MACHINE FOR SAUSAGE TWISTER MICRO BUSINESS SAUSAGE.

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Abstract- The results of the economic feasibility study regarding food processing and sausage determine the profitability to implement a machine suitable for industrial development and independence of foreign technology.

This project aims to design and build a twister sausage machine sausage industry to improve the working conditions of the medium and small producers in this sector. The machine is oriented in the process of continuous formed to optimize development time and production of sausages. thus obtaining an efficient, effective and productive working machine. Which it allows easy captivity, easy connection , easy process control and improve the quality of the final product . Designed according to the working conditions and constituted with materials suitable for food handling . Its operation through a control panel (HMI - PLC -Logo) where the operator manipulates according to the type of gauge (thickness) desired , this interface sends information to the PLC which responds in real time to the ignition mechanism rotary motion and get results in better continuous process with product uniformity.

INTRODUCTION.

Currently in Ecuador there are formal production companies sausages, which manage processes and appropriate technology to ensure product suitable for human consumption, these companies have legal permits and sanitary registration required by this activity. The machinery is costly so it is not easily accessible to families with middle -income and low.

The three largest companies in Ecuador are Pronaca National Food Processing, Meats and Sausages Plumrose Don Diego, whose workforce is 25,000 people directly.

onsider that according to a study published by the newspaper trade (TRADE, 2007) that only 50 % of the market is supplied by companies legally constituted technology to cater to consumers of high and medium high economic level , and the rest borne by micro enterprises , which supply consumers an average economic level and low.

In making sausage country has more than 85 years, there are farms for the care and treatment of pigs, cattle and poultry which are used as raw material for the manufacture of sausages .
Currently the micro enterprises do not have higher productivity in the area formed since their work is manually compared to large industrial factories developed which have machines designed for this type of area , leaving them marginalized and without competitiveness market

CHAPTER I

1. DEVELOPMENT OF SAUSAGE IN A LOCAL COMPANY MICRO.

Overall sausage is made from pork , but also occurs with beef or veal meat and over time some companies increase or decrease the ingredients for the pleasure and health of consumers, however the process processing is the same regardless of the raw material.

Table 1.1 materials and supplies and equipment used for the production of sausage is shown . (Hinojosa , 2012).

Table 1.1 Development of sausage.

MATERIALES	INSUMOS	EQUIPOS
Bandejas. Termómetros Cuchillos Tabla de picar. Mesa de trabajo. Recipientes.	Carne. Proteína de soya. Sal Grasa. Almidón poli fosfato para masa. Saborizantes Colorantes. Especias.	Recepción de materia prima. Picadora de carne (Cúter). Moledora de carne. Embutidora. Atado o torsión. Cocción. Enfriado Almacenado

Source. Author

GRAMA FLOW MANUFACTURING SAUSAGES IN A LOCAL COMPANY MICRO.

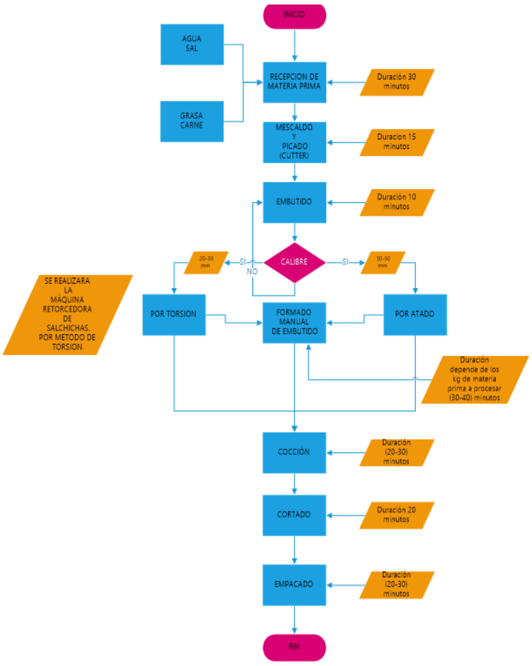

Figure 1.1. Manual twisting process .
Source. Author.

METHODS FOR FORMING OF SAUSAGE SAUSAGE

The sausage depends on the meat mass that is stuffed into casings , which also determine the size and shape of the product , determine technological aspects and development of certain physicochemical processes taking place in these products , so you properties as uniformity filling , resistance to contraction or expansion , permeability , etc. , are very important.

Description of the forming process.

