

Palestine Polytechnic University

College of Engineering



Title

The Recycling of Cartoon

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Abstract

With industrial progress, resource consumption, scarcity of resources, and lack of resources, this is a great motivation to search for alternatives. These are sources of wood. Many industrial sectors consume wood in large amounts annually and scarcity of access. Based on the attempt to find an alternative source of wood burning for heat, we found that there are large quantities of carton are disposed of by traditional methods in the dumps of burning or buried, so here was the starting point of our project in the exploitation of these large quantities of carton was the idea Our project is an environmental, economic, services, industrial and programmatic system based on treating these quantities as an alternative source of wood for obtaining heat, As our project is a miniature system based on the cutting of cardboard dimensions not exceeding the dimensions of the chopping basin And then mixing the carton section with water and peat and then pressed in the form of the form of cardboard cubes used in burning.

ملخص

مع التقدم الصناعي وثورة استهلاك الموارد وشح مواردها وقلة مصادر الحصول عليها كان ذلك دافعا كبيرا للبحث عن بدائل معينة ومن هذه المصادر الخشب، فهناك العديد من القطاعات الصناعة التي تستهلك الخشب بكميات كبيرة سنويا وندرة الحصول عليها، فكان لزاما للبحث عن مصدر بديل عن الخشب. لذلك كانت فكرة مشروعنا قائمة على محاولة ايجاد مصدر بديل عن حرق الخشب للحصول على الحرارة، فوجدنا ان هناك كميات كبيرة من الكرتون يتم التخلص منها بالطرق التقليدية في مكبات النفايات بالحرق او الدفن، لذلك من هنا كان منطلق مشروعنا في استغلال هذه الكميات الكبيرة من الكرتون وكانت فكرة مشروعنا عبارة عن نظام بيئي اقتصادي خدماتي صناعي مبرمج يقوم على معالجة هذه الكميات بحيث تكون مصدر بديل عن الخشب في الحصول على الحرارة. حيث ان مشروعنا عبارة عن نظام مصغر يقوم على تقطيع الكرتون ذو ابعاد لا تتجاوز ابعاد حوض التقطيع ومن ثم خلط الكرتون المقطع مع الماء والجفت ومن ثم ضغطه في قالب التشكيل كمكعبات كرتونية تستخدم في الحرق.

الإهداء

بسم الله الرحمن الرحيم

معلم البشرية ومنبع العلم نبينا محمد (صلّ الله عليه وسلم)

إلى.....

ينابيع العطاء الذين زرعوا في نفوسنا الطموح والمثابرة آبائنا

الأعزاء

إلى.....

أنهار المحبة التي لا تنضب أمهاتنا الأحبة

إلى.....

من يحملون في نفوسهم ذكريات الطفولة والشباب أخوتنا وأخواتنا

إلى.....

كافة الأهل والأصدقاء

إلى.....

من مهّدوا لنا طريق العلم والمعرفة أساتذتنا الأفاضل

إلى.....

من ضحّوا بحريرتهم من أجل حريتنا أسرانا البواسل

إلى.....

من وصلت رائحة دمائهم الزكية إلى السماء الندية شهداؤنا الأبرار

"كن عالماً ، فإن لم تستطع فكن متعلماً ، فإن لم تستطع فأحب العلماء ، فإن

لم تستطع فلا تبغضهم"

ونخص بالتقدير والشكر:

الدكتور د. رائد عمرو

الذي نقول له بشراك قول رسول الله صلّ الله عليه وسلم:
"إن الحوت في البحر، والطير في السماء، ليصلون على معلم الناس
الخير"

للنجاحات أناس يقدرون معناها، وللإبداع أناس يحصدونه، لذا نقدر
جهودك المضيئة، فأنت أهل للشكر والتقدير .. فوجب علينا تقديرك .. فلك
منا كل الثناء والتقدير

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1

Chapter One

Introduction

- 1.1 Overview and Motivation**
- 1.2 Short Description of the system (project idea)**
- 1.3 Objectives**
- 1.4 Problem Statement**
- 1.5 Recognition of the Need**
- 1.6 Time schedule for the project**

1.1 Overview and Motivation

With the fearsome attrition for the natural resources on earth, the need for many techniques that Reduces the use of these resources into other materials was emerged massively.

Cartoons are increasingly used as package in martials and then mostly wasted as unsorted waste. As experiment has shown that cartoons can be used as burning material in tines of increasing prices of fuel heating materials and burnable wood.

The motivation of our project is design and build of an electro mechanic recycling system for increasing wasted cartoons into useful burning material which for privet and even industrial application.

1.2 Short Description of the system (project idea)

An electrical mechanical system, controlled by a PLC, where the west cartoon is filled inside the tank of the machine, this machine serves to provide environment for the cartoon to be able to reuse again and then the west cartoon will be formed cartoon paste a variety of ways depending on the form of the product to be obtained through the Hydraulic Piston to the block cartoons. Block diagram demonstrates the stages of the project as shown in figure 1.1 .

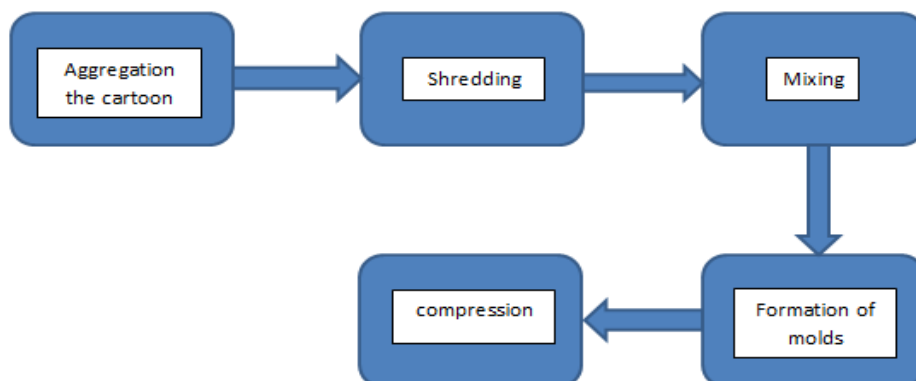


Figure 1.1: The block diagram

1.3 Objectives

1. Design a system that works to recycle the waste carton to preserve the environment and reduced as a result of the wrong ways to get rid of the remnants of carton.
2. Restore restoration green landscape, by reducing the amount of wood used in the carton industry, providing a large proportion of the human needs of the carton through recycling.
3. Reduction of energy consumed in obtaining wood, and turned into a carton, in addition to the reduction in the amount of water used in the process.

1.4 Problem Statement

We have a quantity of the waste carton; these quantities are not reused properly and are disposed from it in harmful ways environmentally shown in figure 1.2 . Some of environmentally dangers:

1. The vast amount of carton waste and Dumpsters carton occupies a large area of more than accommodate those places.
2. The destruction of the aesthetic view of the environment caused by the cutting of trees for use in industrial processes that need to burn wood.
3. The high cost for the heat source by burning wood pieces and transfer it.



Figure 1.2: Environmentally dangers

1.5 Recognition of the Need

The research team conducted a study on the amount of carton that are discarded every day in Hebron and Bethlehem, to decide whether there is the importance of the project and if there is really a need to recycle carton rest and after the meeting with the Chief Executive of the Joint Services for the management of solid waste in Hebron and Bethlehem founded that 15 tons of solid waste per day 10% of solid waste are carton mean a rate of 450 tons per month, this is a large percentage, so we decide to work with them, and solve their problem.

Through this statistic turns out 250 tons of carton is published monthly to Israel companies and the remaining 200 tones are disposed of in landfills either by burning or burial, here was the motive of the establishment of this project.

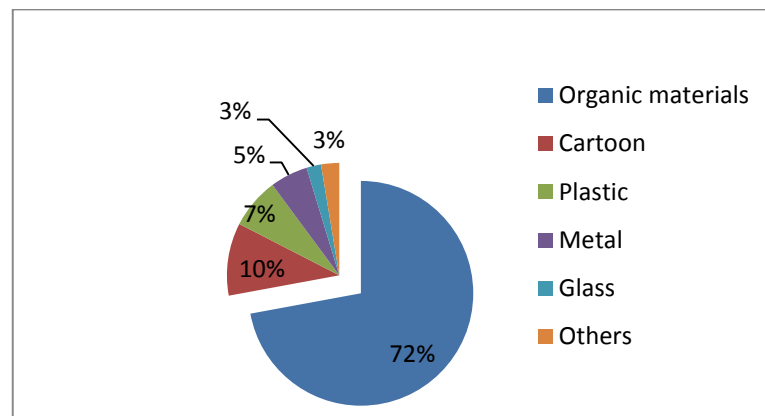


Figure 1.3: solid waste in Hebron and Bethlehem

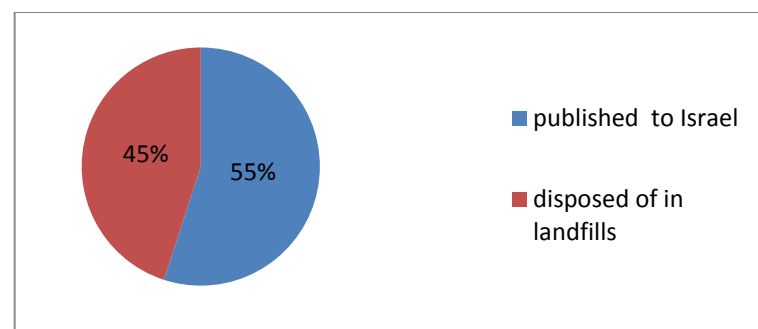


Figure 1.4: Disposal of carton waste per month

1.6 Time schedule for the project

1.6.1 Schedule Time _ first semester

Tasks / Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Selecting project title																
Collection data and information on the subject of the project																
Identify function and task																
Design and Analysis																
Documentation																

Table 1.1: Schedule Time _ first semester

1.6.2 Schedule Time _ second semester

Tasks / Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Modify the design of project																
Data collection																
Analysis the system																
Documentation																

Table 1.2: Schedule Time _ second semester

2

Chapter Two

The Recycling System

2.1 Introduction

2.2 Shredder

2.3 Mixer

2.4 Pneumatic cylinder compress

Introduction

In this chapter, we will show the general stages of the recycling system. In our project we will show the new technology in recycling carton in a full automated system programmed with a PLC, which will allow the user to control the operation of the system, The proposed machine is shown in the figure (2.1).

