

REENGINEERING OF AN ADIABATIC TRAY DRYER FOR SMALL FRUIT AND VEGETABLE GROWERS

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Summary - In the region where the Instituto Tecnológico Superior de Ciudad Serdán is located, agricultural and fruit production predominates. A few years ago, a tray dryer was designed and used for a long time to add value and extend the shelf life of field products such as apples, pears, peaches, tejocote, cactus, chamomile, potatoes, carrots, epazote, and chard, among others, and the continuous use of the equipment exhausted its efficiency in many of its mechanical parts and ceased to be functional for the drying of field products, through a diagnosis in the agricultural sector of the Serdán Valley region in its agricultural activity it was detected that the marketing of fruits and vegetables is done fresh, which generates disadvantages such as low price due to a wide supply and a high rate of intermediarism, In addition to the short shelf life of the product, which has an impact on the low level of income for the producers, making the agricultural activity less and less profitable. The producers of the region have approached the institution to support them in giving them that added value and to learn other alternatives of ways to preserve and commercialize their seasonal products at any time of the year and to be able to place them or cover other markets, The objective of this research work was to reengineer the tray dryer for the dehydration of fruits and vegetables as a technological alternative for small producers within the reach of their economic income and in this way implement a method of conservation with the transfer of technology and in parallel the opportunity to access other markets at any time of the year.

Key words: equipment, fruits, vegetables, reengineering, drying.

Abstract -- In the region where the Technological Institute of Ciudad Serdán is located, agricultural and

fruit production predominates. A few years ago, tray drying equipment was designed and was widely used to give added value and extend the shelf life of farm products. such as apple, pear, peach, tejocote, nopal, chamomile, potato, carrot, epazote, chard among others, and the continuous use of the equipment came to exhaust its efficiency in many of its mechanical parts and it was no longer functional for drying products. In the field, through a diagnosis in the agricultural sector of the Serdán Valley region in its agricultural activity, it was detected that the marketing of fruits and vegetables is carried out fresh, which generates disadvantages such as low price due to a wide supply and a high index of intermediaries, in addition to the short shelf life of the product, which has an impact on the low level of income for producers, making agricultural activity increasingly less profitable. Producers in the region have approached the institution to support them in giving them that value. added and learn other alternative ways to preserve and market their seasonal products at any time of the year and be able to place them or cover other markets, the objective of this research work was to reengineer the tray dryer for the dehydration of fruits and vegetables as a technological alternative for small producers within the reach of their economic income and in this way implement a conservation method with the transfer of technology and in parallel the opportunity to access other markets at any time of the year.

Key words - drying, equipment, Fruits, reengineering, vegetables.

INTRODUCTION

Re-engineering is the fundamental rethinking of and process redesign to achieve substantial improvements in performance measures such as cost, quality, service and speed by optimizing workflows and productivity. The dryers exhibiting

The solid to a hot gas are called adiabatic or direct dryers, in which the heat is transferred from an external medium.

In this work, the term drying will be used to refer to the removal of water from process materials or other substances by evaporation, through the application of heat under controlled conditions.

Food production is a fundamental activity for human survival, but it can also present risks public health if adequate food safety measures are not taken. In this case, it is essential to change the equipment for its operation to ensure the quality and safety of the food produced, as well as to meet the needs of fruit and vegetable producers in the Serdán Valley region.

Quality equipment is designed to meet international food safety standards and ensure the quality and purity of the food produced. This requires rebuilding with high quality materials and rigorous performance testing, which ensures the safety and reliability of the final product. High-quality products have a higher added value, which can result in higher prices and higher profit margins for small producers.

The reengineering of the equipment is essential to guarantee the quality, safety and efficiency of the production process in the use of the surplus that is not placed in the market or to give added value to the product that is not marketed fresh. In addition to updating the functions of the equipment by optimizing the current physical structure, in order to position it as an optional technology for small fruit and vegetable producers.

One year after the founding of the Instituto Tecnológico Superior de Ciudad Serdán, several research projects were carried out, one of them was the design and construction of an adiabatic tray dryer with two purposes: to generate a didactic prototype for the students of the Food Industry Engineering course for the conservation technology course and to meet the demands of small producers in order to give them the opportunity to develop their own products.

