

# ANALYSIS OF BRICK ASEPTIC PACKAGE FILLING PROCESS

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## ABSTRACT

The aim of the project is to analyze brick aseptic package filling machine. The project includes the detail analysis of the problems regarding the machine and improvising the same which was suggested. The machine is the Tetra Pack Brick Aseptic Filling Machine series TBA/19, this machine produces aseptic packages (200ml pocket pack Maaza). The detailed analysis of the machine is done and the same is produced and also implement some designs of the automatic carton packaging system in the project. This machine is high speed filling and packaging it produces 7500 packets per hour and 125 packets per minute. It has an advanced technology used to produce 2 packets in 1sec and High food safety (unique aseptic process). The efficiency plays an important role in this machine.

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## INTRODUCTION

Before arriving at the filling machine, the product is treated so that it is freeform all micro-organisms able of multiplying, which means that it is commercially sterile. The piping is sterilized before conveying any product, which means that the transfer to the filling machine takes place under aseptic conditions. The packaging material is sterilized by the sterile system of the machine. The sterile system also creates a sterile surrounding in which aseptic packages are produced. Aseptic processing is the process by which a sterile aseptic product (typically food or pharmaceutical) is packaged in a sterile container in a way that maintains sterility. Sterility is achieved with a flash-heating process (temperature between 195° and 295°F (91° to 146°C)). The aseptic packages are typically a mix of paper (70%), polyethylene (LDPE) (24%), and aluminium (6%), with a tight polyethylene inside layer.

## ASEPTIC PACKAGE:

The aspect packaging of food, it is broadly old to sterilize a food and a container therefore in separate steps and then fill the container with the food. In one case, a container is sterilized by steam, applied externally thereof with the container open to atmosphere, and such

treatment is continued during filling with sterilized food; and in another case, the container is sterilized by immersion in a sterilizing liquid and then preserved out of contact with the atmosphere until it is filled and capped. Both methods involve disadvantages, the one requiring live steam treatment even during filling, and the other requiring one or more immersion baths of a size capable of immersing a large number of containers followed by removal of the sterilizing liquid. So far as is known, no one discloses the aseptic packaging of foods as taught herein.

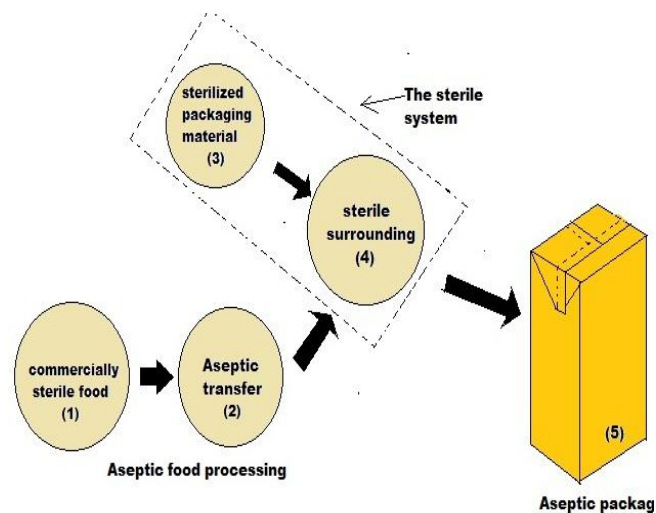


Fig 1: Aseptic food processing

### STERILE SYSTEM:

A chemical sterilizer system for sterilizing items by vaporizing a liquid chemical sterilant in a sterilizing chamber. Pre-evacuation of the sterilize chamber enhances the sterilizing activity. Sterilant is injected into the sterilizer chamber from a prefilled shot chamber. Subsequent to the exposure period, spent sterilant is condensed and fresh air is pumped into the sterilizer chamber from a vacuum pump. An automated valving system uses a minimal number of three-way valves and one or more two-way valves to control the fluid flow functions in the sterilization cycle.