The manual process is the most used in the world, but not the most used in specialized industries in the formed product for processing. Its two modes of operation are very simple, however it is not easy to do. The main drawbacks for the company or worker when seeking to perform this type of process is the uniformity of the product and the time it takes . The manual method is very handy when trying to tie or twist small amounts of product mass , but when it comes to large amount of mass is where it is difficult and causes discomfort worker and economic losses for the company.

Table 1.2. Development of sausages in the local area

Elaboración de salchichas en el área local.	
Métodos manuales	Características
Atado manual	Mayor tiempo en el proceso de trabajo. Fatiga en el trabajador.
Torsión manual.	100% contacto con las manos del operador. Baja producción Desigualdad en el producto. Baja competitividad en el mercado local.

Source. Author

Tied Method Manual.

Figura 1.2.Metodo de atado manual.
Fuente. (CITALSA, 2014)

It was the first craft custom and so came to form each sausage , this method consists , hopefully Stuffer Inlay entire meat mass within an entire strip of natural or synthetic gut of certain length and then begin to tie , tie with thread each distance for the formation of sausage. Used more for sizes from 40mm (sausage)

Method Manual torque

Figure 1.3. Manual twisting process **.**
Source. (Cardenal. , 2015)

As the method of tying is also one of the first craft ways in which workers began this process. Which it consists mortise whole mass within the strips synthetic gut certain length and then start manual torque for the formation of each sausage , as shown in the two standardized .calibres of (20-28) mm.

Characteristics of each method.

• Tied method : 10 to 15 sausages per minute , according to the agility of the operator.

• Torsion Method : 10 to 15 sausages per minute , according to the operator's agility.

ALTERNATIVES FOR FORMING SYSTEM.

A): METHOD OF TORQUE.

Such models are characterized by their high production, excellent quality dosing, ease of cleaning and minimal maintenance. In these the product is fed by a hopper that carries it to a game of paddle that rotates and moves to the dispensing tube to shape inlay , is a continuous system as it is programmable via PC and powered by servo motors with high precisión.
They offer working vacuum without heating or smearing even in delicate doughs and assure excellent presentation , vivid colors and no air bags.

Figure 1.4 Automatic machine continues with additional arm that replaces the function of the operator. VF 608
Source. (HANDTMAN A, 2014)

Advantage.

- Practical and safe operation at different speeds.
- There are no problems entanglements
- Accuracy
- Easy adaptation
- reduced dimensions and high performance components.
- Easy maintenance.
- Machine easy to use.

Disadvantages.

- The operation cost is high depending on the capacity utilization of the machine.
- Its components are not easily found.

B): METHOD OF TIED

The binding machines offer similar to craft tied performed manually. Inlay totally strangling the correct pressure is achieved in each serving and all treating him with the utmost delicacy , avoiding breaks.

It is a mechanical system in which internally has a motor connected to a crank with a fastener for rope and also with a controller for controlling the rotation of each sausage tied to user depending.

Figure 1.5. semiautomatic machine. (T -70)
Source. (GASER , 2014)

Advantage.

- Manageable at high speeds.
- Accuracy.
- reduced dimensions and high performance components.
- Easy maintenance.

Disadvantages.

- The operation cost is high depending on the capacity utilization of the machine.
- Its components are not easily found.
- Possible problems entanglements.

SELECTION OF ALTERNATIVES

Selection criteria.

Table 1.3 results score and weighting each criterion is shown to choose the corresponding alternative.

Table 1.3. Results

CRITERIO	Funcionalidad	Tiempo	Mantenimiento	Mecanismo operación	manufactura	costo	Σ	ponderación
Alternativa A	0.19	0.12	0.095	0.091	0.035	0.035	0.566	1
Alternativa B	0.09	0.12	0.095	0.046	0.035	0.035	0.313	2

Source .Author

CHAPTER II

2. FORMED PROCESS PARAMETERS MANUAL OF A SAUSAGE.

Table 2.1. Test results manually processing sausage.

Nro. De pruebas	Diámetro de la salchicha (mm)	Longitud de cada salchicha(cm)	Peso de la salchicha [Kg]	Número de vueltas por salchicha.(nv)	Tiempo (t) de giro(segundo)
1	28	16	0,0040	3	0.87
2	28	18	0,0048	3	0.90
3	28	18	0,0050	4	0.93
4	28	14	0,0058	4	0.98
5	28	14	0,0060	4	1

Source .Author.

To determine the forming process the necessary factors to make a sausage by hand the following parameters are taken into account:

1) Diameter.
2) Length.
3) Time torsional twist.
4) Number of laps twisting a sausage

It needed to wring a sausage manual process by force.

To find the strength to push it needs a sausage round is by the so-called formula force applying Newton's second law (Zambrano ., 2011) , where the data to consider are the mass and the path that has the body to be molded to the twisting process.

