UNIVERSIDAD RICARDO PALMA

COLLEGE OF ENGINEERING

PROFESSIONAL DEPARTMENT OF INDUSTRIAL ENGINEERING

RESEARCH WORK

PREFEASIBILITY STUDY OF AN AUTOMATED GRATER

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Summary

This project is an automation proposal for a grating machine that aims to optimize productivity and efficiency. Given the educational context of the project, a descriptive research was carried out by reviewing research documents such as educational programs and scientific journals on the topic. Direct observation of the machine condition was also carried out for diagnostic purposes. The information was discussed with third parties (the teachers involved in the construction of the machine) to subsequently obtain information that would allow the construction and design of the grater automation system, which involved the following procedure: the description of the system implemented for automation where The electrical system was manually designed with PLC and the structure was graphed in CAD. And finally he proceeded to do tests to check its operation.

Keywords:implementation, improvement, production system, Grater, PLC, use, automation.

Abstract

The present project is an automation proposal for a grater machine that aims to optimize productivity and efficiency. Given the educational context of the project, a descriptive research was carried out by reviewing research documents such as educational programs and scientific journals on the subject. Direct observation of the condition of the machine was also carried out for diagnostic purposes. The information was discussed with third parties (teachers involved in the construction of the machine) to subsequently obtain information that would allow the construction and design of the automation system of the grater, which involved the following procedure: the description of the system implemented for automation where the electrical system was designed manually with PLC and plotting the structure in CAD. And finally proceeded to make tests to check its operation.

Key words:implementation, improvement, production system, Grater, PLC, utilization, automation.

INDEX

INDEX OF FIGURES

TABLE INDEX

INTRODUCTION

In the constant search to improveindustrial processes and optimize productivity, automation has become a key tool in various sectors. In this report, we will present the development project of an automated grater, an innovative solution aimed at speeding up and simplifying the food grating process.

Grating foods, such as cheese, vegetables or fruits, is a common task in the food industry, as well as in homes and restaurants. However, this process has traditionally been carried out manually, which involves considerable time and effort on the part of operators. Additionally, there is an inherent risk of injury associated with the use of sharp blades.

With the aim of improving efficiency and safety in food processing, an automated grater has been designed and developed that combines the precision of industrial machinery with mechanics and a programmable control system. This revolutionary solution seeks to optimize the grating process, offering consistent, high-quality results, while reducing production times and minimizing risks for operators.

Throughout this report, we will examine in detail the designand the functionality of the automated grater.

Based on the above, this document aims to implement the automation design of the automated grater for food production. Therefore, it carries out a general study of the concepts and definitions associated with each of the parts and a review of the theoretical background related to the project. In the second instance, a study of the machinery is carried out, followed by a structural design based on the deficiencies found.

CHAPTER 1 – THEORETICAL FRAMEWORK

1.1 theoretical foundation

1.1.1 Automation

According to Córdova, E. (2020) "Industrial automation refers to the management of information in companies in order to make decisions in real time. It involves the integration of computing and automated control to allow the autonomous and efficient execution of processes designed according to engineering criteria, in line with the objectives established by business management.

1.1.2 Automated grater

1.1.2.1 Importance

An automated grater has several advantages and importance in the context of the food industry or in any process that requires efficient grating of ingredients. Some of the reasons why an automated grater is important are:

- Higher Productivity: The automated grater can process a significant amount of ingredients in a shorter period of time compared to a manual process. This increases the productivity and production capacity of the production line.
- Saving time and labor: ByBy automating the grating process, the need to use labor in repetitive and monotonous tasks is reduced. This allows staff to be redirected towards other more specialized tasks with greater added value.
- Consistency in quality: The automated grater guarantees a constant and uniform result when grating the ingredients. This is especially important in the food industry, where consistent, standardized quality is required to maintain customer satisfaction.
- Greater food safety: By minimizing human contactdirectly with food, the risk of cross-contamination is reduced and high standards of hygiene and food safety are maintained.

- Reduction of errors: Automation eliminates the possibility of human errors, such as uneven or inconsistent grating, which can affect the appearance and quality of the final product.
- Control and monitoring: Automated graters usually have integrated control and monitoring systems that allow grating parameters to be monitored and adjusted as necessary. This makes it easier to optimize the process and early detect any problems or malfunctions.