### PROCESS BLOCK DIAGRAM:

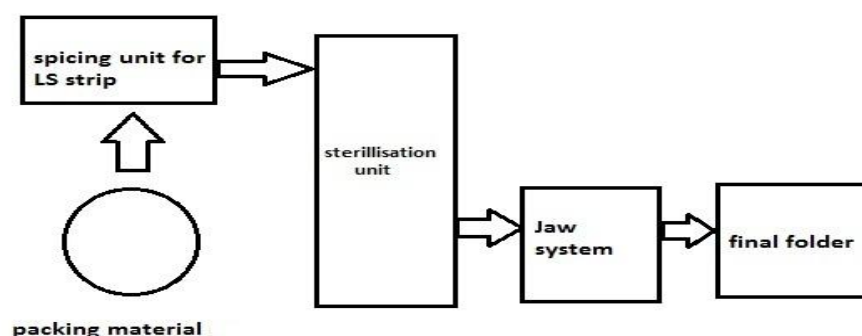


Fig 2: Process block diagram

Packages of this sort are produced on fully automatic Filling Machines, wherein a continuous vertical tube is formed from the web-fed packaging material; which is sterilized by applying a chemical sterilizing agent such as a hydrogen peroxide solution, which, once sterilization is completed, is removed, e.g. evaporated by heating, from the surfaces of the packaging material; and the sterilized web is maintained in a closed, sterile environment, and is folded and sealed longitudinally to form the vertical tube. The tube is then filled downwards with the sterilized or sterile-processed pourable food product, and is fed along a vertical path to a forming station, where it is gripped along equally spaced cross sections by two pairs of jaws, which act cyclically and successively on the tube, and seal the packaging material of tube to form a continuous strip of pillow packs connected to one another by transverse sealing strips. Pillow packs are separated from one another by cutting the relative sealing strips, and are conveyed to a final folding station where they are folded mechanically into the finished, e.g. substantially parallelepiped-shaped, package.

### PACKAGING WEB:

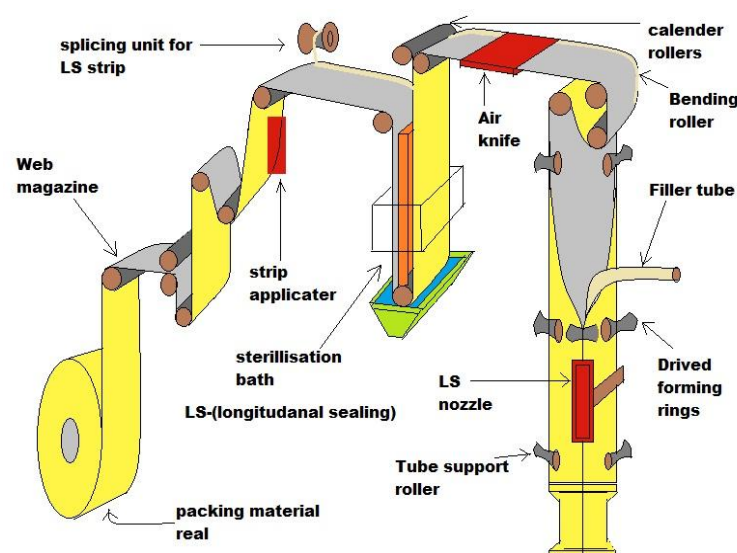


Fig 3: Packaging web formation

The invention relates to a packing material in the form of a web intended for aseptic packages. The packing material is a laminate with the side of the packing material web which is intended to form the inside of the packages consisting of a thermoplastic layer, preferably polyethylene. This polyethylene layer has a sterile surface and is covered in turn by a thin plastic film which completely covers the polyethylene layer and maintains its sterility. On the conversion of the packing material to packages, the thin plastic film is separated from the surface-sterile polyethylene layer, whereupon the remaining packing material is formed to a tube which is filled with sterile contents so as to form closed packing units.