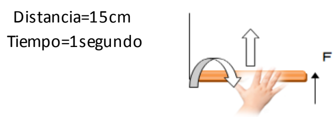

Figure 2.1. Force diagram
Source. Author.

So:

$$F = m * a \qquad \textbf{Equation 2-1}$$

$$a = \frac{0.15m/s}{1s}$$

$$a = 0.15m/s^2$$

$$F = 0.55g * 0.15m/s^2$$
$$F = 0.0000825N$$

Angular velocity needed to wring a sausage.

It is part of the evidence test to manually draw a sausage resulting to 3 turns in one second (rev/s)

Transforming 3rps to rpm.

$$w = \frac{3rev}{s} * \frac{60s}{1min}$$

$$w = \frac{180rev}{min}$$

DESIGN PARAMETERS

Figure 2.2 Flow diagram of the design process for forming sausages

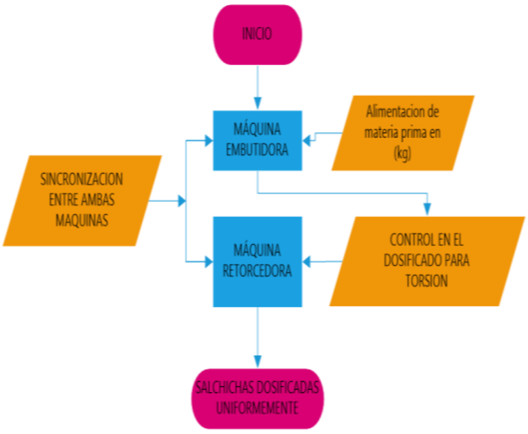

Figure 2.2. Process Flow Diagram.
Source. Author.

MACHINE DESIGN BUILD.

The design of the machine building will be according to the physical workspace, the connection between the stuffing machine, to making energy supply and a mechanism that will be suitable , to work taking into account the characteristics that the worker performs manually, but is more continuity , speed in this process.

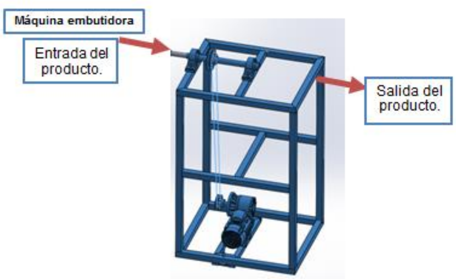

Figure 2.3. Esbojo (mechanism design , structure)
Source. Author.

MATERIALS TO USE.

Through the National Agency for Regulation and Control Health Surveillance (ARCSA) with resolution no. 042-2015 available through the Technical Standard Substitute of Good Manufacturing Practices for Processed Foods , we work with stainless steels of the 300 family (AISI 304)

- **Machine structure.**

Table 2.2 Dimensions of the support structure.

Parámetros	Longitud
Altura	960mm
Largo	600mm
Ancho	500mm

Source. **Author**.

- **Drivetrain.**

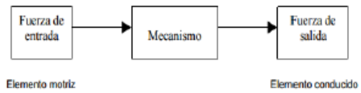

Figure 2.4. Block diagram of a mechanism.
Source. (Myszka 2013)

CHAPTER III

3. CALCULATIONS

Speed ratio by band – pulley.
The transmission of motion between two shafts by pulleys is a function of the difference of the diameters of these, fulfilling at all times (Mott R. , 2008). See Figure 3.1

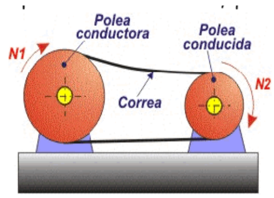

Figure 3.1. Pulley belt drive system.
Source. (Technology, 2007)

The equation is thus.

$$n1 * d1 = n2 * d2$$

Using two pulleys one on the motor shaft and the other on the twister shaft.

Where:

n1 = speed driving pulley= 171.5rpm
n2 = speed driven pulley = 300.8rpm
d1 = diameter driving pulley= 177.8mm
d2 = diameter driven pulley = 101.6mm

Calculation of the speed of the band.

$$Vb = \frac{Pi(d1)(n1)}{60000} \quad \textbf{Equation 3-1}$$

Where:
d1 = 177.8mm
n1 = 171.5
Vb = speed of the band

$$Vb = 1.6m/s$$

Calculating the length of the band.

$$\mathrm{C} = 0.889\mathrm{m}$$

Design an axis.

