe. Can be used in brew fridge fish tank keg incubator and beer tap. Product Attributes: Color: White Black Quantity: 1 Pcs Probe cable length: 100cm/ 39.37inch Temperature Range: 50a" f ~ +70a" f Power source: 2 x LR44 button cell (included) A mini LCD thermometer is a small device equipped with a liquid crystal display (LCD) screen that displays temperature readings. It's compact and often used for quick

temperature checks in various settings such as homes, offices, or laboratories. They're handy for monitoring ambient temperature or checking the temperature of objects or liquids.



Fig 2: Mini LCD Thermometer

weighing machine is a device used to measure the weight of fruits before and after the drying process. It ensures consistency in the drying process by accurately weighing the fruits before and after drying, allowing for precise control over the drying time and temperature. This helps maintain quality and ensures that the dried fruits meet certain weight specifications. Additionally, it can be integrated into automated fruit drying systems for efficient operation. The weighing machine measure weight When a food items placed on the platform of a weighing machine, the reading which it will show depends on the gravitational force acting on the platform.



Fig3: Weighing machine

3) Drying trays

Drying fruit involves removing moisture from the fruit to extend its shelf life. Typically, fruits are sliced or chopped and then placed on drying trays in a dehydrator or oven set to a low temperature. The heat gently removes moisture from the fruit over several hours, resulting in dried fruit that is preserved and concentrated in flavor. Different fruits may require slightly different drying times and temperatures.



Fig4: Drying trays

4) LCD Display

Using an LCD display panel in a fruit dryer serves several purposes:

Monitoring and Control: LCD displays allow users to monitor and control the drying process, including temperature settings, timer functions, and operational modes

Feedback: It provides real-time feedback on the status of the dryer, such as current temperature, remaining drying time, and any alerts or errors.

User Interface: LCD displays offer an intuitive user interface for interacting with the dryer, making it easier for users to operate and adjust settings as needed.

Customization: Some advanced dryers may offer customization options through the LCD display, allowing users to tailor the drying process to different types of fruits or personal preferences.

Overall, the LCD display enhances the functionality and user experience of the fruit dryer by providing convenient control, feedback, and customization options.



Fig5: LCD Display

5) heating coil

Heating elements in fruit dryer machines are crucial components that generate the necessary heat for drying fruits. They typically consist of coils made from materials like nichrome wire or stainless steel. When an electric current passes through these coils, they resist the flow of electricity and produce heat as a byproduct. This heat is then transferred to the air inside the dryer, which circulates around the fruits, causing moisture to evaporate and the fruits to dry.



FIG6: HEATING COIL



VI. RESULT AND DISCUSSION

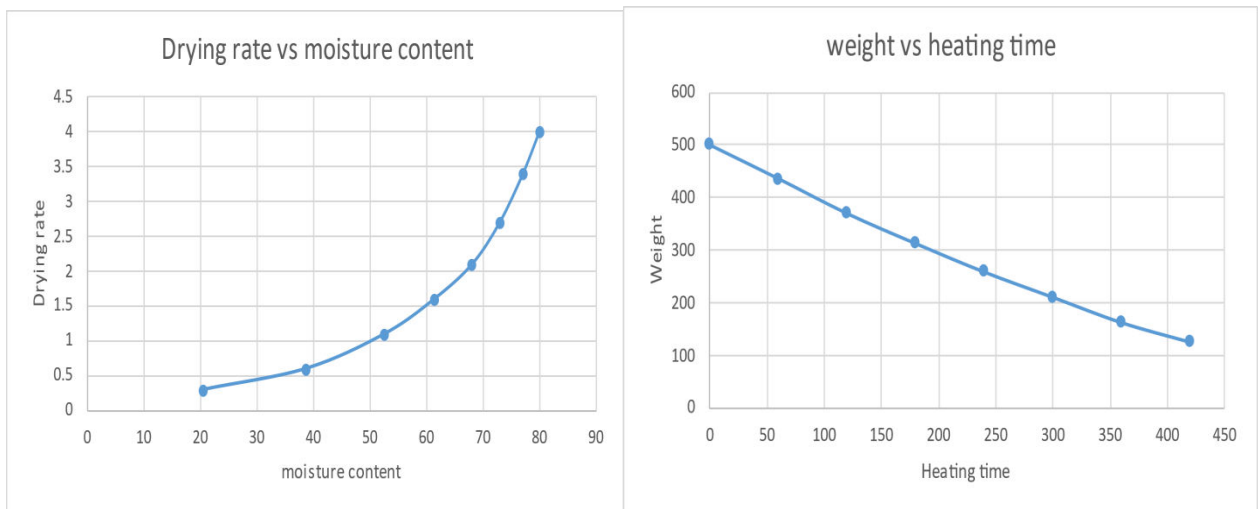
This gives a detailed description of the analysis of experimental results obtained from the intermittent dryer. The experimental results on performance of intermittent dryer has been discussed in the following case 1 where the heat is supplied continuously where as in case 2 heat is supplied Intermittently by 30min hot supply on and 30min hot air supply off till we get a rid of moisture content in the fruit, Experimental results discussed below.