The present invention relates generally to a packing material for aseptic packages. More specifically, the present invention relates to a web of packing material which is provided with an easily separable coating layer for maintaining one surface of the packing material in a sterile condition. The inside of the packing material after tube formation has to be sterilized, so that the sterile contents should keep their sterility in the package, and this is done by heating of the inner plastic layer of the tube with the help of a heater introduced into the tube

or by a chemical process, whereby the plastic inside is put into contact with a sterilizing agent, preferably hydrogen peroxide.

The most common process is, however, that a combination of chemical and thermal sterilization is used. In such a process, the web is brought into contact first with hydrogen peroxide by being dipped into a bath, and the tube formed is subsequently heated by a heater introduced into the tube, so that on the one hand the hydrogen peroxide decomposes and vanishes, and on the other hand the inside of the tube is fully sterilized. The plastic inside of the packing material is actually sterile when the plastic coating is applied with the help of an extrusion process, since the plastic in the coating operation has a temperature of approx. 200° C. that is a temperature which substantially exceeds the temperature at which bacteria and microorganisms can stay alive. However, immediately after cooling, the packing material produced comes into contact with air contaminated by bacteria, so that the plastic coating, sterile at the moment of manufacture, is infected. Thus, the plastic surface of the packing material, which is intended to form the inside of the packing container produced, has to be sterilized when the packaging takes place.

## IMPLEMENTATION

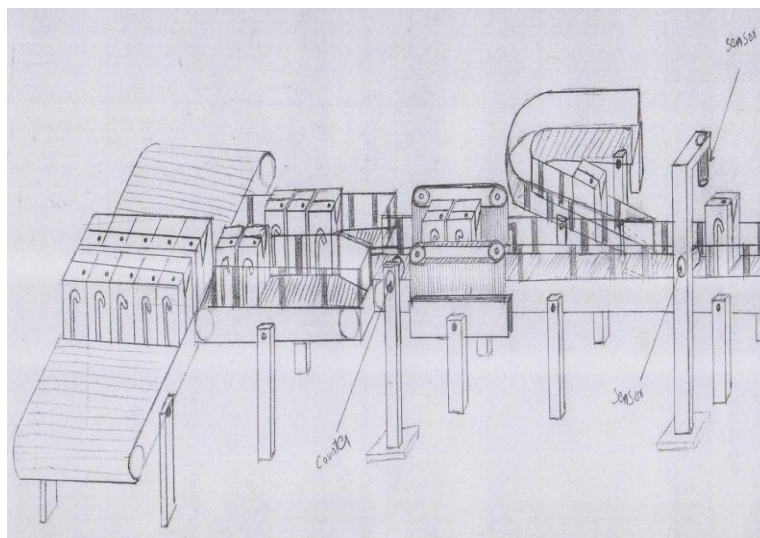


Fig 4: Automatic Rejection process

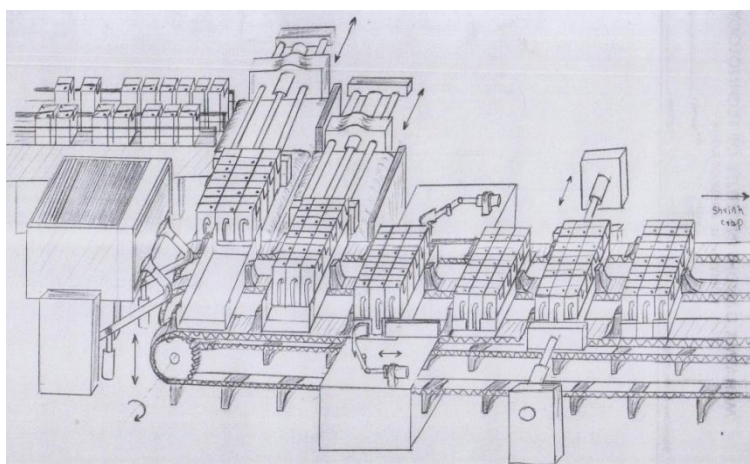


Fig 5: Automatic card board packaging system

This above two processes contains the automatic rejection and card-board packaging. Above process is installed between straw applicator and the shrink wrap. This process is going to increase the production rate and reduce the packaging time.