For shaft design takes into account the loads, as are the result of different components involved in the design of the twisting machine , the main shaft is coupled to the driven and this pulley by two bearings floor provide stability , fixation and self alignment to the rotational movement as is as indicated in the figure below 3.2.

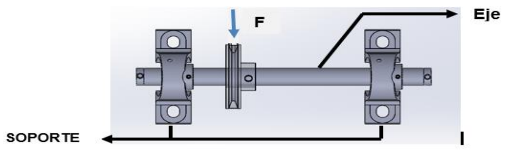

Figure 3.2. Axle bearings.
Source. Author.

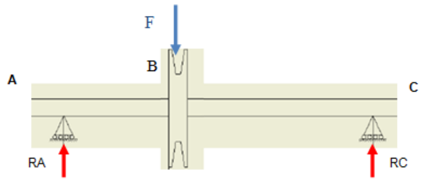

Figure 3.3. Free-Body diagram
Source. Author.

$$\mathrm{TB} = 9550 \frac{*Pd}{n} \quad \textbf{Equation 3-2.}$$

Where:

Pd = design power.

n = speed of the driving pulley .

TB = torque.

TB = 15.3Nm

Calculation of the bending force on the shaft.

By the following equation under the bending force is determined by the axis V-belts. (Mott R. , 2008).

$$Fb = 1.5FN = 1.5 * \frac{TB}{\frac{d2}{2}} \quad \textbf{Equation 3-3}$$

Where:

Fb = flexionaste force on the shaft.

TB = torque. = 15.3Nm

d2 = diameter of the driven pulley .

1.5= constant value for transmission V-belts

So:

Fb = 451.8N

Figure 3.4 diagrams shear and bending moment shown with your corresponding reactions consistent with the calculations made. With a total force on the shaft:

The sum total of the elements.

$$\mathrm{FT} = \mathrm{Fb} + \mathrm{Felements}$$
$$\mathrm{FT} = 451.8 + 2.36\mathrm{N}$$
$$\mathrm{FT} = 454.16\mathrm{N}$$

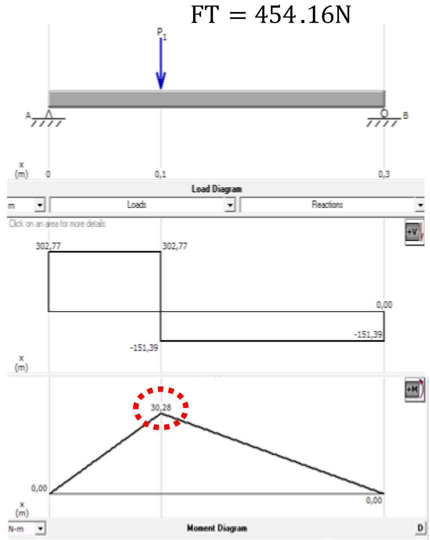

Figure 3.4. Shear, bending moment (Mdsolid)
Source. Author.

Maximum normal stress

$$\sigma = \frac{M*c}{I} \quad \textbf{Equation 3-4.}$$

Where:

σ = maximum normal stress.

I = moment of inertia.

M = maximum bending moment.

c = radius of the outer diameter of the shaft.

If for a hollow shaft , it is the first moment of inertia (I) and then replaced in equation 3-4. If the measures are the hollow shaft .

Data.

D=1.5in.0.0381m

d= 1.44in=0.0366m

Si:

$$I = \frac{\pi}{64} * (D^4 - d^4) \quad \textbf{Equation 3-5}$$

Where:

I = moment of inertia .

D = outer diameter of the shaft.

d = internal diameter of the shaft.

So:

$$I = (1.53x10)^{-8} m^4$$

$$\sigma = 37701565.6\text{Pa} = 37.7\text{Mpa}$$

Torque calculation effort.

$$\tau = \frac{TB*c}{J} \quad \textbf{Equation 3-6}$$

Where:

τ = maximum shear stress.

TB = torque.

c = radius of the outer diameter of the shaft.

J = polar moment of inerti.

Where J is by formula hollow shafts

Data..

D=1.5in.0.0381m

d= 1.44in=0.0366m

$$J = \frac{\pi}{32} * (D^4 - d^4)$$

Where:

J = polar moment of inertia

D = outer diameter of the shaft.

d = internal diameter of the shaft.

$$\tau = \frac{15.3\text{Nm} * 0.01905\,[m]}{(3.07x10)^{-8} m^4}$$

$$\tau = 9525000\text{Pa} = 9.5\text{Mpa}.$$

Calculation of major efforts by the Circle of Mohr.