1.1.2.2 Recommendations for use

The use of food graters is very common when preparing food in restaurants and at home, which is why we recommend some important points when using the classic grater and the automated grater.

Classic food graters:

- Safety: Pay attention to your hands and fingers while using a manual grater. Always use the safety guard or a glove to avoid cuts.
- Proper posture: Maintain an upright and firm posture when grating food to avoid back and arm injuries.
- Proper Selection: Use the appropriate grater size for the type of food you want to grate. Graters with different hole sizes allow you to obtain different grating textures.
- Maintenance:Clean the grater immediately after use to prevent food from drying out and sticking to the blades. Use a brush or soft sponge to remove residue and wash by hand or in the dishwasher according to the manufacturer's instructions.

Automated food graters:

- Familiarize yourself with its operation: Read and understand the instructions for use of the automated grater before using it. Make sure you understand how to properly set up and operate the equipment.
- Safety: As with classic graters, be sure to follow safety precautions and use any guards or safety equipment provided with the automated grater.
- Maintenance: Regularly clean and disinfect all removable parts of the automated grater according to the manufacturer's instructions. Be sure to disconnect it from the power source before performing any cleaning or maintenance.
- Regular inspection: Conduct inspectionsperiodically to verify that all parts are in good working order. If you notice any wear or damage, contact the manufacturer or supplier for assistance or replacement of necessary parts.
- Training and supervision: If multiple people use the automated grater, be sure to provide appropriate training on its safe and efficient use. Monitor its use to ensure correct operation and prevent any misuse.

1.1.3 Production system

According to Caballero (2022) Production systems consist of the integration of individuals, equipment and methods specifically developed to combine materials and processes in a company's manufacturing operations.

This system covers all stages of the production process, from the acquisition of raw materials, through transformation and assembly, to delivery of the final product to the customer. The main objective of a production system is to achieve optimal efficiency, maximizing productivity and minimizing costs, while ensuring quality and customer satisfaction.

1.1.4 PLC

According to the DIEEC (2021) “A programmable logic controller, commonly known as a PLC (Programmable Logic Controller) in English, is a computing device used in industrial automation engineering to automate electromechanical processes. Its main function is to control and supervise machinery in factories, assembly lines and amusement rides. This device acts as a specialized computer that runs predefined programs to manage specific control and monitoring tasks in industrial environments.”

ControllersProgrammable logic devices are equipped with input terminals, also known as sensors, to which various devices such as pushbuttons, limit switches, photocells and detectors are connected. They also have output terminals, called actuators, that connect to contactor coils, solenoid valves, lamps and other devices. The action of these output devices is determined by the input signals that are activated at all times, according to the program stored in the controller.

These programmable logic controllers meet the requirements of both continuous and discontinuous processes. They have the ability to control and regulate variables such as pressures, temperatures, levels and flow rates, as well as perform other related functions, such as timing, counting and logic. In addition, they have an additional communication card that allows them to be part of a distributed control network, which makes them powerful elements within said network.

1.1.5 Sensors

According to Baez and Ochoa (2018), sensors are electromechanical instruments that transform physical magnitudes into quantifiable values of those magnitudes. In most cases, these quantifiable values are expressed as electrical signals that are encoded in analog or digital format.

Sensors are instruments created with the purpose of identifying and quantifying changes in the physical environment in which they are located, transforming them into electrical or digital signals that are understandable and usable by other systems.

These changes can encompass various variables such as temperature, pressure, luminosity, movement, proximity, humidity, among many others.

1.1.6 Actuators

According to Sicma21 (2022) An industrial actuator is a device responsible for generating movement by converting the energy and signals it receives within the system. Depending on their design and function, actuators can produce rotary or linear motion.

Linear actuators are characterized by generating a movement in a straight line. These actuators have the ability to move forward or backward along a set linear path. That is, they can travel a predetermined distance in any direction before stopping.

On the other hand, rotary actuators generate a rotational movement, which implies that the actuator rotates in a circular plane.