### AIR DIAGRAM DEVELOPMENT

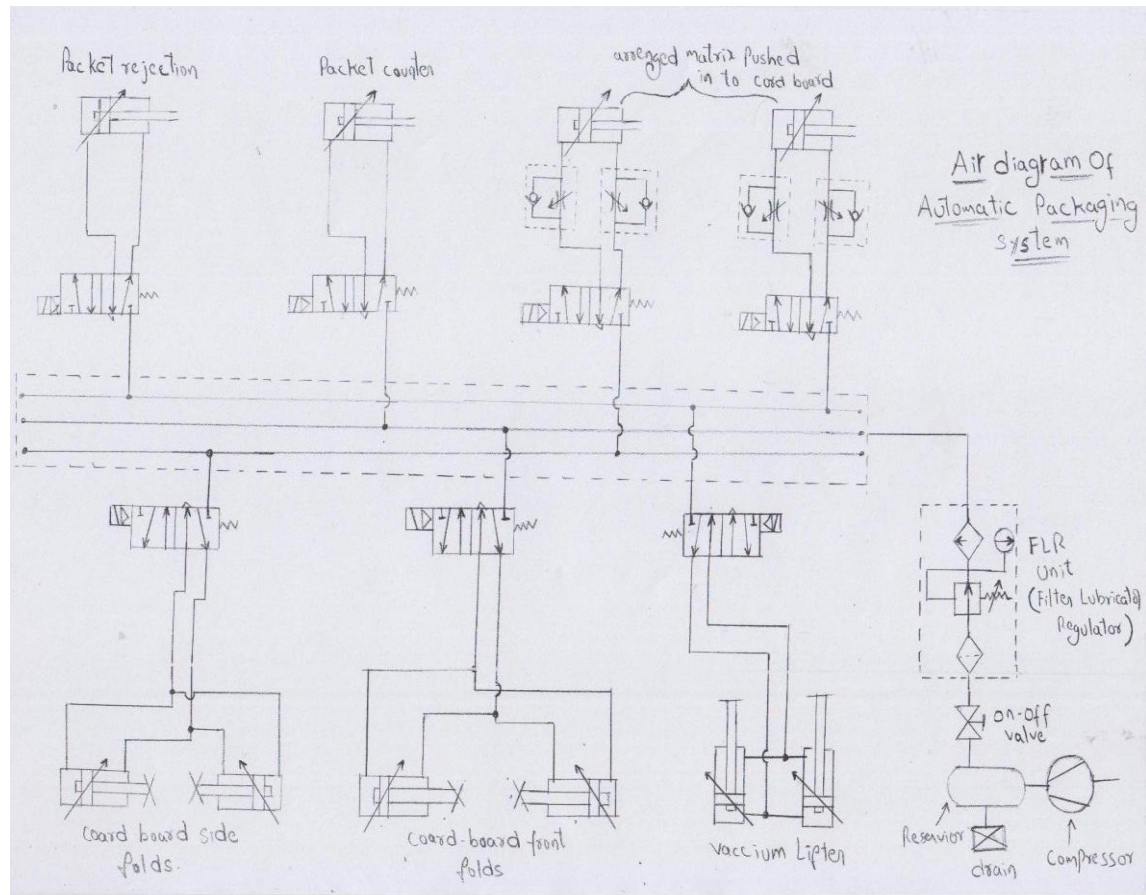


Fig.6 Air supply system for APS (automatic packaging system)