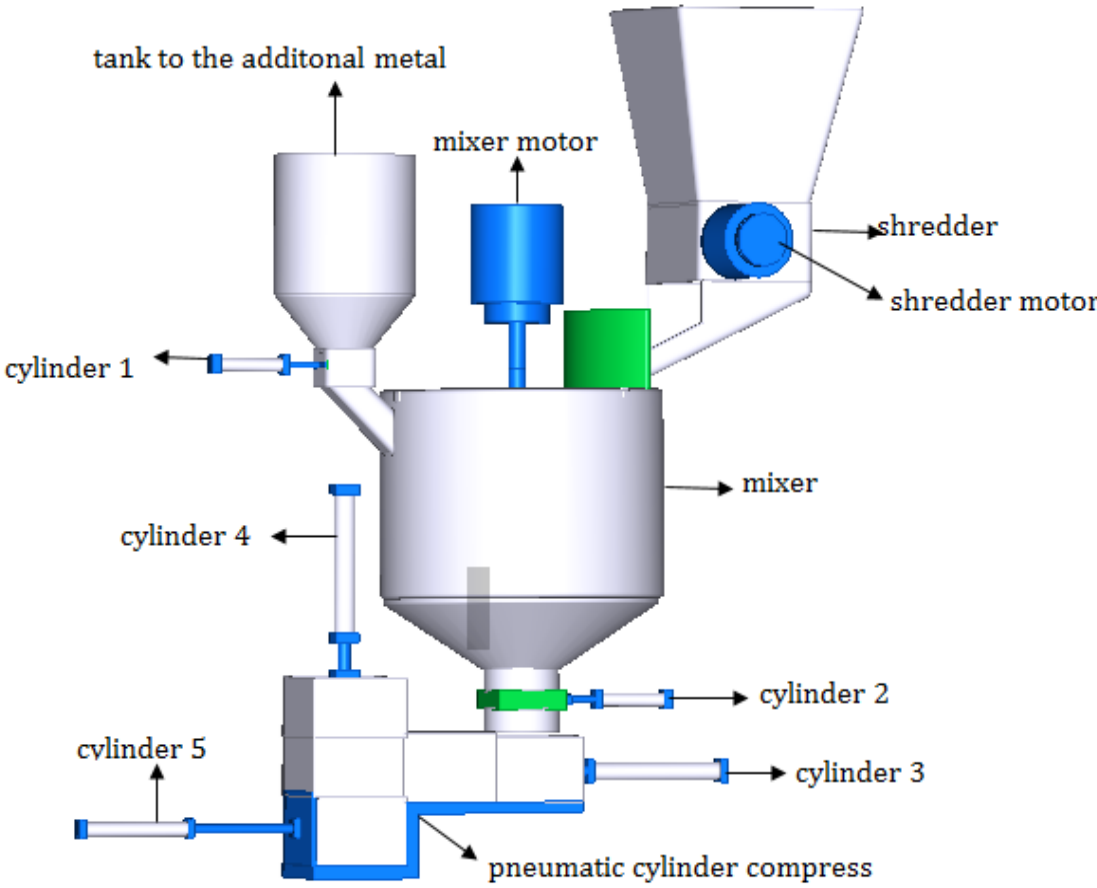


Figure 2.1: The Proposed Machine

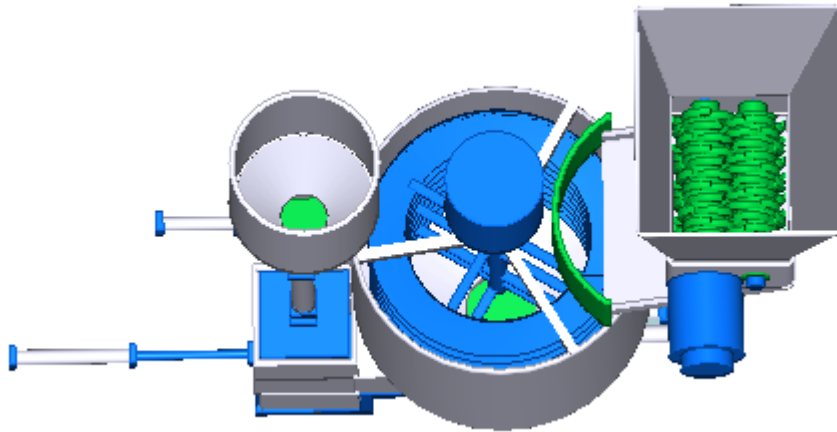


Figure 2.2: Top hand of the machine

In order to draw an image in our minds about how the machine works and how the manufacturing stages pass through it to get the final product, we divided the stages of production into four general stages, these stages are:

- 1) Shredder
- 2) Mixer
- 3) Pneumatic Cylinder Compress

2.1 Shredder

The first stage of the project in which they are after preparing raw cartoon from his sources are cartoon cut up into small pieces by cutting blade have a two rods the blade distributed into them by a certain way, and the rods are moving in opposite circular motion by 3 phase motor with speed of 100rpm attached to the rod of the one hand and on the other hand the rods attached with some by Spur Gear to transmission motion, The shredder is shown in the figure (2.3).

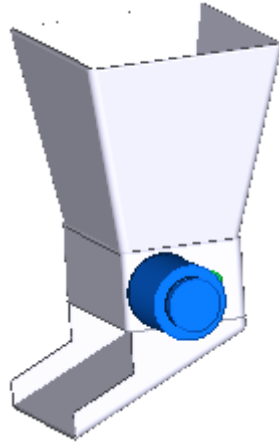


Figure 2.3: The shredder

2.1.1 Parts of shredder :-

1) Shredder container

General shape of the conical four-faceted and faceted is tilted at an angle to be practical sliding carton to teeth shredder to slide easy and flexible.

2) Shaft and Blades

Contain tow shaft are rotating an opposite direction, in tow shaft some blades to cutting carton and at one blade there are teeth cutting.

2.2 Mixer Stage

The ideal mixing quality and for dry, moist and viscous materials at variable are filling levels in a fast mix process. During in this stage, the system mix carton and additional metal which is already in the vertical tank and this happens through a helical ribbon impeller. This impeller is controlled by a motor above the tank; the mixer is shown in the figure (2.4).

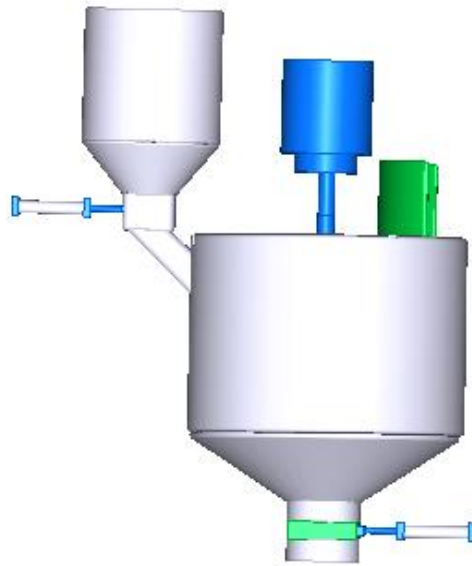


Figure 2.4: The mixer

2.2.1 Parts of mixer :-

1) Tank Mixing

It is a stainless steel tank, it has a cylindrical design to facilitate the mixing process, we chose stainless steel to resist high weights of the mixture, and this steel should be smooth to avoid the mixture from the cohesion with the tank sides.

The vertical tank contains a shaft, through the center, with the mixing elements. The center shaft is driven by a flywheel connected to a drive motor. In addition, the drive motor shaft is stepped down by a gear reducer.

2) Mixing Elements

The mixing elements consist of a center driveshaft and the actual component that provide the mixing action. This component is ribbon blender. The Ribbon blender is used for mixing or blending the cartoon in the tank. The mixing process will be according specific amount for all material and according to some laws in order to get a good percentage of materials without the use of estimates in the mixing process.

3) Tank to the additional metal

This tank contain external martial of Wood shavings and peat to be added to the paper during the mixing process.

2.3 Pneumatic cylinder compress

The fourth stage of the project it uses a pneumatic cylinder compress to compress the resulting mixture from the blender used after the mixing process within the cubic form template using two double acting cylinders, the pneumatic cylinder compress is shown in the figure (2.5).

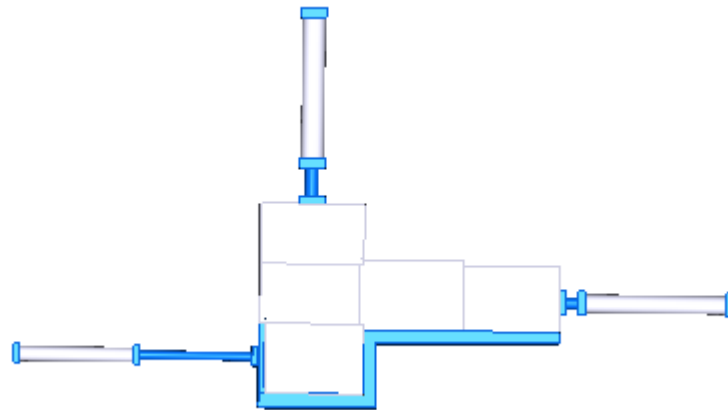


Figure 2.5: The pneumatic cylinder compress

3

Chapter Three Mechanical Parts

3.1 Introduction

3.2 Proposal System Description and Specifications

3.3 Mechanical Design

3.3.1 Shredder Machine

3.3.1.1 Shredder Blade Calculation

3.3.1.2 Power Requirement for Cartoon Shredder Design

3.3.1.3 Shaft Design and Shaft Dimension

3.3.1.4 Spur Gear Design

3.3.2 Mixer Machine

3.3.2.1 The tank mixer

3.3.2.2 Mixture Ribbon

3.3.2.3 Mixture Drive

3.3.2.4 Double acting cylinder

3.3.3 Pneumatic Cylinder Compress

3.1 Introduction

As explained before, Recycling cartoon pass through several stages, the cartoon assembly in the basin shredder then be cartoon cut up into small pieces and is collected inside the basin is then transferred cartoon cut through the carrier to the basin mixer, the cartoon section mixing with additives and water supply to the work of a mixture viscous through a tank of water, then the mixture is transferred through a hole in the bottom of the basin mixer into molds and then is pushed Al mixture into the pressing stage.

Since the machine used for preservation of the environment and in order to maintain the product, most of the machine parts are made of steel. and in order to obtain a good and simple design a set of parameters must be considered, these parameters are related to the machine itself such as: safety, portability, cost, design simplicity, availability, work space, on the other hand, the design must be able to produce efficient suitable for user related into the international standard.

3.2 Proposal System Description and Specifications

The first step in mechanical design is to know the whole operation of the system and to know how the machine is bind as shown in figure (3.1).

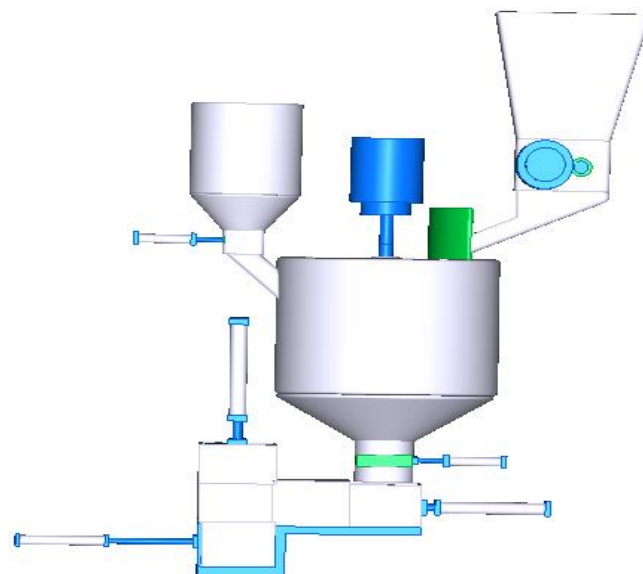


Figure 3.1: The Proposed Machine

3.3 Mechanical Design

In this section each block will be explained in details, the used material for most parts in this machine is stainless steel (1020) because it resistant the high weights.

3.3.1 Shredder Machine

In this part will explain how to design of the carton shredder machine. The design process begins by calculating the power required for the cutting process. The power will be a reference in choosing the electric motor. After determining the electric motor, the following design process is the calculation of machine parts according to the concept and construction design.

Was chosen the general shape of the stage of cutting, as shown in the in figure (3.2), the shredder container and aggregation basin it has been designed in the form of cone allows the cartoon slip easily to the shredder blades, the dimensions of the container and basin are shown in the in figure (3.3).