Unlike linear actuators, rotary actuators are not limited by a defined path, meaning they can continue to rotate in the same direction for as long as necessary without restrictions.

1.1.7 Innovation

According to Zambrano (2019) The improvement of the learning process is driven by educational innovation, which consists of the application of a set of ideas, beliefs, strategies and processes in current educational practices. Its objective is to introduce changes in the daily dynamics of the classroom.

Innovation refers to the process of creating and developing new ideas, products, services or processes that provide value to people and improve the way activities are carried out.

The innovation process is characterized by being disruptive, seeking creative solutions to existing problems. To do this, it is based on experimentation and continuous learning.

1.1.8 Process

According to UTEL (2019) It is a set of interconnected activities and processes that cover design, material selection, planning, production and management, in order to develop products.

Industrial processes are often repetitive and designed to optimize efficiency, maximize production and ensure the quality of the final product. They may involve specialized machinery, advanced technology, control and supervision systems, as well as the participation of trained personnel at each stage of the process.

1.1.9 Programming

According to Pérez-Palencia (2018) Programming is considered a technical activity intended mainly for a group of the population in the field of computer and computer engineering. This is mainly due to the high level of abstraction it requires and the complexity necessary for its development. However, for some time now efforts have been made to overcome these limitations through programming that has a visual language, as well as facilitating any type of projects and activities, sharing and disseminating them, and promoting the use of multimedia resources. In addition, objects are created that materialize these abstract codes, making what is planned visible and promoting student motivation by seeing their progress.

1.1.10 ladder language

According to Burrete (2018) The ladder diagram, also known as a stair diagram, is a graphical programming language that is based on classic electrical control schemes.

Ladder is one of the different programming languages for programmable logic controllers (PLCs).

To program a PLC with Ladder, in addition to being familiar with the rules of switching circuits (also called Contact Logic), it is necessary to know each of the elements that make up this PLC.

language. The most common ones are described in general terms below (see Fig 1):

- Normally open contact (E1): if the associated variable E1 is '0', the contact remains open, and if it is '1' it is closed.
- Normally closed contact (E2): if the associated variable E1 is '1', the contact remains open, and if it is '0' it is closed.
- Output, coil or relay (S1): the associated variable S1 will takethe value of the variable (or combination of variables) that is at its input (left side connection point). It can also be locked or unlocked, indicated with an S or R as indicated in the cases of S2 and S3.

Figure 01: Basic elements of the ladder diagram

Source: Burrete.A(2018) Introduction to Industrial Automation. https://bookdown.org/alberto_brunete/intro_automatica/

1.2 Goals

This project aims to design and implement an ecological kitchen instrument that can grate food using an automated system in order to reduce the impact on the time resource when grating for production lines that

They use this raw material and reduce the intervention of operators and reducing the risk of contamination and/or cuts.

1.2.1 General objective

Develop an automated system for grating and transferring food.

1.2.2 Specific objectives

a. Implement actuators and control technology to automatically monitor and adjust the speed and pressure of grating, ensuring the quality of the process.
b. Program and develop a system to control the automated system, facilitating its operation.
c. Optimize the automated system to maximize productivity and minimize cycle times, thereby reducing the total time required for food processing.

CHAPTER 2 – DETAILED DESCRIPTION OF THE CURRENT PROCESS

Currently, small food industries do not have machinery that satisfies the process of cutting or grating food in the same article, which causes misuse of resources such as time, space and money when carrying out operations.

The operations of our multifunctional grater project range from the manual operation of entering the food through the grater input tray, to the transportation and storage of the grated product.

