

Review of Selection of Mechanism for Automation of Food Packaging

¹S. R. Sobhrajani, ²P. S. Puranik, ³B. M. Garala

¹M.E. (Cad/Cam)²Head, Mechanical Engineering Department ³M.Tech(Mech. Engineer)

^{1,2}Atmiya Institute of Technology & Science³Industrial Automation Services

¹sunil061289@gmail.com²pspuranik@aits.edu.in³bgarala@yahoo.com

Abstract—All major industries create wealth but if there is one industry that plays a unique role by way of both creation of wealth through a wide range of manufacturing activities and also by way of preserving the wealth or value created by many, many other industries, it is packaging - primary as well as secondary. The review deals with need of selecting mechanism for automation of food packaging for packing strips of snack packets in carton. The problem comes under the category of secondary packaging or end of line packaging where a mechanism has to be selected for stacking primarily packed strips of packets in carton. The best suited mechanism as per DFA/DFM is to be selected. The selection of mechanism depends on different parameters and feasibility of it for particular task.

Keywords- Mechanism, automation, packaging

I. INTRODUCTION

All major industries create wealth but if there is one industry that plays a unique role by way of both creation of wealth through a wide range of manufacturing activities and also by way of preserving the wealth or value created by many, many other industries, it is packaging (primary as well as secondary). It is however understood that in today's scenario, where food processing has become very important, it is imminent to understand, classify and promote the food processing & packaging equipment sector, worldwide. The technologies available in India in the agro-food processing equipment sector are still in the learning curve when compared to the developed countries. There has been a net inflow of equipments from Europe, especially from Sweden, Denmark, Germany, and Czechoslovakia and also from Australia.

In India[1], packaging machinery manufacturers find most of the demand for their products in the food processing sector. Approximately 50% of the packaging machinery and materials produced is absorbed by the food processing sector, personal products (10%), the tea and coffee industry (10%), and industrial products account for the remaining portion of the demand. Another factor, which has provided substantial stimulus to the packaging machinery industry, is the emphasis on the rapid growth of exports. The export policy has been placing emphasis on value-addition. With this, the need for adopting better packaging methods, materials and machinery to ensure quality, has become very urgent for Indian food products in the international market, which demands high quality standards.

Various packaging equipment [1] is currently being imported by the Indian food packaging industry. No canning lines are manufactured in India. All cans presently used by a few beer manufacturers and soft drink companies are imported. Technology, price, credit, delivery, and performance standards are critical factors that determine

whether packaging equipment can be sold in the Indian market. Due to intense competition in the end-user market, the cost of equipment and low running cost remain one of the primary factors that influence the sale of the packaging equipment. Upgrading would be another extremely important factor in the buying decision of the end-users. The Indian exporter would need to have a clear plan regarding the provision of upgrades and add-ons to their products, especially those required for capacity expansion. After-sales service is also a key concern of buyers.

The process of food packaging has been broadly categorized into two types:

- Primary packaging is the material that first envelops the product and holds it. This usually is the smallest unit of distribution or use and is the package which is in direct contact with the contents.
- Secondary packaging is outside the primary packaging, perhaps used to group primary packages together, used for bulk handling, warehouse storage and shipping. The most common form is a palletized unit load that packs tightly into containers.

This kind of packaging is also known as 'end of line' packaging. The end of line packaging is when the "formed, filled and sealed" product is to be further packed into a carton/container/cardboard box which is done at the end of line. 'End of line' packaging or 'secondary packaging' play a vital role in packaging industries. Many special purpose machines have been patented for stacking/sorting of primarily packaged food in cartons/cardboard boxes.

II. SELECTING/DEVELOPING A SYSTEM FOR AUTOMATION OF HIGHLY LABOUR INTENSIVE PROCESS

S. Davis et al., [2] researched and developed an automated system for the assembly and packaging of triangular sandwiches. This process was highly labour intensive with little automated machinery available. They analyzed the manual production techniques and developed a machine which completes the final assembly of the sandwich and then cuts and packages it into a plastic container for dispatch.