The continuous use of the equipment resulted in the non-functionality of some mechanical parts, which in the long run led to the failure of some of the mechanical parts, which in the long run led to the failure of the equipment, which in the long run led to the failure of some of the mechanical parts.

The equipment was left idle and out of order in the institute's fruit and vegetable workshop for many years. Abandoning the attention to this agricultural sector that trusted in learning the methodology of food drying and the possibility of implementing the technology to have the opportunity of another extra income by marketing the products at another time of the year.

Based on the above, contact was made again with the agricultural producers where they requested support in order to find alternative methods of preservation to extend the shelf life of their products in an optimal way and to be able to market them at any time of the year, as well as not to have losses of their fresh production, for this it was decided to evaluate the components and functionality of the drying equipment, This led to identify those aspects and parts, especially mechanical, that could be redesigned, rebuilt or changed to reuse the dehydrator equipment and make it suitable for drying fruit and vegetable products as a technological alternative for small farmers and to promote technological development both to extend the shelf life and to give it a commercial added value, so the objective was to redesign the adiabatic tray dryer equipment for small farmers.

The redesign of an equipment or installation is considered important for this project since on the one hand it enables a didactic equipment for the realization of practices related to the drying or dehydration of fruits for the students of the Food Industry Engineering career and on the other hand and very important the attention to the request of the small producers to give that added value to products that are not placed in the commercialization in fresh, incorporating characteristics that reduce or eliminate the risk of being a source of contamination for the processed products, both directly and indirectly, since in the redesign it was detected that the galvanized steel trays which are in direct contact with the product, are a source of contamination due to wear and tear during the drying process.

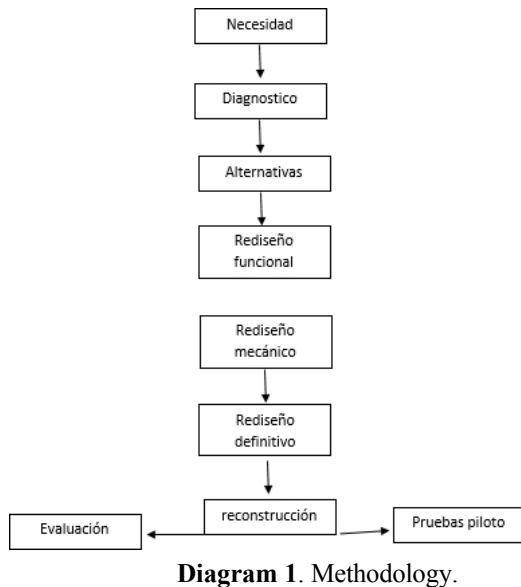
This work presents a redesign of a prototype tray dryer that operates with gas combustion in order to obtain a product in less time. The redesign was obtained by performing calculations of material and energy balance; it was obtained that for a nominal capacity of 10 kg of fruit and 8 kg of vegetables the components of the equipment are:

- a) 1Hp motor
- b) air duct

- c) fan
- d) drying chamber
- e) exhaust fan
- f) adiabatic layer with fiberglass reinforcement
- g) Trays of 52cm by 80 cm
- h) Separation of supports between tray and tray of 10cm
- i) 1 double-leaf door with hermetic seal

DEVELOPMENT

The following methodology was used to determine the reengineering:



Two aspects were considered for the alternatives section:

1. Dryer design from new according to budget.
2. Redesign of the dryer based on the allocated budget and replace only non-functional parts.

The second alternative was chosen based on the cost of construction or redesign of parts and improvements. One of the parts to be changed was the fan that carries the hot air: according to Hernandez the term ventilation refers to the supply of air needed at the pressure required to overcome the different resistances, for the selection of the fan the following was considered:

- a) Maximum working temperature 75°C
- b) Height above sea level 2520
- c) Required air flow $Q=0.32\text{m}^3/\text{s}$
- d) Static pressure 0.79 in. of water column Fan

selection:

- a) Soler Palau centrifugal fan model SA9/4
- b) 1 Hp single-phase motor 127V at 60Hz
- c) Engine braking power 0.92BHP
- d) Rpm 1725
- e) Maximum air flow rate 2600 m³/hr

The doors were demolded in order to install the hermetic white rubber tape to ensure the heat concentration in the drying chamber.