Data for Mohr's circle:

$$\sigma x = 37.7\text{MPa}.$$
$$\sigma y = 0$$
$$\tau xy = 9.5\text{Mpa}.$$

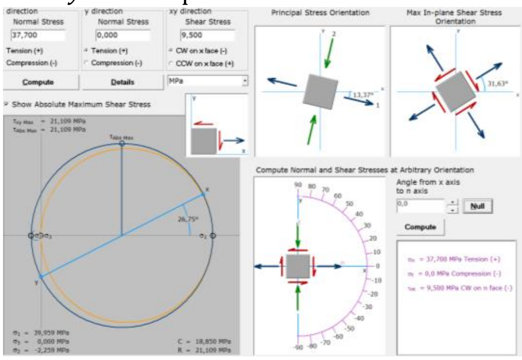

Figure 3.5. Circle Mhor (Mdsolid)
Source. Author

Based on the results achieved easily find the principal stresses and maximum shear stress. (Mott R. , 2008)

$$Tmax = R = 21.10\text{MPa}$$

$$n = 5.2$$

It is concluded that for the 1.5 inch shaft diameter can work without difficulty as it presents a reliable safety factor.

Analysis of the structure.

For the construction of the square tube structure AISI 304 was used 1.5mm thick

The total load (PT) supporting the beam A-B is as follows as shown in Figure 3.6.

$$PT = 20\text{N} + 342.2\text{N}$$

$$PT = 362.2N$$

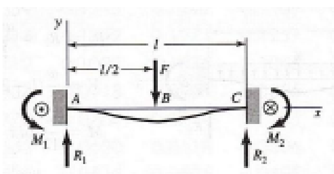

Figure 3.6 Beam A- B (model with central charge fixed supports)

Source. Author.

Below the disgramas of coirtante force and bending moment figure it is maded.

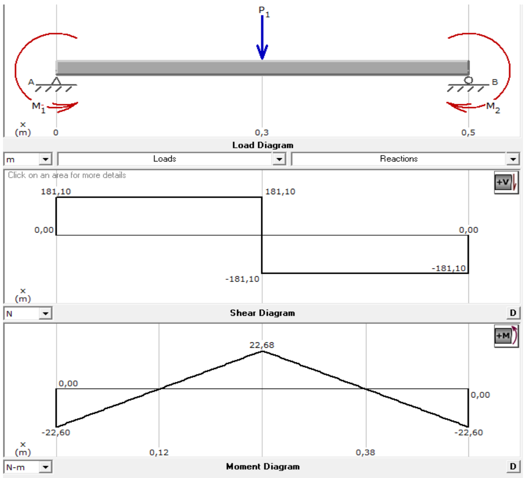

Figure 3.7. shear , bending moment (Mdsolid)
Source. Author.

Efforts A- B beam subject to bending.

Maximum normal stress

$$.\sigma_{\max} = \frac{M * c}{I}$$

Where:

$\sigma_{\max}$ = máximum normal stress.

I= moment of inertia of the square profile with respect to the neutral axis =1.21cm^4

M= maximum bending moment.=22.6Nm

c= distance from the neutral axis of the beam to the far fiber.=12.5mm

So.

$$\sigma_{\max} = \frac{22.6Nm * 0.0125m}{(1.21 * 10^{-8} m^4)}$$

$$\sigma_{\max} = 23.34Mpa.$$

Maximum shear stress flexural.

$$\tau max = \frac{VQ}{It} \qquad \textbf{Equation 3-7}$$

Where:

τmax = maximum shear stress.

V= Maximum shear beam A-B= 181.1N

Q= First moment of inertia about the centroidal axis of the cross-sectional area of that part , is on the opposite side of the shaft where it will calculate the shear stress = 621.81mm^3

I= moment of inertia of the cross section of the beam =1.21cm^4.

t= Profile thickness at the site will calculate the effort cortante=1.5mm

Esfuerzo de Von Mises (σ`).de la viga A-B.

$$\sigma` = \sqrt{\sigma x^2 - 3\tau^2{}_{xy}} \qquad \textbf{Equation 3-8}$$

σ`= Von Mises combined effort.

σx= normal stress in the x axis.

τxy= Shear stress in the x-axis

So:

σx= σmax=23.34Mpa

τxy=0.

σ `=23.34Mpa
n = 9.42

Analysis of the structure by solidwork.