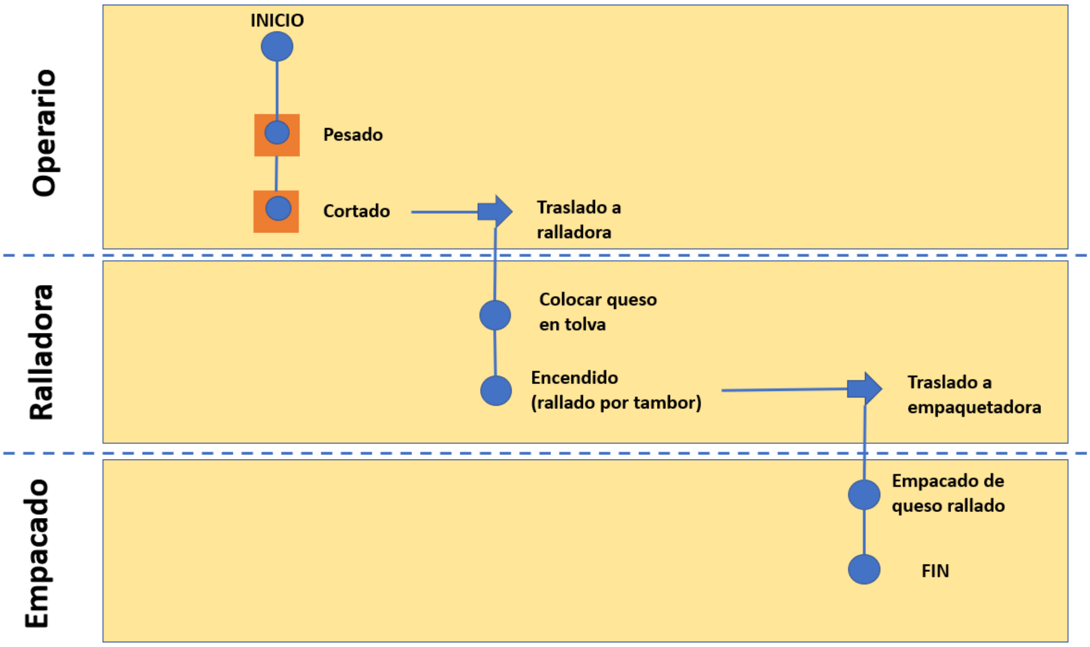

Figure 02 Operation diagram of the grating process.

Source: self made.

2.1 Process description

The operation of our project proposal begins from the ignition where it will be composed of a rotational movement in the drum area, using a crank connected to a rotor with the objective of grating the food as it enters the hopper, a second movement of push caused by the piston to keep the food in the system and a third movement to transfer the finished product. The project is based on the unification of these movements with the objective of improving food processing centers, their process and methodology that leads to the moment they grate food, presenting as an alternative a better use of time and space.

2.2 Description and details of production indicators before automation

- Production cycle time

This production indicator, known as cycle time, allows measuring the duration necessary to produce a specific product. To calculate it, it is taken as starting point the moment in which the order ofproduction and as an end point the moment in which the product is considered finished.

In the case of the project in question, this indicator is high before the implementation of automation. This is because manual activities require more time to complete, due to planned or unplanned stops, as well as imprecise movements that slow down the process.

- Quality performance

In this case, the production key performance indicator (KPI) focuses on analyzing the percentage of products manufactured without errors. This involves determining the number of products that meet the quality standards established at the end of the production chain. Because the process is manual, there is a greater chance of human error occurring during the performance of activities as accuracy is not constant. These errors can negatively affect performance, decreasing the quality of the final products.

- Rejection rate

The rejection rate is a key performance indicator (KPI) that evaluates the number of products that do not meet established quality standards. In non-automated processes, this indicator tends to be high due to the lack of precise and uniform scheduling that ensures that products are manufactured exactly within the parameters established for an acceptable product. This leads to a greater number of rejected products, since the required quality criteria are not met.

CHAPTER 3 – CURRENT PROCESS DESIGN

3.1 3D CAD plans of the current situation or video of the current situation.

Figure 03 Current cheese grater

Source: Kitchenshop

CHAPTER 4 – PROPOSAL DESIGN TO AUTOMATE THE PROCESS

4.1 Detailed description of the proposed process

STEP 1: Operator places the “food” on the grater, and a deposit on the conveyor belt.

STEP 2: The “STAR (green)” button is pressed (it will turn on the grater motor)

STEP 3: The actuator extends by applying pressure on the “food” until it is completely extended, remaining in that position for about 2 seconds. At the end of this time, it will return to its initial position. (The “food” is expected to be fully processed)

STEP 4: After the product falls on top of a tank located on the conveyor belt, immediately after the cylinder has retracted, the belt motor will begin to work for 5 seconds, causing the conveyor belt to begin moving the tank to a ramp. where the process will end.