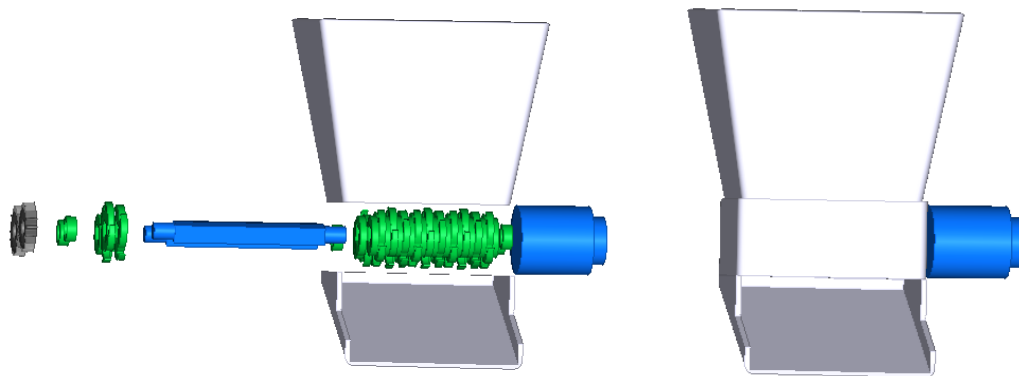


Figure 3.2: The general parts of shredder

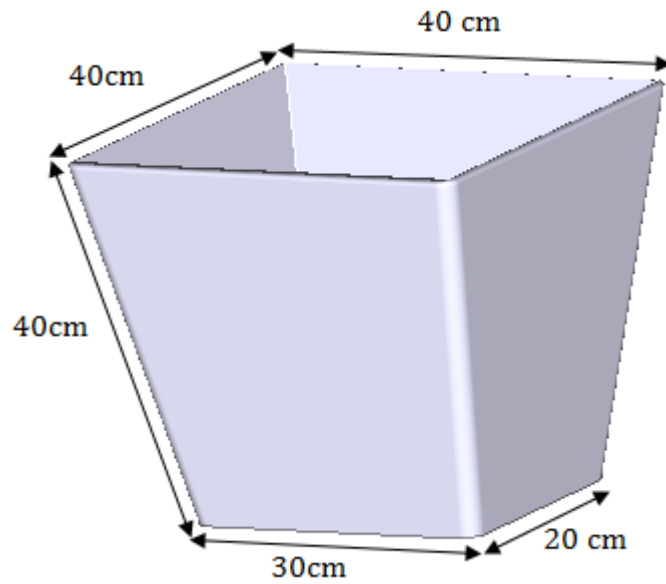


Figure 3.3: the shredder container

3.3.1.1 Shredder Blade Calculation

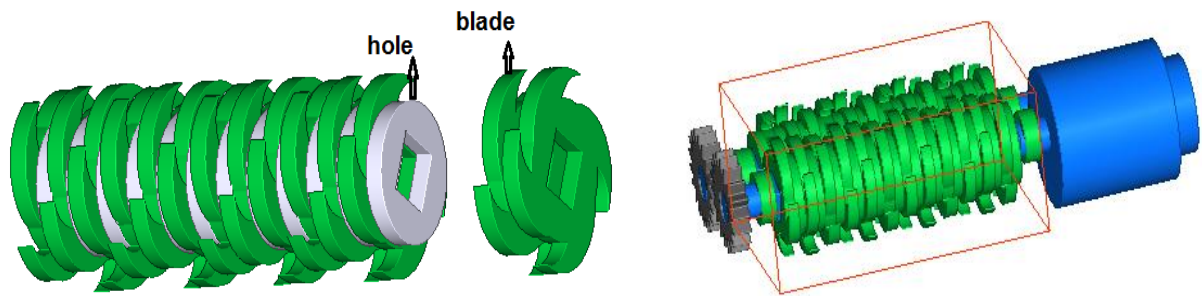


Figure 3.4: The Shredder Blade

The number of blades for one shredder is equal 12 and 12 holes so the length of shredder is 48 cm.

Between blades there is a hole, and the one blades divider to four a knife and the angle between it is 90° .

The one blade is leading the second blade by 22.5° .

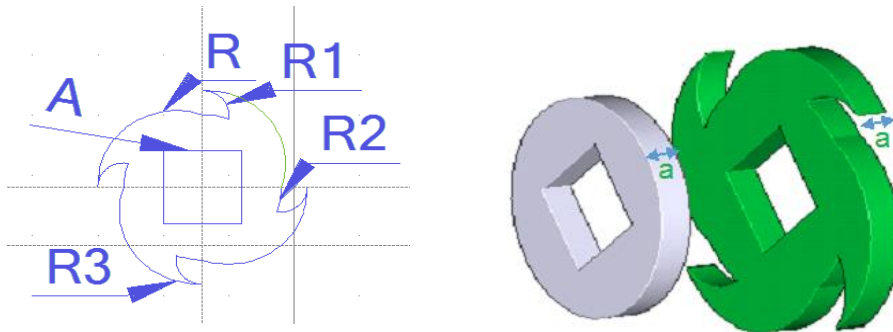


Figure 3.5: The dimensions of the blade

The dimensions of the blade:-

R= 5 cm, R1= 1.5 cm, R2= 4.5 cm, R3= 6 cm, A= 3*3 cm², a= 2 cm

The cutting forces for vertical and horizontal direction can be formulated as follows:

$$F1 = Fi * i * K \quad \text{ref(2)} \quad (3.1)$$

$$F2 = Fi * i * K \quad \text{ref(2)} \quad (3.2)$$

Note:-

F1 = Cutting Force for Vertical Direction (Kg)

F2 = Cutting Force for Horizontal Direction (Kg)

Fi = Cutting Force per Blade (Kg) (1.25Kg)

i = Number of Blade (12 blades)

k = Number of Blade Cutting Edge (4 edge)

So that $F1 = 1.25 * 12 * 4 = 60 \text{ Kg}$

$F2 = F1 = 60 \text{ Kg}$

3.3.1.2 Power Requirement for Cartoon Shredder Design

The power required to crush a paper is influenced by torque and speed of blade, Power Requirement for cutting process can be calculated by formula:

$$P = \frac{T*n}{9.74*10^5} \quad \text{ref(2)} \quad (3.3)$$

Note:

P = Power Requirement (Kw)

T = Torque (kg.mm)

n = Blade speed (rpm) (100 rpm)

Torque in the blade occurs due to cutting force in the vertical cutting direction (F1) and the horizontal cutting direction (F2), so the total torque in the blade can be calculated by formula:

$$T = (F1 * R1) + (F2 * R2) \quad \text{ref(2)} \quad (3.4)$$

Note:

T = Torque (Kg.mm)

F1 = Cutting Force for Vertical Direction (Kg) (124.8 Kg)

F2 = Cutting Force for Horizontal Direction (Kg) (124.8 Kg)

R1 = Radius of blade on F1 point (mm) (60mm)

R2 = Radius of blade on F2 point (mm) (60mm)

The Cutting Force per Blade $F_i=900$ kg so

$$\begin{aligned} \text{Torque } T &= (F1 * R1) + (F2 * R2) \\ &= 2 * (F1 * R1) = 2(60 * 0.06) \\ &= 72 \text{ Kg.m} = 7.2 \text{ KN.m} \end{aligned}$$

$$\begin{aligned} \text{power Requirement } P_R &= \frac{T * n}{9.74 * 10^5} \\ &= \frac{7.2 * 100}{9.74 * 10^5} = 0.739 \text{ Kw} \end{aligned}$$

3.3.1.3 Shaft Design and Shaft Dimension

Shaft is static or dynamic part having a round cross section, which is attached to elements such as gears, pulleys, steering wheel, crank, sprocket and other power transmission elements. Shaft can receive bending load, strength, pressure and torque; either alone or in combination with others. The shaft is shown in the in figure (3.6).

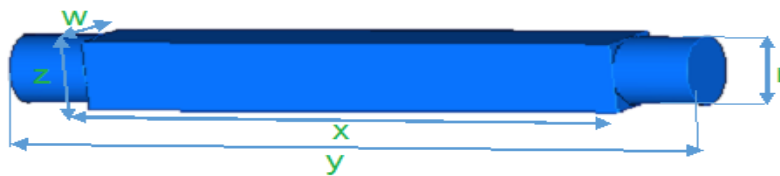


Figure 3.6: The shaft

Shaft Dimension:-

X= 28 cm, Y= 40, Z= 3cm, W=3 cm, R= 3cm

1. Torque load of shaft

The torque load occurs at the shaft rotation of the reception of the electric motor. The torque is the ratio of the power requirement and shaft speed by the formula:

$$T = 9.74 * 10^5 \frac{P_R}{n} \quad \text{ref(2)} \quad (3.5)$$

Note:

T = Torque (kg. mm)

P_R = Power Requirement (kW)

n = Shaft Speed (rpm)

Power requirement is obtained from the power of electric motors after that is multiplied by a correction factor by the following formula:

$$P_R = f_c * P \quad (3.6)$$

Note:

P_R = Power Requirement (kW)

P = Electric Motor Power (kW)

f_c = Correction Factor

Correction factors have been taken according to the values of use of the transmission power; we are choosing the correction factor(f_c) to equal 1.5

Power electrical motor $P = \frac{P_R}{f_c} = 0.4928 \text{ Kw}$ (3.7)

So we needed 3 phase motor are 0.38 hp

3.3.1.4 Spur Gear Design

Gear transmission classified according to the location of shaft, the direction of rotation, and the teeth formed lines. Spur Gear is a gear of the parallel shaft with teeth aligned in two zones of the cylinder is called "pitch field". Both surfaces of the cylinder are crossing each other with a fixed parallel axis. The spur gear is shown in the in figure (3.7).

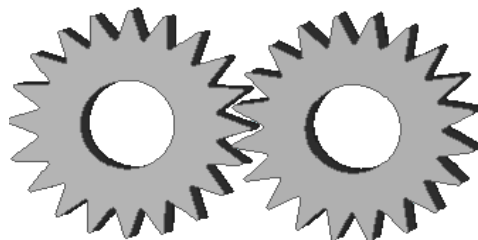


Figure 3.7: The Spur Gear

The main parameters of the spur gear is the pitch circle or module, pitch diameter, outside diameter, whole depth, Spur Gear form as shown in the following figure (3.8).

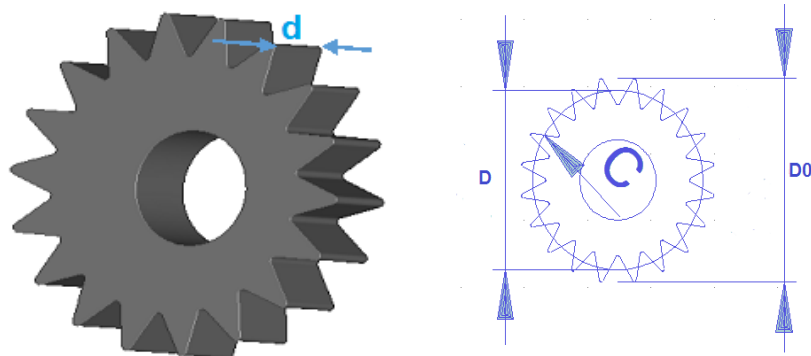


Figure 3.8: The main parameters of the spur gear

C = Pitch circle (cm)

D = Pitch Diameter (cm)

D0 = outside Diameter

d = whole depth (4 cm)

Standard dimension of spur gear; main dimensions of spur gear is expressed with a pitch diameter is an imaginary circle that rolls without slipping as a point of meeting two tooth profile pairs. The tooth size is expressed by the pitch circle is the distance along the circle of the distance between two profiles of adjacent teeth. Pitch circle is a circle which has the radius of half the pitch diameter with its center at the axis of the gear. The relationship between pitch diameter and pitch circle can be seen by the following equation:

$$C = \frac{\pi * D / 2}{T} \quad \text{ref(2)} \quad (3.8)$$

Note:

$$D = 8 \text{ cm}$$

$$T = 20 \text{ Teeth}$$

$$C = \frac{3.14 * 8/2}{16} = 0.785 \text{ cm}$$

The tooth size may be determined from the amount of pitch circle, because the pitch circulars the circumference of a pitch divided by the number of tooth. However, because the pitch circle always contains π factor used as a dimension of the tooth is less convenient. To remedy this, take a measure called 'module' with the M symbol, where:

$$M = \frac{D}{T} \quad \text{ref(2)} \quad (3.9)$$

Note:

$$M = \text{Module}$$

$$D = \text{Pitch Diameter (mm)}$$

$$T = \text{Number of Teeth}$$

$$M = \frac{8}{16} = 0.5 \text{ cm/teeth}$$

Outside diameter, it is the overall diameter of the gear which is the pitch circle plus two addendums. Its relationship with module can be described by formula:

$$D_0 = 2M + D \quad \text{ref(2)} \quad (3.10)$$

Note:

$$D_0 = \text{Outside diameter (mm)}$$

$$M = \text{Module}$$

$$D = \text{Pitch diameter (mm)}$$

$$D_0 = 2 * 0.5 + 8 = 9 \text{ cm}$$

Gear ratio is comparing the speed ratio or the pitch diameter ratio or the number of teeth ratio.