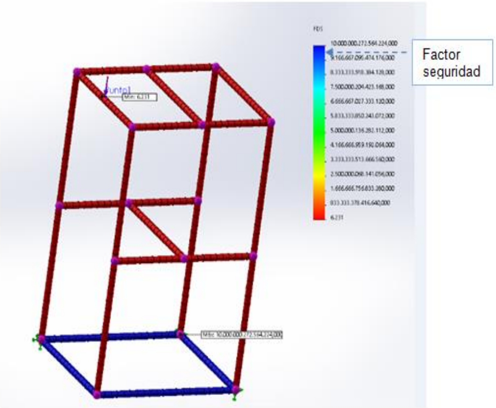

Figure 3.8. (Security factor)

Source. SOLIDWORKS.

With the data obtained in analyzing the beam AB of the structure and by the simulation performed in the software it determines that the structure supports the load which is to subjected , for being secure and having a factor reliable security, It concludes the approval of the structural construction of the machine with a profile of 25x25x1.5mm square tube.

MATHEMATICAL MODEL BAND PULLEY SYSTEM.

Mathematical modeling transmitting power from the system .The system coupling devices are used to achieve maximum energy transfer , the system takes as input a signal 20.6Nm torque , which serves for the operation of the transmission system comprising pulley band output angular velocity (w2 = 300.8 rpm) figure 3.10 , which optimizes the forming process considering the number of laps you need to twist a sausage is obtained.

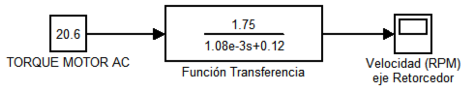

Figure 3.9. Transfer function (band pulley system**).**
Source. MATLAB

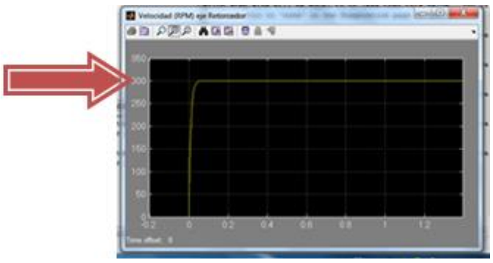

Figure 3.10. Angular velocity (gearmotor)
Source. SIMULIKN (MATLAB)

CHAPTER IV

4. DESIGN OF CONTROL AND DISPLAY.

For the selection of the type of sausage , the operator must place the corresponding tube the thickness of the sausage (size) who want to process , once it is ready, it is continuing to power the machine , so it had an actual push button General on, once the TD Logo screen is displayed and the operator will follow the steps for selecting the type of sausage to be processed(tipo1-2-3), after that we proceed to filling and forming of each sausage function of time , by the PLC program , figure 4.1 . The panel also will have its own counter sausages and two leds , a light emergency stop and a work light.

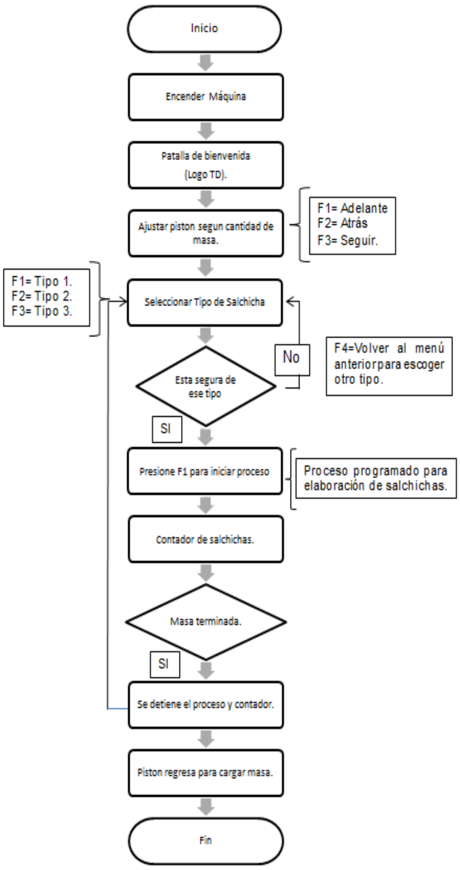

Figure 4.1. Schematic flow chart control.
Source. Author

CHAPTER V

5. DECRYPTION OF PROCEDURE COSNTRUCCION MACHINE.

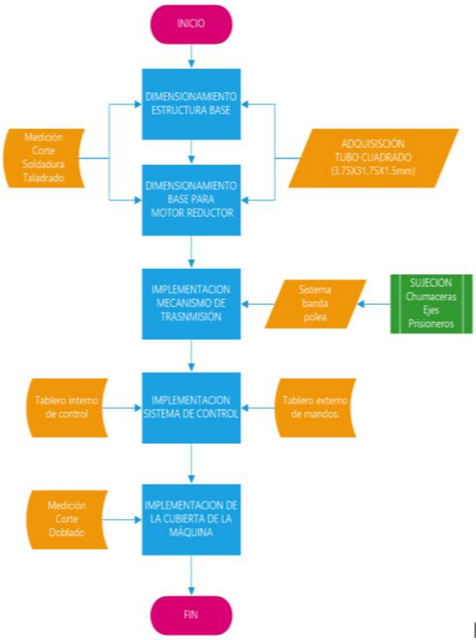

Figure 5.1 Flow Chart (Construction).
Source. Author

FUNCIONALITY TEST.