Case1:Continuous heating

CASE1								
Drying time	Exit air	Guave fruit weight(g)	solid weight (g)	Moisture Weight (g)	wetbasis moisture(%)	Dry basis moisture (%)	Water removed (g)	water removal rate
								g/g solids/min
min		5mm	5mm	5mm	5mm	5mm	5mm	5mm
0		500	100	400.0	80.0	4.0		
60	51	436	100	336.0	77.1	3.4	64	0.011
120	53	370	100	270.0	73.0	2.7	130	0.011
180	60	313	100	213.0	68.1	2.1	187	0.010
240	62	259	100	159.0	61.4	1.6	241	0.009
300	64	211	100	111.0	52.6	1.1	289	0.008
360	64	163	100	63.0	38.7	0.6	337	0.008
420	64	126	100	26.0	20.6	0.3	374	0.006

Graphcase1

The experimental result in case 1, the weight is decreased and consuming or heating time will be increasing and drying rate is increased with moisture content will be decreased



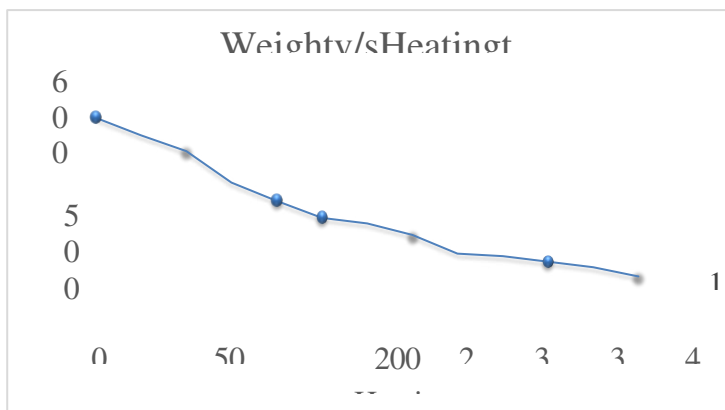
Case2:Intermittent heating

CASE2

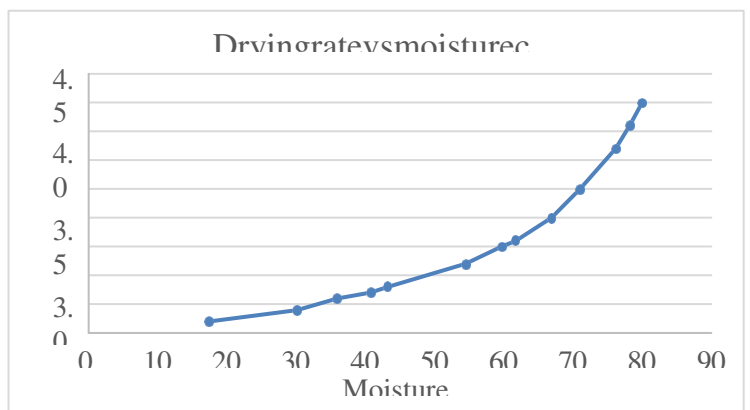
Dryin gtime min	Exit air	Guava fruit weight(g)	Solid weigh t(g)	moisture weight (g)	Wet basis moisture (%)	Drybasis moisture(%)	Water Remove d(g)	water removal rate g/g solids/mi n
		5mm	5mm	5mm	5mm	5mm	5mm	5mm
0		500	100	400.0	80.0	4.0		
30	51	458	100	358.0	78.2	3.6	42	0.007
60	53	421	100	321.0	76.2	3.2	79	0.006167
90	60	345	100	245.0	71.0	2.5	155	0.012667
120	62	302	100	202.0	66.9	2.0	198	0.007167
150	64	261	100	161.0	61.7	1.6	239	0.006833
180	64	248	100	148.0	59.7	1.5	252	0.002167
210	64	220	100	120.0	54.5	1.2	280	0.004667
240	64	176	100	76.0	43.2	0.8	324	0.007333
270	64	169	100	69.0	40.8	0.7	331	0.001167
300	64	156	100	56.0	35.9	0.6	344	0.002167
330	64	143	100	43.0	30.1	0.4	357	0.002167
360	64	121	100	21.0	17.4	0.2	379	0.003667

GRAPHCASE2

In intermittent heating(case 2) the weight is decreased with heating time.the drying rate is increased with moisture. So when we using intermittent dryer save the electrical energy



WEIGHT VS HEAT TIME



DRYING RATE VS MOISTURE CONTENT

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