### PACKET REJECTION PROCESS DEVELOPMENT

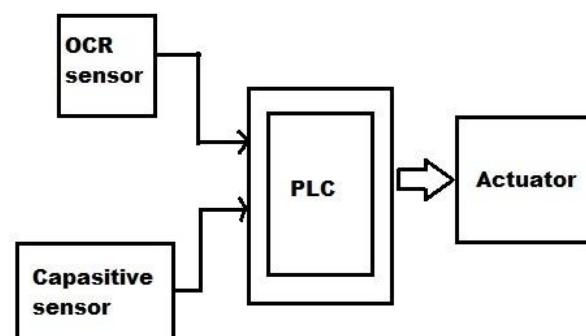


Fig 7: Blok diagram of rejection process

Packet rejection unit rejects the tetra pack which has no straw, no manufacturing date and price. If date or price is not read on the packet, it will be rejected. This unit contains the two different sensors that monitor every packet arriving in the unit. One of the sensors detects the straw and other one detects the date and price. If any one of the sensors is not detected flapper is moved and rejects the particular packet. After packet is come out the final folding unit, the top of the packet sprayed price and the manufacturing date with the help of spray unit. Further the package is moved in to the straw applicator; in this place straw is stacked side of the packet. Here what is the matter is some of the packets are missing straw and price and mf date those packets are picked by hand and again placed it into the particular process by this way time is wasted. The above specifying rejection process is reject those packets automatically.

### **OPTICAL CHARACTER RECOGNITION (OCR) SENSOR DEVELOPMENT**

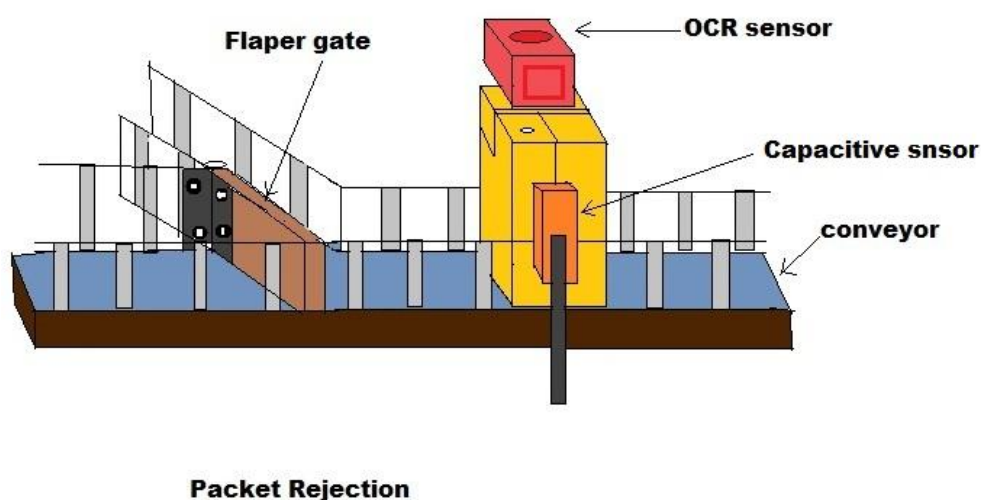


Fig 8: 3D view of packet rejection process

Optical character recognition, usually abbreviated to OCR, is the mechanical or electronic conversion of scanned images of handwritten, typewritten or printed text into machine-encoded text. The function of OCR is that the character images can be scanned through scanner and then recognition engine of the OCR system interprets the images and turn images of handwritten or printed characters into ASCII data (machine-readable characters).

The technology provides a complete form processing and documents capture solution. Usually, OCR uses a modular architecture that is open, scalable and workflow controlled. It includes forms definition, scanning, image recognition capabilities. An optical character recognition system for identifying typewritten characters and converting such to standard code for transmission. To achieve recognition of a character, the character, as it is scanned, is recorded in a corresponding array in memory and the memory address for each scan coordinate is then modified to correspond with the virtual character center.

This coordinate centre of the character is derived by inspection of the scanning array in parallel with the memory storing pass to determine the two adjacent all white rows and columns bounding the character.