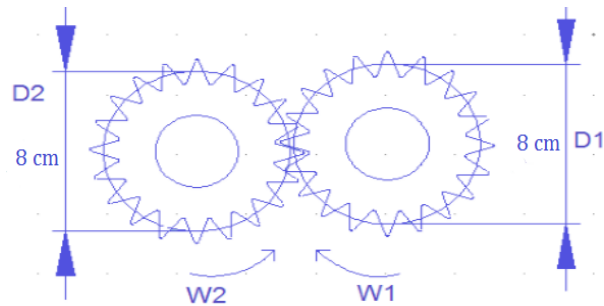


Figure 3.9: The gear ratio

Gear ratio may be expressed by the formula:

$$i = \frac{n_1}{n_2} = \frac{D_2}{D_1} = \frac{T_2}{T_1} \quad (3.11)$$

Note:

i = Gear ratio

n_1 = Speed of pinion (rpm)

n_2 = Speed of gear (rpm)

T_2 = Number of teeth of gear

D_1 = Pitch diameter of pinion (mm)

D_2 = Pitch diameter of gear (mm)

We want value of ratio (i) to equal 1.

3.3.2 Mixer Machine

3.3.2.1 The tank mixer

The first step in the whole operation start in the tank as shown in figure (3.11) which designed to hold (75kg) of mixture.

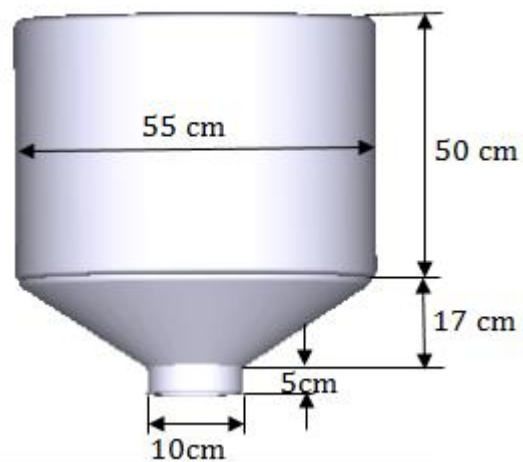


Figure 3.10: The Mixer Tank

Area Calculations:

First: the cylinder area (A_1)

$$A_1 = 2\pi r_1 h_1 + 2\pi r_1^2 = 1.3 \text{ m}^2 \quad (3.12)$$

Where:

h_1 : height of cylinder (m) ($h_1 = 0.5$ m).

r_1 : radius of cylinder (m) ($r_1 = 0.27$ m).

A_1 : area (m^2).

Second: circular truncated cone area (A_2):

$$A_2 = \pi(g(r_1 + r_2) + r_1^2 + r_2^2) \quad (3.13)$$

$$g^2 = h_2(r_1^2 + r_2^2) \quad (3.14)$$

Where:

h_2 : height of circular truncated cone ($h_2 = 0.16$ m).

r_1 : radius of the big circle (cm) ($r_1 = 0.27$ m).

r_2 : radius of the small circle (cm) ($r_2 = 0.05$ m).

A_2 : area (m^2).

Depends on equation (3.17)

$$g = 0.01206 \text{ m}^2$$

Depends on equation (3.16)

$$A_2 = 0.248 \text{ m}^2$$

To find the area of stainless steel that need to make the tank, should found the total area of the upper parts:

$$\text{Total area} = A_1 + A_2 = 1.3 + 0.248 = 1.548 \text{ m}^2$$

Volume Calculations:

The total volume of tank = volume of the cylinder + the volume of the cone

First: the volume of the cylinder (V_1)

$$v_1 = \pi r_1^2 * h_1 = 40 \text{ L} \quad (3.15)$$

Second: the volume of the cone (V2)

$$v_2 = \frac{\pi h^2}{3} (r_1^2 + r_2^2 + (r_1 * r_2)) = 19.1L \quad (3.16)$$

The total volume of the tank (V) = 90.17 + 19.1 = 59.1 L = 0.059 m³

3.3.2.2 Mixture Ribbon

The ribbon blender is a vertical styled helical blade mixer as shown in figure (3.11). That ribbon blender is of highly efficient and versatile mixing machine designed to homogeneously mix dry process, thorough mixing is accomplished by continuously moving the process media from the center to both ends of the container and in reverse direction. Which diameter area estimated about 60 cm, and consumes a 220 voltage and a current of (2A) and it will turn in speed of (60 rev/min).

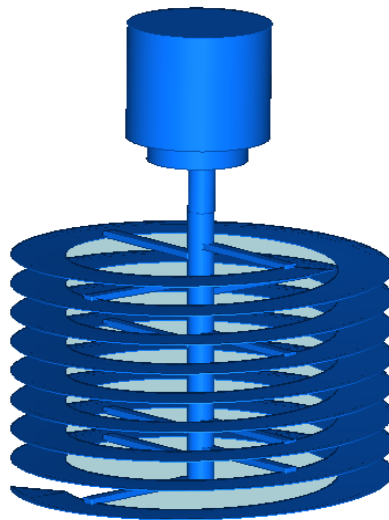


Figure 3.11: The Ribbon Mixer

3.3.2.3 Mixture Drive

(380 / 220)V AC motor. In this project we will use two motors of the type AC 380-220 V. that used to run the mixer; the motor will be connected with gear ratio to control the speed of motor and make the speed of blades slow.

In order to choose the suitable motor to rotate the internal blades must account several important points.

- Dynamic Viscosity of slurry.
- Reynolds number
- Power number
- Power consumption

1) Dynamic Viscosity of concrete (μ).

The dynamic viscosity of a fluid expresses its resistance to shearing flows, where adjacent layers move parallel to each other with different speeds.

Kinematic viscosity (dynamic viscosity) of the liquid is the amount of liquid's resistance to flow at his movement and the relationship of these highly liquid heat resistances. The more heat, less kinematic viscosity.

Viscosity affected by a time of mixing in the beginning, but with over time it stabilizes at the same concentration of the solution, also if the percentage of water increases the viscosity will decrease.

At unit weight $W = 0.25$, and at Temperature = (20°).

The Dynamic Viscosity (μ) = 3 Pa.s.

2) The Reynolds number

The Reynolds number is defined as the ratio of momentum forces to viscous forces , also used to characterize different flow regimes within a similar fluid, such as laminar or turbulent flow:

- a) Laminar flow occurs at low Reynolds numbers, where viscous forces are dominant, and is characterized by smooth, constant fluid motion($Re < 10$).
- b) Turbulent flow occurs at high Reynolds numbers and is dominated by inertial forces, which tend to produce chaotic eddies, vortices and other flow instabilities ($10^3 < Re < 10^5$).

The Reynolds number (Re) defined as in equation (3.20):

$$Re = \frac{d^2 N \rho}{\mu} \quad (3.17)$$

Where:

d: Impeller diameter in m (0.6 m).

N: Rotational speed in revaluation / sec (1rps).

ρ : Density of the cartoon in (kg/m³) (700kg/m³).

μ : Dynamic viscosity in (Pa.s) (4.7Pa.s).

So, $Re = 84$ not laminar but is turbulent flow.

3) Power number (Po).

The power number also known as (Newton number) is a commonly used dimensionless number relating the resistance force to the inertia force.

The power-number has different specifications according to the field of application.

The power number is defined as in equation (3.21):

$$P_0 = \frac{P}{\rho N^3 d^5} \quad (3.18)$$

Where:

d: Impeller diameter in m (0.6 m).

N: Rotational speed in revaluation / sec (1rps).

ρ : Density of the cartoon in kg/m3 (700 kg/m3).

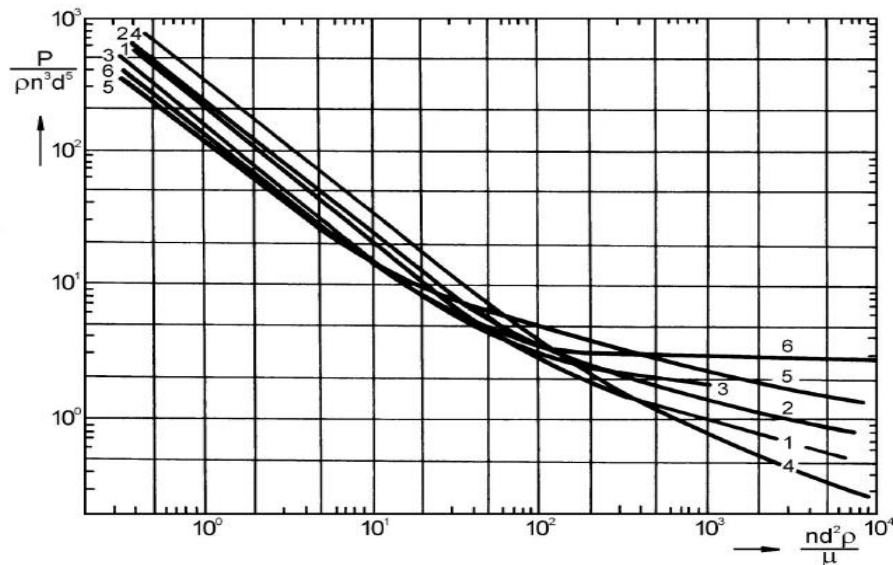


Figure 3.12: Power Characteristic of Close Clearance Agitator

Through the curve describe in figure (3.13) for this type of blades, they depend mainly on the Reynolds number.

$P_0 = 6$.

4) Power consumption (P).

$$P = \rho d^5 N^3 P_0 \quad (3.19)$$

$$\begin{aligned} P &= 700 * 0.6^5 * 1^3 * 6 \\ &= 326.59 \text{ W} \end{aligned}$$

The connected motor power should be higher since to account for electrical and mechanical losses of the agitator drive system.

The gear box must reduce the speed of motor and increasing the torque of the motor, Use gear box 1:20 to reducing the speed of the motor from 1400 rpm to 60 rpm, and increasing the torque.

Select the motor which has 0.5 hp and power larger than the power on the shaft the motor.

3.3.2.4 Double acting cylinder

At this stage there are two double acting cylinders as shown in figure (3.13). First cylinder working when giving an electric signal rushes back to be dropping of the material added to the mixer. The second cylinder work after processing the mixture when you give an electric signal cylinder rushes back to be dropping of the mixture from the blender ready to mold and when the mold is full the cylinder rushes forward automatically.

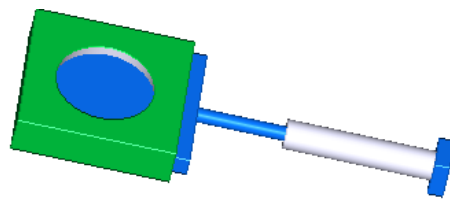


Figure 3.13: The Double acting cylinder

3.3.3 Pneumatic Cylinder Compress

At this stage we are working on a pneumatic cylinder compress design which is based on the formation of the mixture ready to cube-shaped mold using two double acting cylinders where these cylinders operate sequentially and automatically when the rush of the mixture into the mold, the first cylinder works to push the mold forward and Stabilizes under the cylinder Pressure, the cylinder pressure works when the mold exists rushes forward and works to compress material within the mold, and after the time the cylinder return back. The pneumatic cylinder compress sequence shown in the figure (3.14).