4.2 3D CAD drawings of the chosen proposed situation or video of the improved situation

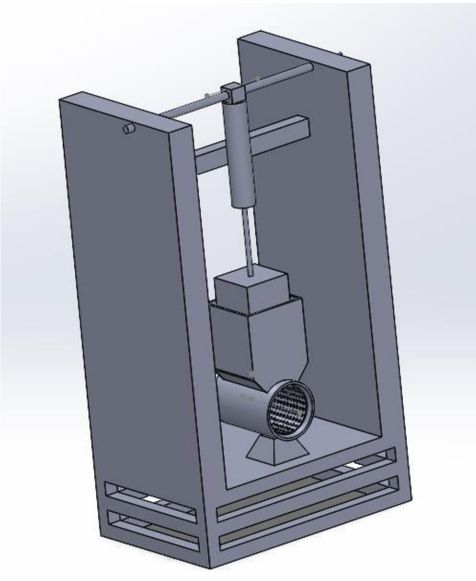

Figure 04 Automated grater proposed in CAD.

Source: self made.

4.3 Analysis diagram of the proposed process

Table 1: Analysis diagram of the proposed process

CURSOGRAMA ANALÍTICO	OPERARIO / MATERIAL / EQUIPO			
DIAGRAMA núm: Hoja num:	RESUMEN			
Objeto: Rallado de alimentos	ACTIVIDAD	ACTUAL	PROPUESTA	ECONOMIA
Actividad: RALLADO	Operación ○	5		
	Transporte ⇨	2		
Método: ACTUAL	Espera D	0		
	Inspección □	3		
Lugar:	Almacenamiento ▽	2		
Operarios(s): Ficha num:	Distancia			
	Tiempo			
Compuesto por: Fecha: 25/06/23	Costo			
Aprobado por: Fecha: 25/06/23	Mano de obra Material			

DESCRIPCIÓN	C	D (m)	T (min)	SIMBOLO ○	⇨	D	□	▽	Observaciones
Almacenamiento de alimentos a rallar	1		10					●	Almacenamiento de los diferentes alimentos seleccionados para rallar
Retirar del almacén el producto	1		2	●					
Inspección para funcionamiento del prototipo	1		2				●		
Ingresar alimento por la bandeja de entrada	1		0.3	●					
Inspeccionar que alimento este correctamente colocado	1		0.2				●		
Encender Ralladora	1		0.05	●					
Rallado de alimento	1		0.15	●					
Descenso del alimento al depósito	1		0.1	●					
Transporte del depósito sobre la faja	1	0.2	0.15		●				
Inspección del alimento rallado	1		0.3				●		
Traslado a otra área	1	1	1		●				
Almacenamiento del alimento rayado	1		5					●	
Total		1.2	21.3	05	02	0	03	02	

Own Preparation

4.4 Detailed description of the materials to be used (sensors, preactuators, actuators, motors, PLC, etc.).

- 1 double-acting pneumatic cylinder 15 cm
- 1 5/2 solenoid valve
- 2 24V motors
- 2 6mm hoses

- 2 flow control valves
- 2 silencers
- 5 m 18 gauge multi-core cable
- 2.5 mt of 18 galvanized cable
- 1 Winiton plug
- 1 Saimens PLC 4 inputs
- 1 24V power supply
- 3 Hose couplers
- 1 Push button 2 buttons
- 1 Conveyor Belt
- 1 black elastic of 1 m, thickness 5 cm.
- 3 Grating drums
- 1 acrylic grating structure
- 4 wooden boards