The coordinate center is then calculated by dividing the bounded row and column increment by two. The recognition of the character pattern is then performed by a set of Boolean discriminates selected to achieve the highest probability of in - character hits against a lowest probability of misses.

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## PHOTO SENSOR

A photo sensor is an electronic component that detects the presence of visible light, infrared transmission (IR), and or ultraviolet (UV) energy. Most photo sensors consist of semiconductor having a property called photoconductivity , in which the electrical conductance varies depending on the intensity of radiation striking the material.

A photoelectric sensor, or photo eye, is a used to detect the distance, absence, or presence of an object by using a light transmitter, often infrared, and a photoelectric receiver. They are used extensively in industrial manufacturing. There are three different functional types: opposed (through beam), retro reflective and proximity-sensing (diffused).

## PACKET COUNTER

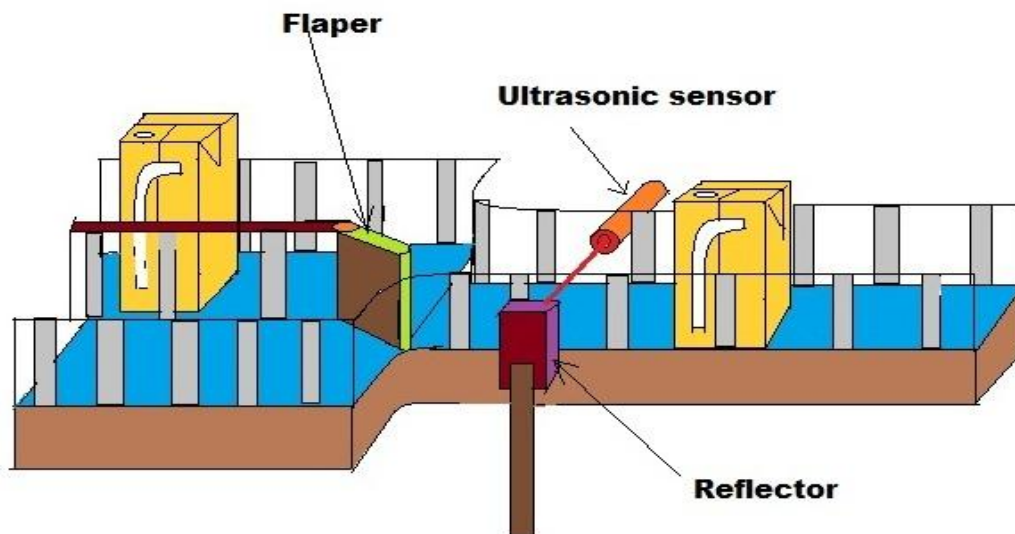


Fig 9: 3D view of packet counter

Here the packet is counted and at the same time packets are arranged in the form of a 3x9 matrix. In this formation of the matrix, it is easy to push the packets in to the card board. Here the sensor contains the transmitter and receiver; the sensing mode is retro reflective method

A retro reflective arrangement places the transmitter and receiver at the same location and uses a reflector to bounce the light beam back from the transmitter to the receiver. An object is sensed when the beam is interrupted and fails to reach the receiver.

### HOW SENSOR WORKS

The photo sensor generates the infrared or ultraviolet light. In this place, sensor unit detection and count the packets, the packets are moved across the sensor, transmitter produced light beam is interrupted and fails to reach the receiver, this time sensor is inactive and count the packet. Also this unit supports one line in multiline with the help of the flapper. The pneumatic cylinder is operated by the flapper. Count is reached certain point processor sends signal to the cylinder, cylinder is activated flapper is moved left side packages are moved along the right conveyor and the next count point reaches the flapper is moved right side, packages are moved along the left conveyor. By this way of operation we can easily arrange the packages in to matrix form and easily push the packages in to the card board.