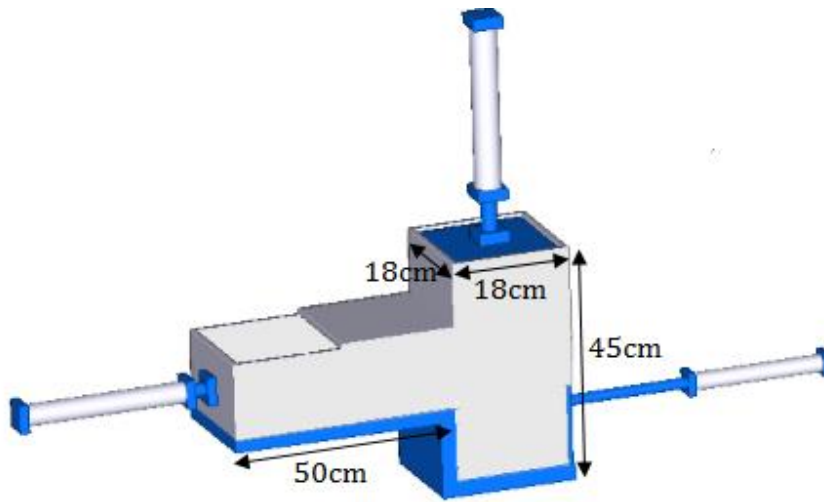
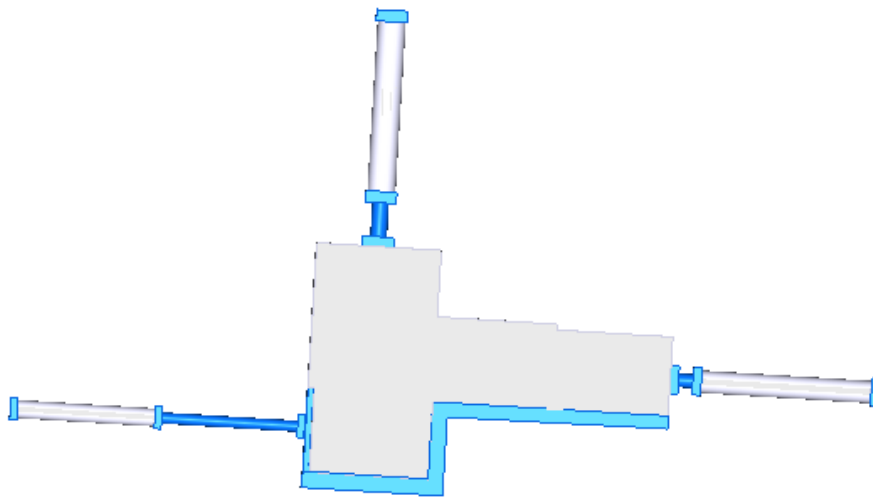


Figure 3.14: The pneumatic cylinder compress sequence

4

Chapter Four Electrical Parts

4.1 Introduction

4.2 Motor calculations

4.3 Switches

4.4 Contactors

4.5 Cylinders

4.6 Control valves

4.7 Limit switches

4.8 Clemens

4.9 Led Lamp

4.1 Introduction

This chapter contains the electrical component specifications (motor, sensor, overload, etc), power & control circuit, and protection.

4.2 Motor calculations

There are two motors

1. Shredder motor
2. Mixing motor

1. Shredder motor calculation

The shredder motor power that obtain by the equation (3.3) equal 0.75 Kw.

$$P = \frac{T*n}{9.74*10^5}$$

Motor Table	
Max current	2.5 A
Input power	0.75 kw
Voltage	380-220 V
Cos (φ)	0.66
Phase speed	3 phase pole 50
Speed	1400 rpm
IP	55



Figure 4.1: shredder motor

Table 4.1: shredder motor

2. Mixing motor calculation

The mixing motor that obtain by the equation (3.19) equal 326.59 W

$$P = \rho d^5 N^3 P_0$$

Motor Table	
Max current	2.5 A
Input power	0.5 kw
Voltage	380-220 V
Cos (φ)	0.66
Phase speed	3 phase pole 50
Speed	1400 rpm
IP	55



Figure 4.2: mixer motor

Table 4.2: mixer motor

To protection the motor we used overload switches and it defined as overload relays are intended to protect motors against excessive heating due to prolonged motor over currents up to and including locked motor currents. Protection of the motor due to short circuits or grounds is a function of circuit breakers, or motor short-circuit protectors.

In this project we used three Overload, first Overload for a shredder motor and second Overload for mixer motor. As shown in figure 4.3.



Figure 4.3: over load

4.3 Switches

The emergence switch are used to stop the machine immediately when something wrong happened with the machine as shown in the figure 4.4.a. The start pushbutton switch are used to turn on the project as shown in the figure 4.4.b .The stop pushbutton switch used to turn off the project as shown in the figure 4.4.c . The pushbutton switch are used to turn on the shredder motor as shown in the figure 4.4.d. The pushbutton switch are used to turn off the shredder motor as shown in the figure 4.4.e.



a- Emergence switch



b- Start pushbutton switch



c- Stop pushbutton switch



d- Push button switch on shredder motor



e- Push button switch off shredder motor

Figure: 4.4

4.4 Contactors

A contactor is an electrically controlled switch used for switching a power circuit, similar to a relay except with higher current ratings.

A contactor is controlled by a circuit which has a much lower power level than the switched circuit.

Contactors come in many forms with varying capacities and features. Unlike a circuit breaker, a contactor is not intended to interrupt a short circuit current. Contactors range from those having a breaking current of several amperes to thousands of amperes and 24 V DC to many kilovolts. The physical size of contactors ranges from a device small enough to pick up with one hand to large devices approximately a meter (yard) on a side. Contactors are used to control electric motors, lighting, heating, capacitor banks, thermal evaporators, and other electrical loads.

In this project we used three contactors, first contactor for a shredder motor and second contactor for conveyor motor and third contactor for mixer motor. As shown in figure 4.2.



Figure 4.5: contactor

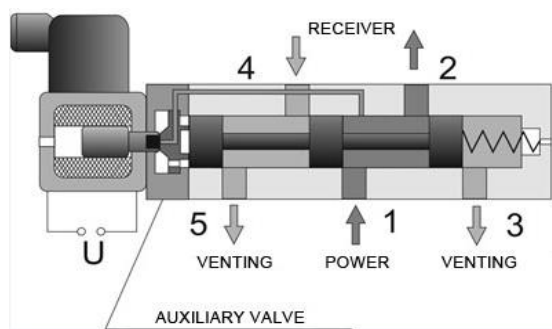
4.5 Cylinders

the cylinders as working at 24 V DC and In this project we used five cylinders, first cylinder for additional metal, the second cylinder for mixer, the third cylinder to move the mixture from mixer to compress stage, the fourth cylinder to compress the mixture, and the fifth cylinder to push the bloke compress. And we are used four limit switch to limit the motion of the cylinders, and we are controlling of them by five electrical control valve.

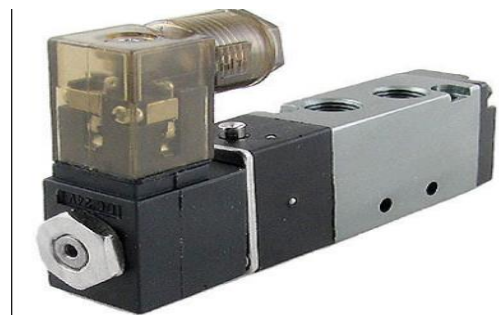
4.6 Control valve

(5/2 directional control valve):

When a pressure pulse is input into the pressure control port 'P', the spool will move to the left, connecting power '1' and work passage '2'. Work passage '4' will then make a release of air through '3' and '5'. The directional valves will remain in this operational unit signals of the contrary are received. Therefore, this type of directional control valves is said to have the function of 'memory'. As shown in figure 4.6. A. Cross section. B. 5/2 directional control valve. C. Pneumatic symbol.



A



B



C

Figure 4.7

4.7 limit switches

Limit switch is a switch operated by the motion of a cylinder part or presence of an object. They are used for control of a sequence of the cylinder, as safety interlocks, or to count objects passing a point

In project there are five limit switch as showing in figure 4.5.



Figure 4.8: limit switch

4.8 Clemens

Used to connect wires and a range the connections as shown in figure 4.6.



Figure 4.9: Clemens

4.9 Led Lamp

We are using tow led at first led to show shredder motor are on as shown in figure 4.10.A, and the second led to show the mixer motor are on as shown in figure 4.10.B.



Figure 4.10: led lamp

5

Chapter Five

PLC Programming

- 5.1 Introduction**
- 5.2 PLC Characteristic**
- 5.3 PLC Connection**
- 5.4 State Graph**
- 5.5 Flow Chart**
- 5.6 PLC Code**

5.1 Introduction

As it has been mentioned before the Rest concrete recycling system is fully automated and the process is performed sequentially, this can be performed by using PLC (programmable logic controller). This made adding automation capability and safety precautions possible, which is explained through this chapter.

5.2 PLC Characteristic

Programmable Logic Controller (PLC) is a digital computer used for automation of electromechanical process, such as control of machinery on factory assembly lines, PLCs are used in many industries and machine. Unlike general-purpose computers, the PLC is designed for multiple inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery backed up or non-volatile memory

A PLC is an example of a hard real time system since output results must be produced in response to input conditions within a limited time otherwise unintended operation will result. In our controlling design it is desirable to use a PLC with 10 input and 7 outputs mentioned in table 5.1 and table 5.2, It must be compatible to use with 220 volt.

Input	Symbol	Address	Logic allocation
Stop(NC)	Stop	X0	X0 = 0, Operation is stop
Emergency switch(NC)	Emg	X1	Turn off all process
Start(NO)	Start	X2	X2=1, Operation is run

Start shredder(NO)	S1	X3	X3=1, shredder motor is run
Stop shredder(NO)	S2	X4	X4=1,shredder motor is stop
Limit switch 1	LS1	X5	X5=1,ther as cylinder 2 is open
Limit switch 2A	LS2A	X6	X6=1,there as cylinder 3 is close
Limit switch 2 B	LS2B	X7	X7=1, there as cylinder 3 is open
Limit switch 3	LS3	X10	X10=1;there as cylinder 4 is close
Limit switch 4	LS4	X11	X11=1, there as cylinder 5 is close

Table 5.1: input parameters

Output	Symbol	Address	Logic allocation
Mixer motor	MX	Y0	Y0=1, mixer motor is run
Led lamp 1	L1	Y0	Y0=1, led lamp 1 is run
Shredder motor	MS	Y1	Y1=1, shredder motor is run
Led lamp 2	L2	Y1	Y1=1, led lamp 2 is run
Cylinder 1	C1	Y2	Y2=1, cylinder 1 is close
Cylinder 2	C2	Y3	Y3=1, cylinder 2 is close
Cylinder 3	C3	Y4	Y4=1, cylinder 3 is open
Cylinder 4	C4	Y5	Y5=1, cylinder 4 is open

Cylinder 5	C5	Y6	Y6=1, cylinder 5 is close
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Table 5.2: Output parameters

The used PLC is DELTA DVP24-EC as shown in figure 5.1, with 10 inputs and 7 outputs.