4.5 Design of the electropneumatic circuit of the proposed process.

4.6 Programming in process ladder language

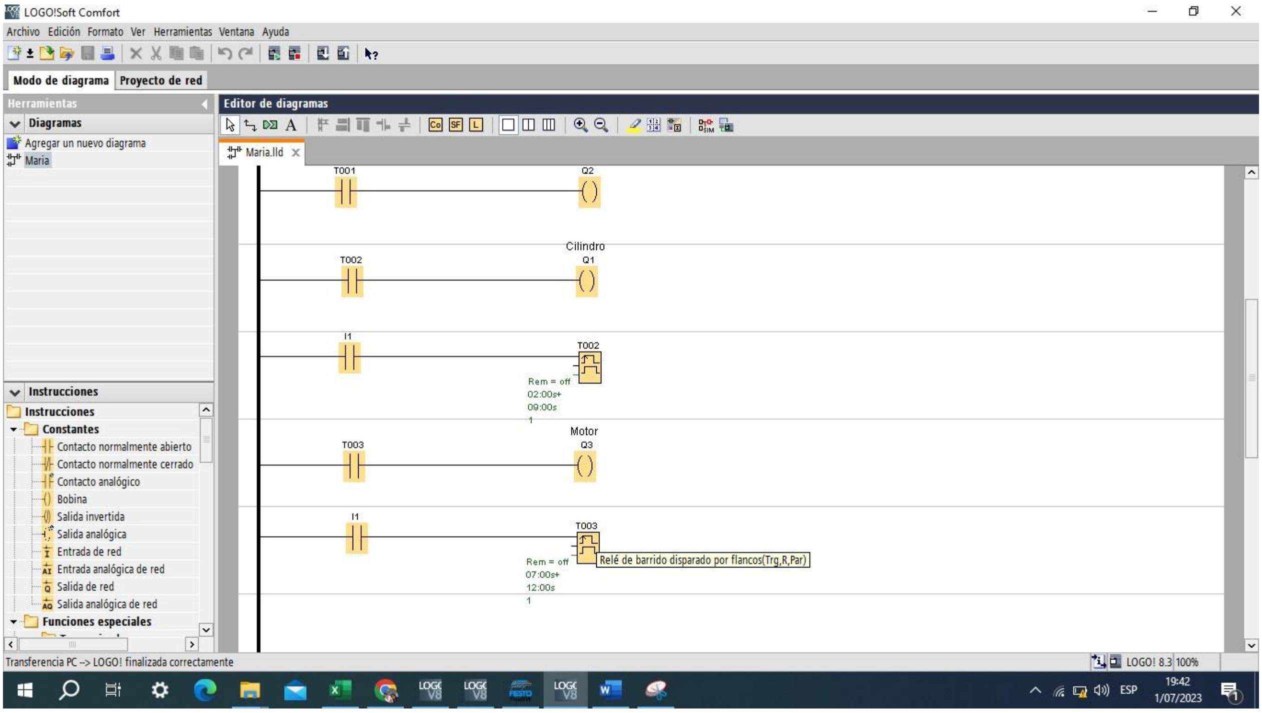

Figure 05: Project Ladder Scheduling

Own elaboration

4.7 Description and detail of production indicators after automation

After automation to a grater we evaluate the indicators to determine the effectiveness of the automation

- Production capacity

After implementing automation, it is crucial to evaluate whether production capacity has increased. The introduction of automation can allow for more streamlined and efficient processing, which in turn can lead to an increase in the amount of grated food produced per unit of time. It is important to analyze this aspect to determine the positive impact that automation has had on the productivity and efficiency of the production line of grated products.

- Production efficiency

After implementing automation, it is necessary to perform a production efficiency evaluation to determine if the utilization of resources has been optimized.

available resources. Automation has the potential to reduce unplanned downtime and improve efficiency in machine use, which in turn should result in greater production efficiency. It is essential to conduct a thorough analysis to verify whether automation has managed to improve resource utilization and maximize efficiency in the production process.

- Improved precision

  People who perform manual and repetitive tasks are often prone to making errors. Boredom, fatigue, or task complexity can affect your level of concentration and increase the likelihood of errors.

  Through Robotic Process Automation (RPA), these errors can be effectively eliminated. To evaluate this, you can measure the amount of work that typically needs to be redone due to human error and then compare it to the amount of work that needs to be redone after implementing automation.

- Number of compliance deficiencies or errors

  By using RPA, it is possible to reduce or eliminate error-prone data entry. By reducing errors, you also reduce the possibility of facing regulatory compliance problems.