Table 5.1. Answ er box vacuum machine.

PRUEBA	OBSERVACIÓN	DETALLE	SI CUMPLE	NO CUMPLE
1	Conexión eléctrica.	Lectura de alimentación de entrada y salida (220v).	X	
2	Sistema de control eléctrico.	Respuesta de mandos del control del PLC	X	
3	Pantalla de visualización.	Entrada y salida de señal de la pantalla.	X	
4	Indicadores luminosos.	Activación y desactivación de los Leds luminosos cuando la máquina este en desarrollo.	X	
5	Pulsador de paro de emergencia.	Detiene el proceso de formado por algún imprevisto inesperado.	X	
6	Sistema del mecanismo mecánico.	Marcha y paro del moto reductor mediante poleas.	X	
7	Sistema ergonómico de la máquina.	Adecuada forma de trabajo para el operador.	X	
8	Tipos de diámetro para cada salchicha.	Montaje y desmontaje para tipos de calibre.	X	

Source. Author

ANALYSIS.

Performance tests to determine the time and length of the product in different types of caliber.

A. Type 1 - caliber 21mm.
B. Type 2 - caliber 23mm.
C. Type 3 - caliber 28mm.

TESTING PROCESS FOR EVERY CALIBER.

By calculating the mean deviation (MD), using each of the lengths of the 21 tests, where:

$$\mathrm{DM} = \frac{\sum_{1=1}^{n} |xi - \bar{x}|}{\mathrm{n}} \qquad \textbf{Equation 0-1}$$

A minimum and maximum range is then obtained margin of error with respect to the length of each type of sausage.

$$\mathrm{R} = \bar{x} \pm DM \qquad \textbf{Ecuación 0-2}$$

The following tables and figures depending on the length of time for the preparation is shown in the process of each sausage.

Table 5.2 Data in the process of developing a sausage sausage type 1

N salchichas	Longitud cm	Tiempo seg
1	15,2	2,7
2	15,4	5,4
3	15,6	8,1
4	15,8	10,8
5	15,5	13,5
6	15,4	16,2
7	15,5	18,9
8	15,4	21,6
9	15,6	24,3
10	15,7	27
11	15,5	29,7
12	15,9	32,4
13	15,5	35,1
14	15,6	37,8
15	15,8	40,5
16	15,8	43,2
17	15,8	45,9
18	16	48,6
19	15,6	51,3
20	16	54
21	15,6	56,7

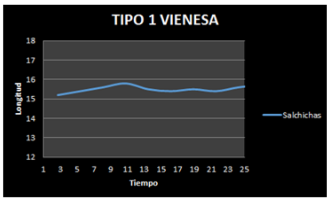

Figura 5.3 Pruebas de salchicha tipo1.

Fuente. Autor.

$$\overline{\mathrm{x}} = 15.63cm$$

$$\mathrm{DM} = 0.17\mathrm{cm}$$

$$\mathrm{R} = (15.46 - 15.8)\ \mathrm{cm}$$

In Figure 5.3 the characteristic curve shown in process inlay type 1 enters the range of 15.46 cm to 15,8cm long.

Table 5.3 Data in the process of developing type 2 sausage

N salchichas	Longitud cm	Tiempo seg
1	18	3
2	18	6
3	18,3	9
4	18,5	12
5	18,3	15
6	18	18
7	18	21
8	18	24
9	18,2	27
10	17,9	30
11	17,9	33
12	17,9	36
13	17,7	39
14	17,9	42
15	18,4	45
16	18,3	48
17	18,2	51
18	17,6	54
19	17,5	57
20	18	60
21	18	63

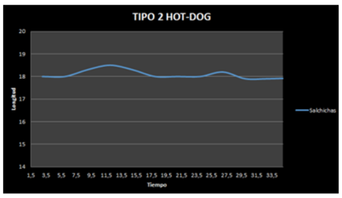

Figura 5.4 Prueba de salchicha tipo 2.