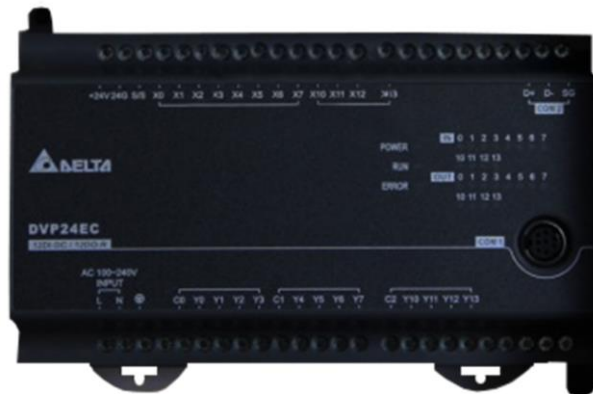


Figure 5.1: DELTA DVP24-EC

5.3 Plc, switches and output Connection

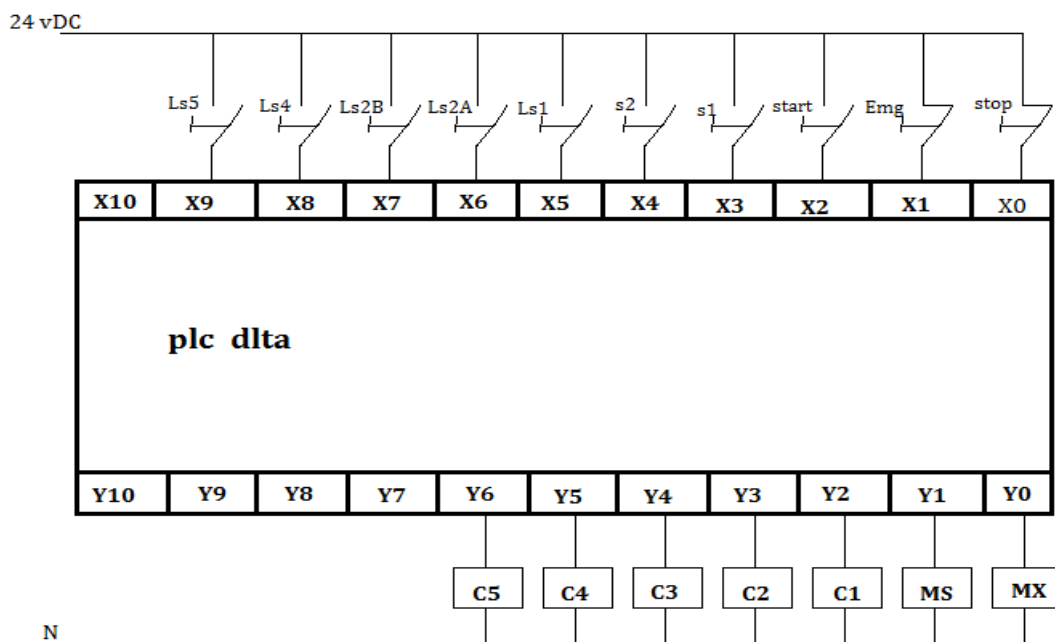
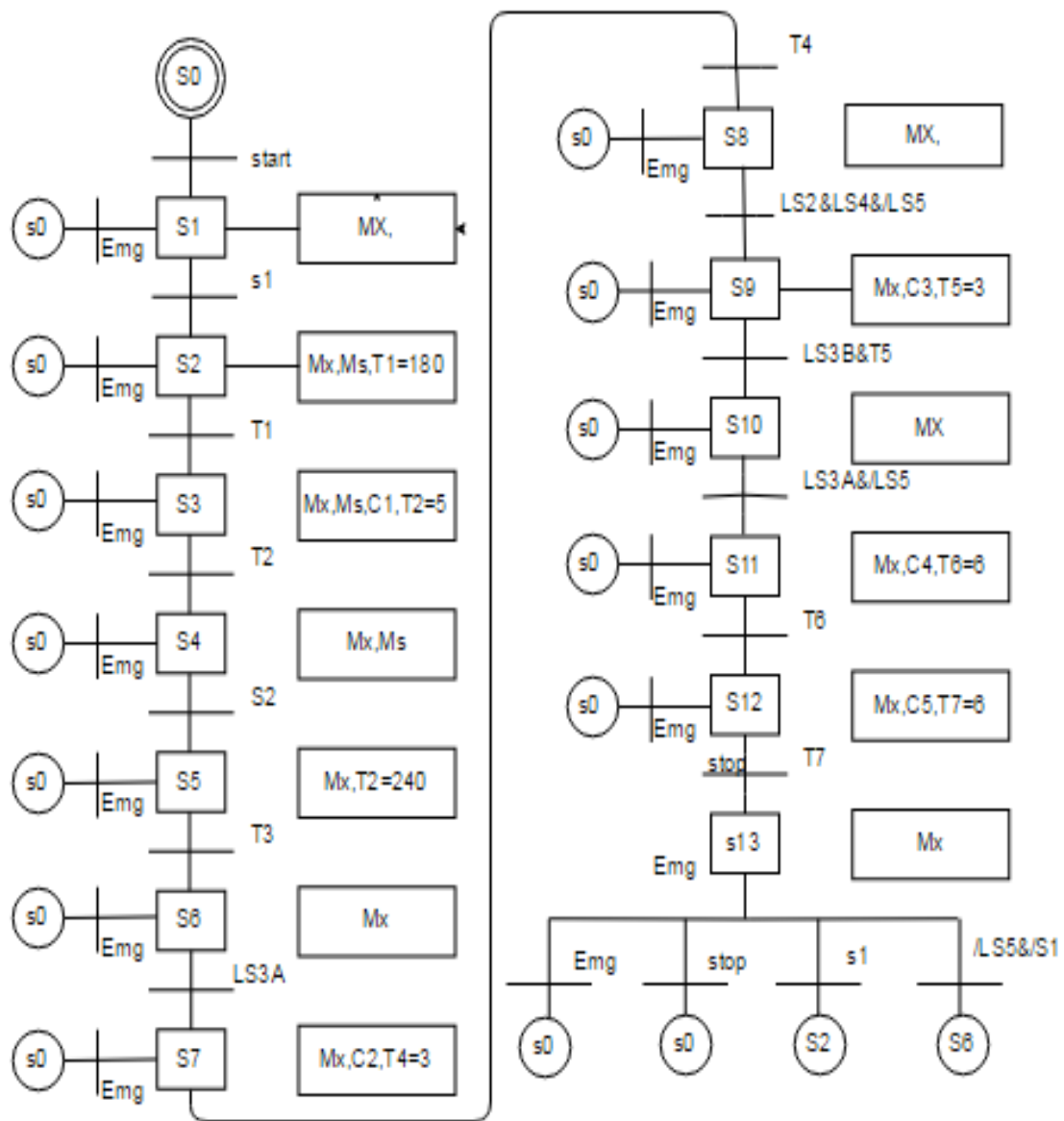
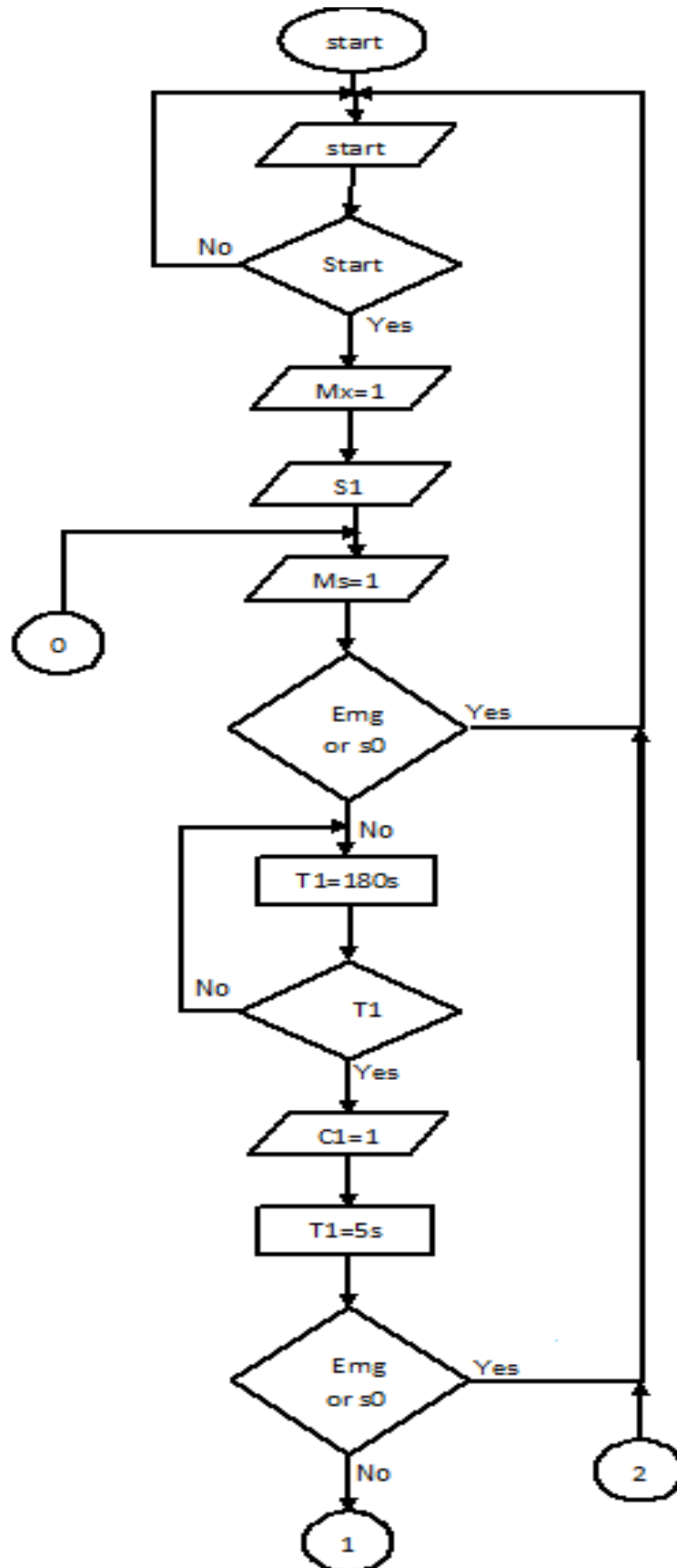


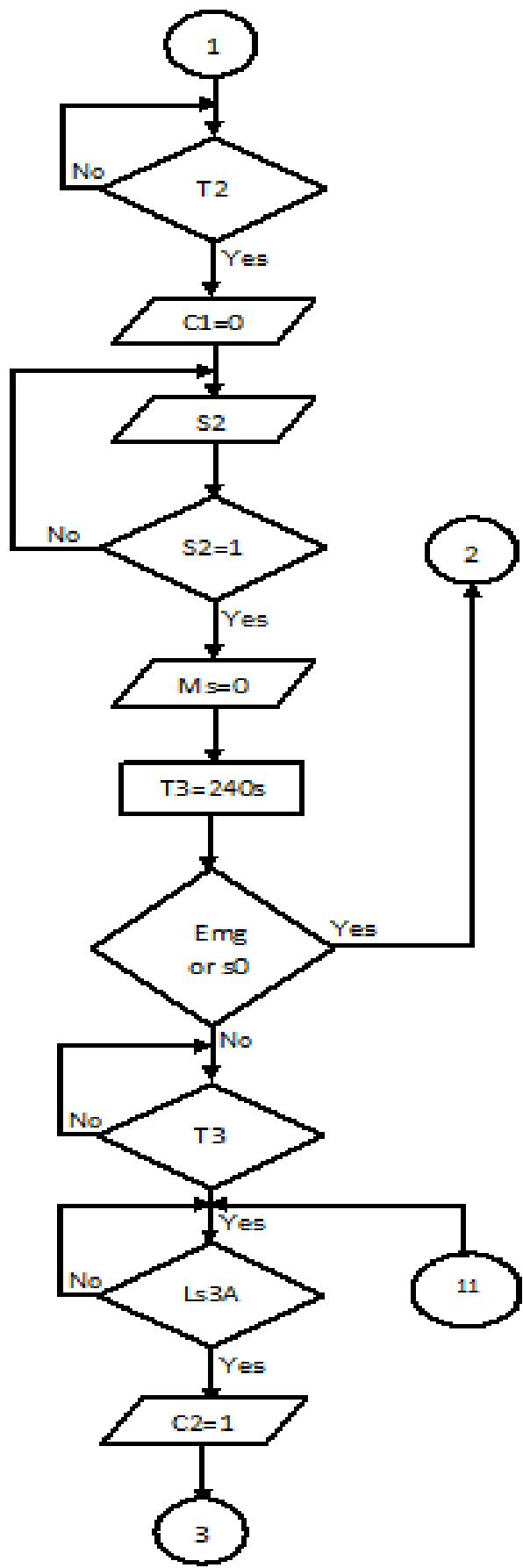
Figure 5.2: PLC, switches and output Connection