- Process speed

  Process speed is an indicator that measures the time required to complete a series of tasks. Incorporating robots in collaboration with employees can significantly speed up these processes.

- Workforce optimization

  After implementing automation into a process and freeing up employees from manual tasks, labor cost savings can be quantified. This can be measured in terms of full-time employees (FTE) and also includes costs associated with hiring, training and salaries.

- Cost reduction and increased profitability:

The manufacturing cost per unit is obtained by dividing the total production cost, excluding the cost of materials, by the total number of units produced.

This indicator reflects the efficiency in the use of existing resources. By implementing automated processes, significant savings are achieved in resources such as labor and materials, resulting in a direct reduction in production costs.

CHAPTER 5 – INVESTMENT AND OPERATION COSTS

5.1 Cash flow

Fixed assets

In the food grinding and grating industry, the equipment, machinery and accessories are made of stainless steel, washable with sodium hydroxide and withstand high process temperatures. This equipment is depreciable over time and even has a residual effect for the industrial use of these. In this case we will use a handmade model

Table 02: Table of Materials Necessary for the Process

Material	Cant	Unid	Precio	
			Unit	Total
Cilindro neumático de doble efecto 15 cm	1	Unid	80	80
Electroválvula de 5/2	1	Unid	60	60
Motores de 24V	2	Unid	17	34
Mangueras de 6 mm	2	Unid	2	4
Válvulas controladores de caudal	2	Unid	8	16
Silenciadores	2	Unid	2.5	5
Cable multifilar calibre 18	5	mts	1	5
Cable galvanizado de 18	2.5	mts	2.9	7.25
Enchufe Winiton	1	Unid	13	13
PLC Saimens 4 entradas	1	Unid	600	600
Fuente de alimentación de 24V	1	Unid	60	60
Acopladores para manguera	3	Unid	3	9
Pulsador 2 botones	1	Unid	56	56
Faja Transportadora	1	Unid	60	60
Tambores de rallado	3	Unid	3	9
Estructura acrílica de rallado	1	Unid	20	20
Tablas de madera	4	Unid	15	60
Tornillos	50	Unid	0.25	12.5
Riel Dim	1	Unid	1.3	1.3
arandela	25	Unid	0.2	5
Varilla sin fin	1	Unid	3.5	3.5
tuerca	25	Unid	0.2	5
abrazadera	1	Unid	2.5	2.5
Equipos y Herramientas				
Taladro de mano 12 V	1	Unid	85	85
Destornillador milimetrico	1	Unid	1.5	1.5
Destornillador	1	Unid	2	2
Sierra	1	Unid	1.2	1.2
Silicona	1		5	5
				1222.75

Own Preparation

Intangible assets

This type of investments are made in assets that are constituted by the acquired services or rights that are essential for the implementation of the project and that are susceptible to amortization.

Table 03: Table of Intangible assets

Bienes Intangibles	Valor
Estudios de Proyectos	200
Imprevistos	100
	300

Own Preparation

Working Capital

For the daily operation of the fresh cheese production schedule, working capital is the first early requirement for the start of the process in the first 3 months.

Table 04: Working Capital Table

	1	2	3
Materia Prima e insumos			
Queso	3375	3375	3375
Mano de Obra			
Operario	1025	1025	1025
		Total	4400

Own Preparation

Investment

Table 05: Total Investment Table

Inversion	
Activos Tangibles	1222.75
Activos Intangibles	300
Capital de Trabajo	4400
Total	5922.75

Own Preparation

Table 06: Income Projection

	Año 0	Año 1	Año 2	Año 3	Año 4	Año 5
Proyeccion de la Demanda		1500	1700	1900	2100	2300
Precio		32.00	32.96	33.95	34.97	36.02

Own Preparation

Table 6 and 7 shows the flow of inputs and outputs of the economic operations of the production of grated cheese over the 5-year horizon, considering a residual income in year 5, from the sale of some equipment or machinery that has already been paid for. depreciation effect its price, on the other hand in year zero the investment and costs such as working capital and the value of tangible and intangible fixed assets are considered.