The control panel for the basic functions the adiabatic tray dryer equipment was installed, with on/off buttons for the fan, extractor and equipment functions.

The galvanized steel trays were replaced with 304-gauge stainless steel trays to ensure the safety of the products to be dried.

The reengineering was follows:

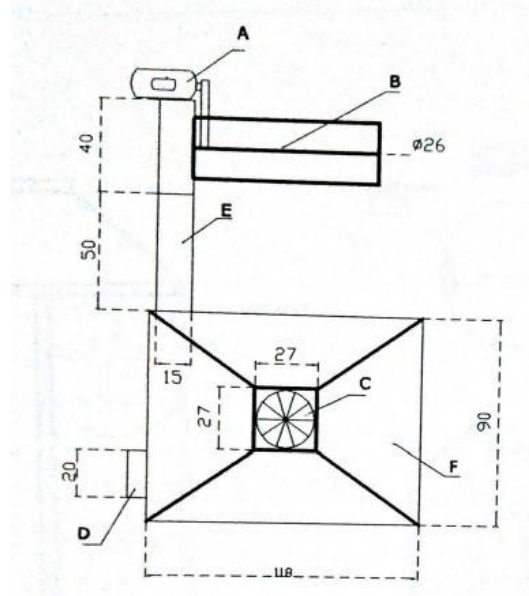


Figure 1. Top view.

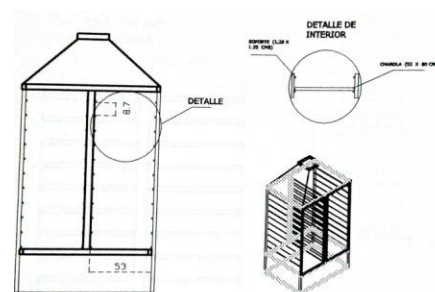


Figure 2. Interior view with tray distribution.

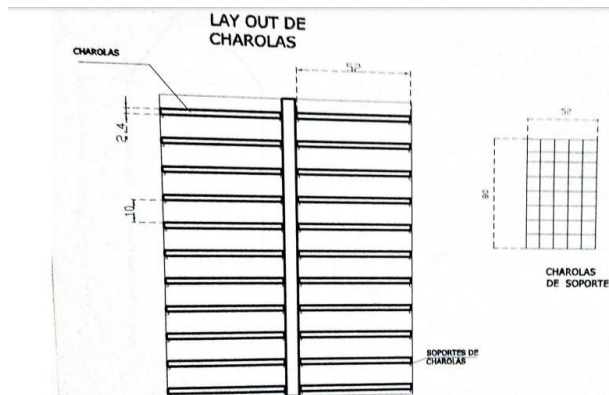


Figure 3. Lay out of redesigned stainless steel trays.

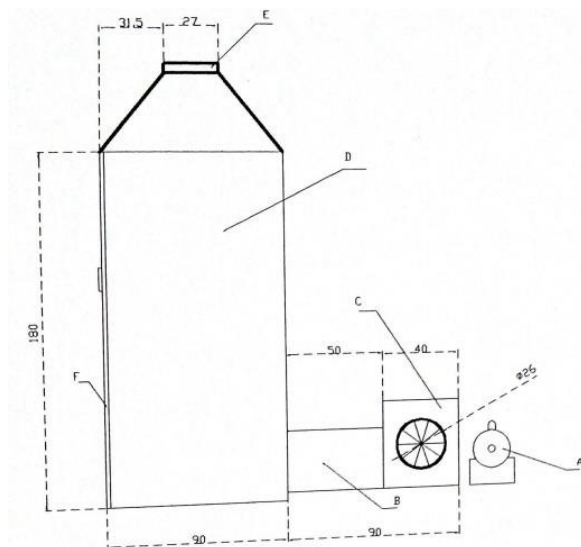


Figure 4. Side view .