### AUTOMATIC CARTON PACKAGE SYSTEM

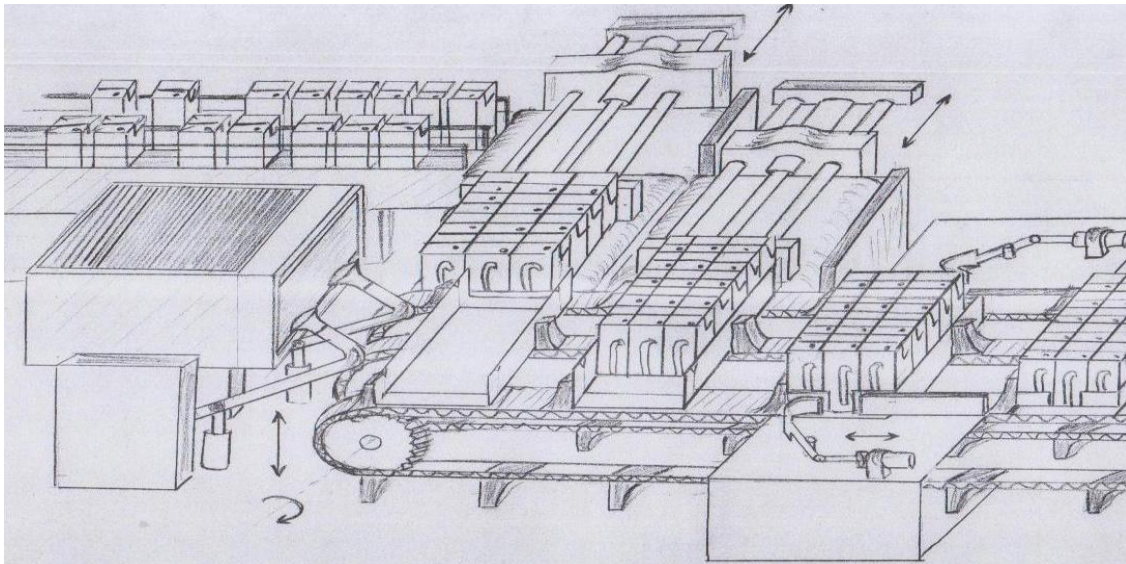


Fig 10: carton packaging system

Carton is the name of certain types of containers typically made from paperboard which is also sometimes known as cardboard. Many types of cartons are used in packaging. Sometimes a carton is also called a box.

Packages are arriving this unit form like a 3x9 matrix. How the matrix formed? Here coming packages are in Column manner there is a flapper is placed above the packages, the flapper is hold the packages when the 3 rows reached. By this way matrix is formed. Pneumatic cylinder or servo drive is used to push the formed matrix in to the carton.

There is slotted type conveyor, cartons are placed in to the slots with the help of vacuum grippers, when the matrix is formed carton is placed in the slot both operations are occurred at a time in the result arranged matrix is placed in to the carton. Further the carton is moved to carton flap folding unit, here both sides of the conveyor there is a fixed guides carton is moved along the guide first flaps are folded and the remaining flaps are fold with the help of

the pneumatic cylinders. After folding the flaps some glue is spray on the surface of the flaps result Carton is sealed here no required any staples. Further completed carton package is moves to the shrink wrap.