Operating Cash Flow

Table 07: Operating Cash Flow

Descripciòn	Año 0	Año 1	Año 2	Año 3	Año 4	Año 5
Ingresos por Ventas		S/ 48,000.00	S/ 56,032.00	S/ 64,502.72	S/ 73,431.25	S/ 82,837.45
Costo de Ventas		S/ 32,220.25	S/ 33,186.86	S/ 33,186.86	S/ 33,186.86	S/ 33,186.86
Gastos de Ventas		S/ 200.00	S/ 201.02	S/ 202.03	S/ 203.05	S/ 204.06
Ganancia Antes de Impuestos		**15579.75**	**S/ 22,644.13**	**S/ 31,113.83**	**S/ 40,041.35**	**S/ 49,446.53**
Impuesto a la Renta		S/ 4,673.93	S/ 6,793.24	S/ 9,334.15	S/ 12,012.41	S/ 14,833.96
Depreciacion + Amortizaciòn		S/ 5,100.00	S/ 5,610.00	S/ 6,171.00	S/ 6,788.10	S/ 7,466.91
Flujo de Caja Operativo -FCO		**S/ 16,005.83**	**S/ 21,460.89**	**S/ 27,950.68**	**S/ 34,817.05**	**S/ 42,079.48**

Own Preparation

Economic Cash Flow

Table 08: Economic Cash Flow

	INVERSIONES					
Activos Fijos	-S/ 1,222.75					
Recupero de Activos Fijos		-S/ 1,259.43	-S/ 1,297.22	-S/ 1,336.13	-S/ 1,376.22	-S/ 1,417.50
Capital de Trabajo	-S/ 4,400.00					
Recupero de Capital de Trabajo						
Flujo de Inversiones - FI	**-S/ 5,622.75**	**-S/ 1,259.43**	**-S/ 1,297.22**	**-S/ 1,336.13**	**-S/ 1,376.22**	**-S/ 1,417.50**
Flujo de Caja Economico - FCE	**-S/ 5,622.75**	**S/ 14,746.39**	**S/ 20,163.67**	**S/ 26,614.55**	**S/ 33,440.83**	**S/ 40,661.98**

Own Preparation

5.2 Economic viability (NPV, IRR)

a) Net Present Value (NPV)

The net present value (NPV) is an investment criterionwhich consists of updating the net cash flows that the project will generate to know how much will be gained or lost with that investment, discounted at a certain interest.

b) IRR

IRR or Internal Rate of Return is oneof the most recommended investment project evaluation methods. It is frequently used to analyze the viability of a project and determine the rate of profit or profitability that can be obtained from said investment.

Table 09: Economic viability table

TIRE	296%
COK	30%
VANE	S/ 52,425.86

The IRR and NPV indicators show that they are greater than the shareholder's opportunity cost (COK), meaning that the viability of the investment is profitable.

CONCLUSIONS

1. By automating the grating process, implementing a PLC, it allows us continuous and constant operation that significantly improves efficiency and productivity in the processes, whether in a food factory or a business, optimizing the time and space used in addition to reducing downtime.
2. In a company focused on the food sector, having an automated grating process helps reduce manual labor and this can generate savings in labor costs. Therefore, by optimizing this process, we require less physical space, generating better organization in the plant and using resources more efficiently.
3. The implementation of an automated grater using a PLC is very feasible since the rotational, pushing and transfer movements are controlled in an efficient way, having a positive impact on the quality of the final product, since the movement controlled by the PLC ensures a homogeneous, more uniform and consistent result unlike grating it manually, this increases the quality of the final product.

RECOMMENDATIONS

1. It is recommended to make aDetailed analysis of implementation costs, PLC, mechanical components, installation, etc. This is essential to evaluate whether the project is financially viable, however, it should also be taken into account to evaluate the benefits in order to have greater knowledge of whether it is profitable or not.

2. It is recommended to have a preventive and corrective maintenance planfor the automated grater, where maintenance routines are established that ensure we obtain spare parts and also have trained personnel in case of machine failure.

3. It is recommended to implement a monitoring and tracking system to evaluate the performance of the automated grater; an analysis must be carried out continuously to identify possible optimization improvements.

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