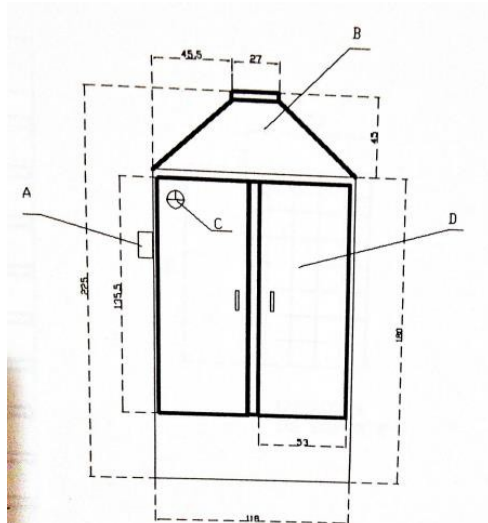


Figure 5. Front view, double-leaf door

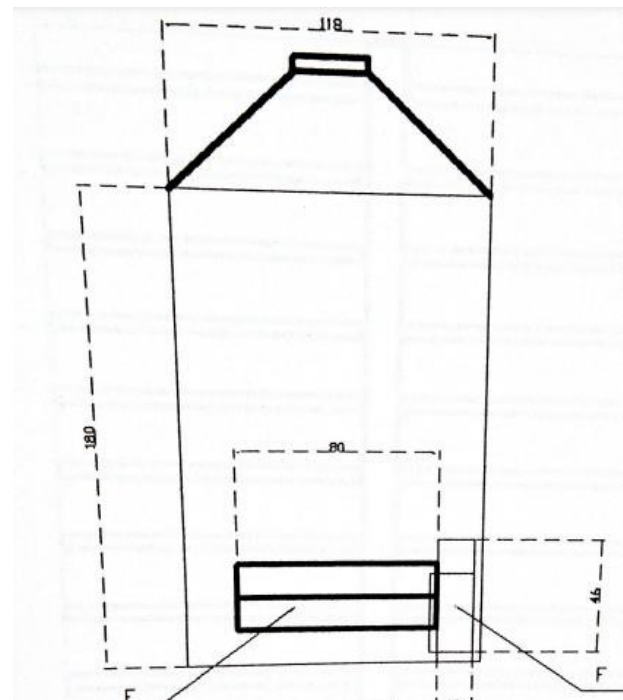


Figure 6. Rear view, hot air inlet.

DISCUSSION AND ANALYSIS OF RESULTS

For this section it was found that the redesign of the tray dryer equipment for small fruit and vegetable producers is an option for the transfer of appropriate technology for small fruit and vegetable producers that allows adding value to fruits and vegetables in the Serdán Valley region.

The fan that carries hot air to the drying chamber was changed, which allows the air to be distributed uniformly for proper drying of fruits and vegetables and to ensure that at the end of the process the humidity level is 11%, in order to extend the shelf life of the products that are not placed fresh on the market. The galvanized steel trays were replaced with stainless steel trays to ensure the safety of the products.

CONCLUSIONS

The purpose of the reengineering work was achieved with the redesign of an adiabatic tray dryer for small fruit and vegetable producers, making it more functional. To verify the functionality based on the redesign of the equipment, pilot tests are recommended for the drying of fruits and vegetables in the region.

According to the obtained from the re-engineering of the dryer equipment it is intended to detach three lines of

The research will involve students of social service, professional residency and complementary research credits, from the Food Industry Engineering career and students from the Computer Science or Mechanical Engineering career to work on a first line of research, considering the following:

1. Research line for the automation of the drying process under the application of technical and scientific knowledge for the search of sustainable solutions to the problems related to the automation of drying processes in food.
2. Line of research related to the standardization of drying processes in fruits, vegetables and aromatic species produced in the region of the Valley of Ciudad Serdán, taking drying times and temperatures to support the automation process.
3. Line of research based on the physical, chemical and enzymatic changes that fruit and vegetable products undergo during the drying process, as well as which aromatic and functional components are preserved or are susceptible to changes during drying. Likewise, storage management and how to preserve and extend shelf life through studies of modified atmosphere packaging systems, physical treatments, addition of chemicals and others, directly related to quality.

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CONTRIBUTION ROLES

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Writing - Preparation of the original draft	Luz Maria Hernandez Romero
Supervision	José Felipe F. Juárez Chain
Validation	Luz Maria Hernandez Romero Supporter: Mayra Luna Román



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