## PACKAGE PUSHER

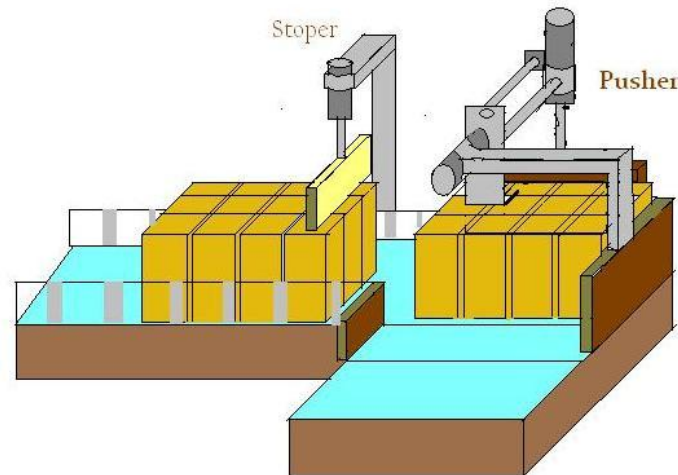


Fig 11: package pusher arrangement

This unit contains three pneumatic cylinders and the vision sensor. This unit is worked based up on the vision sensor, the vision sensor monitors the packages when the required matrix is formed the stopper stops immediately the remaining packages. At the same time pusher actuators push entire matrix in to the carton. These operations are done step by step. The 4bar pressure is required to operate the actuators.

## VISION SENSOR

Photoelectric Vision Sensors are optical multi-pixel sensors with a pass/fail PNP output. Individual virtual detectors can be logically linked or grouped for evaluation of different objects with several characteristics for inspection. Typical applications photoelectric Vision Sensors include Material handling, Packaging, Food processing, Transportation.

## CYLINDER CALCULATIONS

The force exerted by double acting pneumatic cylinder on outstroke can be expressed as. The force exerted on in stroke can be expressed as

$$F = p \pi (d_1^2 - d_2^2) / 4$$

Where

$d_1$  = full bore piston diameter (m)

$d_2$  = piston rod diameter (m)

The force exerted from a double acting pneumatic cylinder with 4 bar full bore diameter of 90 mm (0.09 m) and rod diameter 20 mm (0.02 m) can be calculated as

$$\begin{aligned} F &= p \pi (d_1^2 - d_2^2) / 4 \\ &= (4^5 \text{ N/m}^2) \pi [(0.09 \text{ m})^2 - (0.02 \text{ m})^2] / 4 \\ &= 2.417 \text{ KN} \end{aligned}$$

### Rod stresses:

Due to the forces acting on the cylinder, the piston rod is the most stressed component and has to be designed to withstand high amounts of bending, tensile and compressive forces. Depending on how long the piston rod is, stresses can be calculated differently. If the rods length is less than 10 times the diameter, then it may be treated as a rigid body which has compressive or tensile forces acting on it. In which case the relationship is:

$$F = A\sigma$$

Where:

$F$  is the compressive or tensile force

$A$  is the cross-sectional area of the piston rod

$\sigma$  is the stress

### In stroke and Outstroke:

Although the diameter of the piston and the force exerted by a cylinder are related, they are not directly proportional to one another. Additionally, the typical mathematical relationship between the two assumes that the air supply does not become saturated. Due to the effective cross sectional area reduced by the area of the piston rod, the in stroke force is less than the outstroke force when both are powered pneumatically and by same supply of compressed gas.

$$F_r = PA_e$$

$F_r$  is the resultant force

$P$  is the pressure or distributed load on the surface

$A_e$  is the effective cross sectional area the load is acting on

### Outstroke:

Using the distributed load equation provided the  $A_e$  can be replaced with area of the piston surface where the pressure is acting on.

$$F_r = P(\pi r^2)$$

Where:

$F_r$  Represents the resultant force

$r$  Represents the radius of the piston

$\pi$  Is pi, approximately equal to 3.14159.

## CONCLUSION

Now the above implementation process in the company does the manually. The filling machine produces 7500 packets per hour; the output of the shrink wrap can't reach this figure because the packages are arranged manually. The automatic carton packaging system is reduced manufacturing lead time and increases the output production. ACPS (automatic carton packaging system) is occupying very less space as compared to manually packaging processing. The Packaging Line Monitoring system (PLMS) gives you a completely automatic alarm system. By applying the PID controllers to control the process parameters. The controlling of the above system is PLC and SCADA based.

## FUTURE SCOPE OF THE PROJECT

The project has been found very useful to the company it reducing the manufacturing lead time and increases the product. Therefore, by performing these simple experiments and based upon the results obtained, slight modifications in the drive mechanisms resulted in saving of energy and money likewise.

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