Fuente. Autor

$$\times = 18.02cm$$

$$\mathrm{DM} = 0.19\mathrm{cm}$$

$$\mathrm{R} = (17.83 - 18.21)\ \mathrm{cm}$$

In Figure 5.4 the characteristic curve shown in process inlay type 2 entering the range 17.83cm to 18.21cm long.

Table 5.4 Data in the process of developing a type 3 sausage

N salchichas	Longitud cm	Tiempo seg
N salchichas	longitud	tiempo
1	14,3	2,8
2	14,5	5,6
3	14,6	8,4
4	14,8	11,2
5	14,6	14
6	14,4	16,8
7	14,5	19,6
8	14,4	22,4
9	14,6	25,2
10	14,7	28
11	14,5	30,8
12	14,7	33,6
13	14,5	36,4
14	14,6	39,2
15	14,7	42
16	14,6	44,8
17	14,5	47,6
18	14,4	50,4
19	14,6	53,2
20	14,8	56

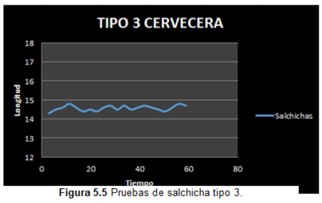

Figura 5.5 Pruebas de salchicha tipo 3.

Fuente. Autor.

$$\overline{X} = 14.57cm$$

$$\mathrm{DM} = 0.10\mathrm{cm}$$

$$\mathrm{R} = (15.46 - 15.8)\ \mathrm{cm}$$

In Figure 5.5 the characteristic curve shown in process inlay type 3 entering the range 15.46cm to 15.8cm long.

Figure 5.6 is a sample of obtaining the product of any caliber through the twister machine.

Figure 5.6 Process formed (twister machine sausage).
Source. Author

Table 5.5 data as the process performed manually formed sausage and implementing the twisting machine are shown.

Table 5.5 . Results based on the total time to produce each sausage.

PARAMETROS				TIEMPO		
Tipo	Calibre (ф=mm)	Longitud (cm)	Cantidad de masa(Kg)	Antes (seg)	Después (seg)	Optimización (seg)
1	21	16	9	2.7	1.8	0.9
2	23	18	9	3	2	1
3	28	14	9	2.8	1.6	1.2

Source. Author.

As seen in Tables 5.5 described above , it is concluded that the implementation of the twister machine is favorable processing time optimizing sausages 36.5 % in the production process.

CHAPTER VI

6. CONCLUSIONS.

- ✓ The main parameters of minimum construction, are the forward speed of 3 turns , considering the distance of 15 cm for a standard sausage and averaging time 1 second which help in the design of the machine for the operation of the transmission mechanism.
- ✓ The elements formed by the twisting machine were selected according to the needs of work, such as material selection AISI 304 to have excellent corrosive properties , exceeding the type 302 in a wide variety of environments, whereas the mass of meat at temperatures between 8 ° C-10 ° C The structure is designed to support a maximum effort according to Von Mises criterion 23.34Mpa y minimum safety factor of 9.42 is obtained , load-bearing Another is the rotating shaft , which supports a bending stress of 454.8N , which It designed with a safety factor of 5.3 , which is coupled to a drive system pulleys in a 4 : 7 a V- belt type.
- ✓ Implementing a display (HMI) enables a direct interface with the appropriate operator to control the twisting machine. This screen is connected to a PLC - logo 230 RC via serial communication (RS -485),

for implementing the system using a block programming (FUP), this being a logical language that facilitates and develops control operations by " Timmer”.

- ✓ The development of mathematical modeling of the mechanism of the twisting sausage machine is based on the transfer function for rotating systems T(s) = (Js + B) w(s) where the angular velocity (w(s)) involved, the inertia (J) , the viscosity (B) and the torque (T(s)) , the structure of the machine is focused under the Von Mises criterion shaft design and by the method of Goodman.

- ✓ In performance testing three types of sausages is analyzed, as are Viennese hot dog and beer . In the first 21 tests were carried out , obtaining a range between 15.46 cm to 15.8 cm in length and output time of 1.8 seconds, with a 33 % optimization . In the second with a total of 21 trials , a range between 17.83 cm to 18.21 cm in length and output time of two seconds it is obtained , with a 33 % optimization . And finally the third type with the same number of tests , a range of 14.47 cm to 14.67 cm in length and 1.6 seconds time was obtained , with a 42 % optimization . Then the percentage of optimizing production time is 36.5 %.
- ✓ The user manual can better understand the use or proper operation of the machine, explaining step by step preventive maintenance with a monthly review , which consists of lubricating bearings , belt tension and correct external and internal cleaning of the machine.

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