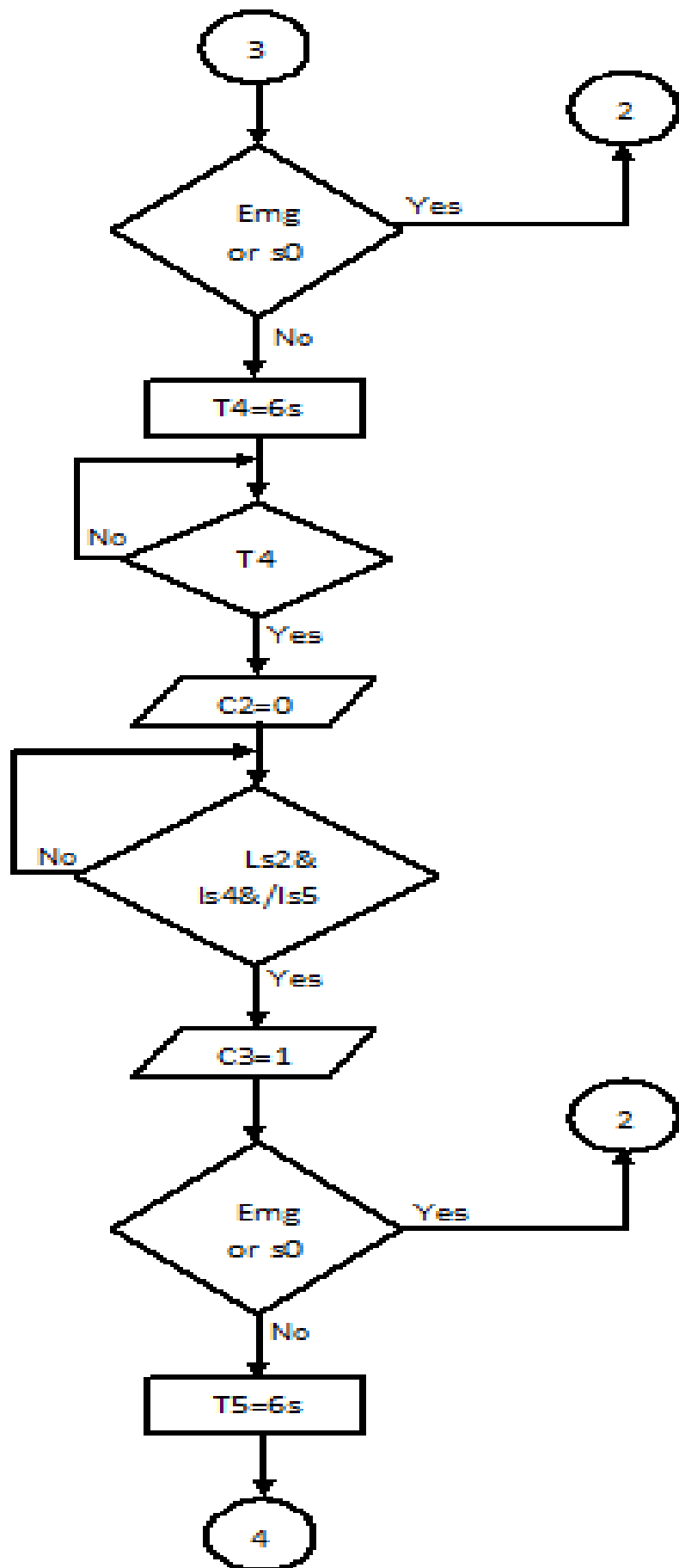
5.4 State Graph

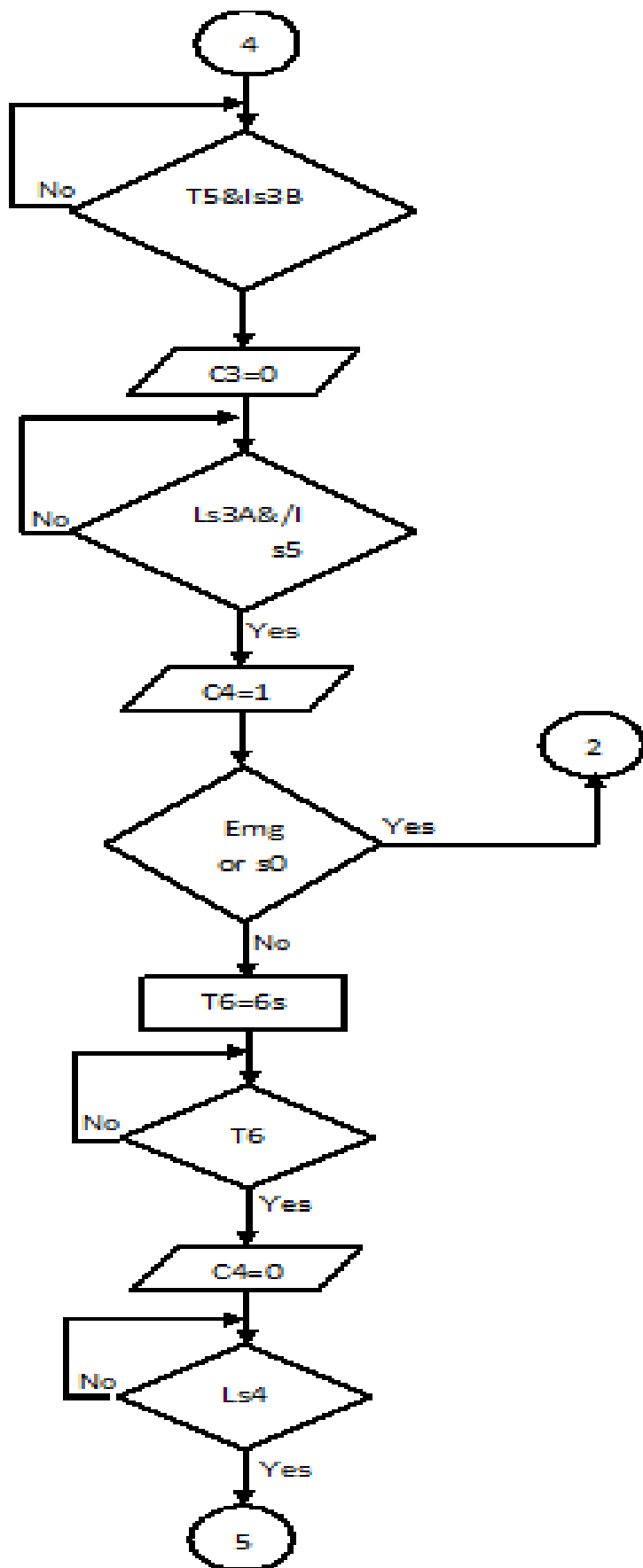


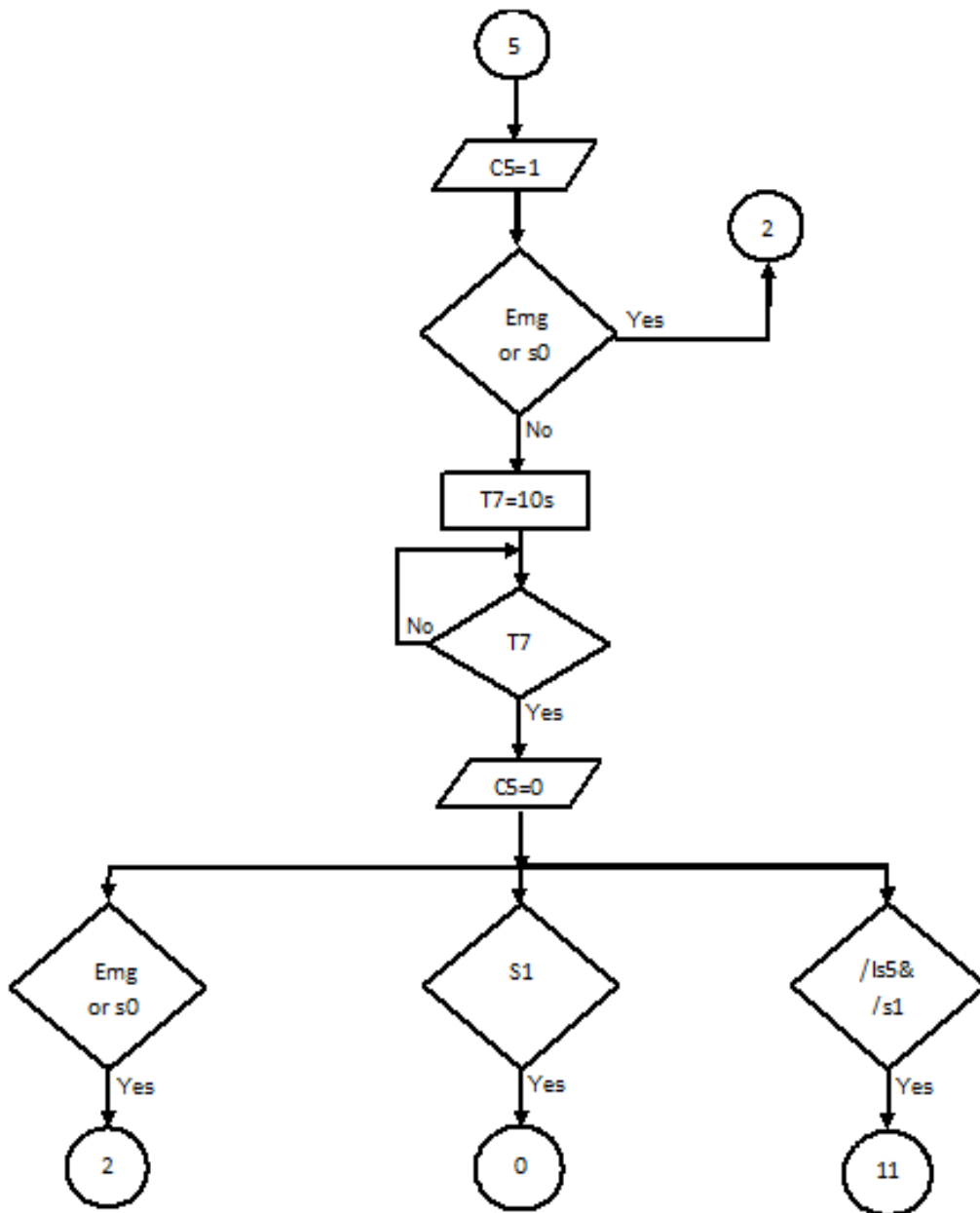
5.5 Flow chart



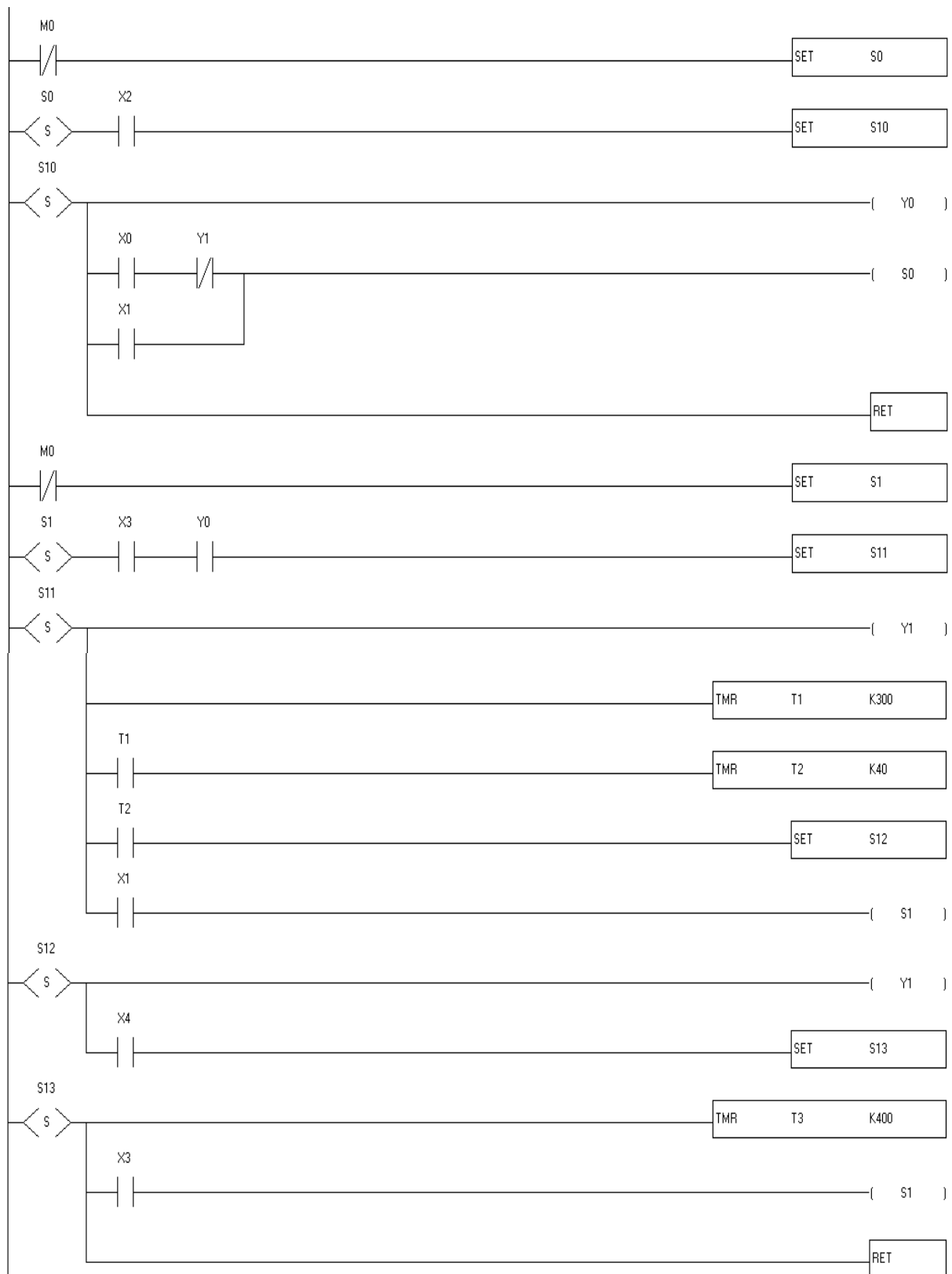


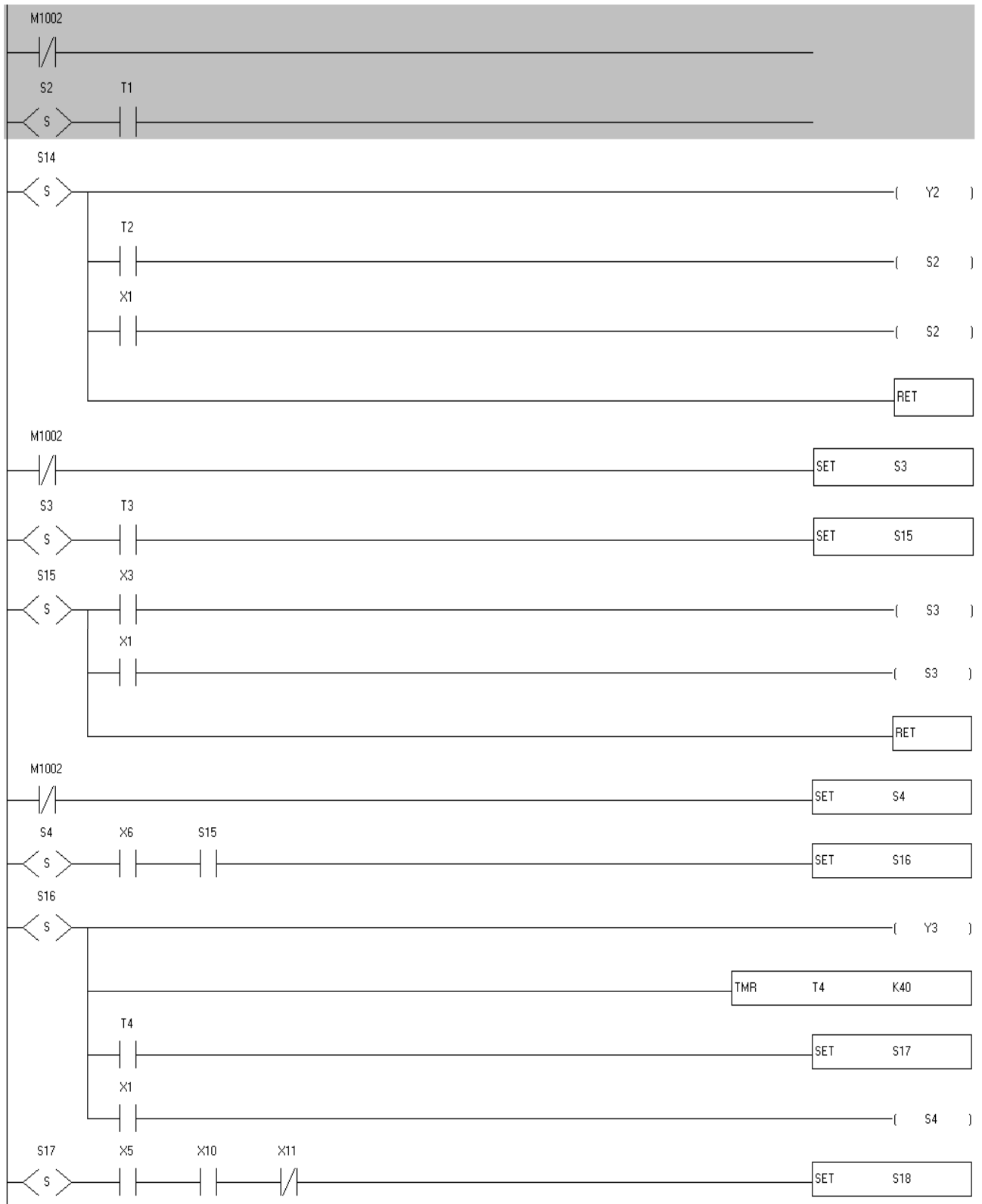


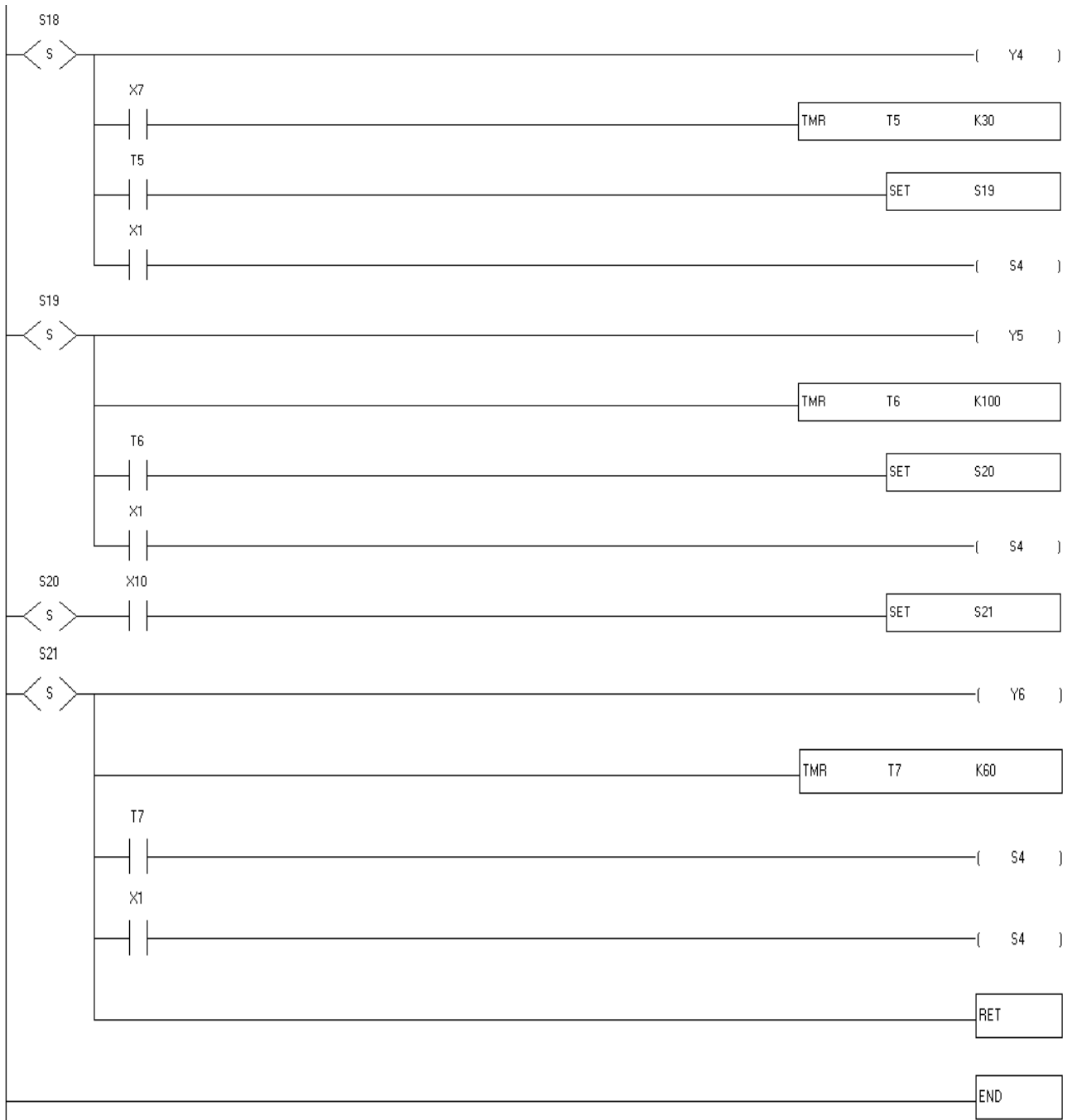




5.6 Plc Code







6

Chapter six Experimental Result & Recommendations

- 6.1 Introduction**
- 6.2 Experimental Result**
- 6.3 The Practical of Project**
- 6.4 The Cost of Project**
- 6.5 Recommendations**

6.1 Introduction

This chapter provides experimental result and, some recommendations from the work team for this project. In this chapter we are listing some goals hope to be accomplished or_ at least_ under attention

6.2 The Practical of Project



Figure 6.1 : practical of project

6.3 The Cost of Project

Number	Name of Component	Cost (JOD)
1	Shredder	850
2	Motor of Shredder and Gear	80
3	Mixer	170
4	Motor of Mixer and Gear	80
5	Cylinders	65
6	Actuators	50
7	Over loads # 2	11
8	Contactors # 2	11
9	Plc delta	150
10	Transformer 220/24	7
11	Wires and pneumatic pipe	8
12	Circuit breakers # 2	5
13	Electrical cabinet	25
14	Switch's and lambs and Clemens	27
15	Limit switches	18
Total cost		1557

Table 6.1: the cost

6.4 Experimental Result

We made some experiments on parts of our project and these are some of results:

Shredder stage: we are putting boxes of cartoon that maximum dimension 20*15 cm² in shredder and cutting the cartoon by cutting blade to small pieces.

Mixer stage: after we put the cartoon in shredder and cutting it, the small pieces cartoon will be pass to container of mixer and add the water in mixer, and after added the water for 3 min we are putting the additional metal (الجفت) for 5 second, and after complete the mixing we going to the next stage

Compress stage: After the mixing stage and complete the mixing operation, we will compress the mixing metal by three cylinders.

6.5 Recommendations

1. To study the possibility of introducing the SCADA and LABVIEW in the programming of these machines
2. The development of the project by adding the animation to control
3. To study the possibility of HMI programming of these machines

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Researchers: Kevin Johnson, Kelly Costello, Spencer Baker, Elizabeth Mitchell, Jeff Vomacka, and Miles

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