They suggested that when designing automation for food assembly/packaging tasks it is often useful to study how the production is accomplished manually, although direct duplication of human operations is unlikely to lead to the ultimate automated solution.

Also they suggested that while designing an automated system for any food assembly/packaging tasks the current state of automated systems for the same should be studied. The current manual processes can then be analysed to provide an initial starting point for the design of an automated system. After analysis of current manual

processes, they can be divided into individual specific functions and then an automated system for each of the function can be developed one by one.

They suggested a robot based approach for designing a fully automated system which allows each of the specific functions to be extensively tested before construction of a dedicated automation prototype. Before the prototype for fully automated system is constructed each of the individual processes can be tested using a robot. This allows assessment of each task without the expense of building the full prototype. Also it allows many solutions to be tested rapidly, often within days, enabling the optimal solution to be identified.

According to a white paper 'Selecting a case packing system' by Fallas Automation [6], a case packer for the automation of secondary packaging problem can be selected based on:

- Product type
 - 1) Rigid - chipboard cartons of cookies and candy or tubs of detergent.
 - 2) Semi-rigid - over-wrapped trays of cookies, stand-up pouches of coffee, or packs of shingled sliced cheese.
 - 3) Flexible - bags of candy or pouches of ketchup.

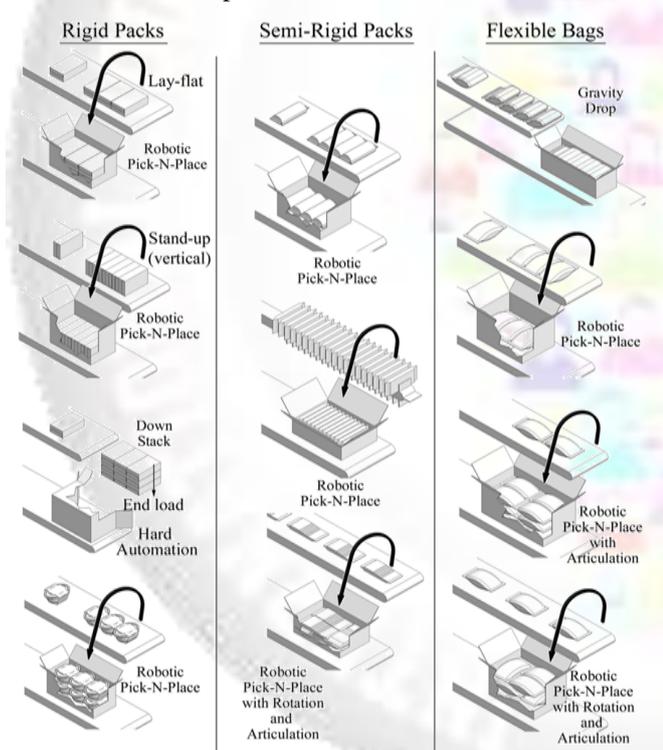


Figure 1: Case Packer Selection Based on Product Type

All three types of product require different approaches. Automatic case packing started with the easy applications, i.e. rigid cartons. The original non-robotic case packers were referred to as hard automation machines and are still in use today, but because of reduced flexibility, robotic pick and place case packers are taking over. The new robotic pick and place case packers combine high speed with more flexibility and ease of change-over.

Semi-rigid articles are not always suited to hard automation due to the nature of the product and may be

advisable to go with robotic pick and place solutions. Flexible products require a totally different approach, often with sophisticated in feeds, which conveys the products without any pressure. The simplest case packer is the gravity drop packer where a pre-counted collation is fed into a cradle, known as bomb-bays, which open up and deposit the layer into the shipping case, which is located directly below the bomb-bays. The main problem with gravity drop packers is the inability to do complex pack patterns. If the pack patterns are outside the scope of the simple gravity packer, then a robotic pick and place case packer is required. Also the gravity packer is not recommended for extremely delicate products.

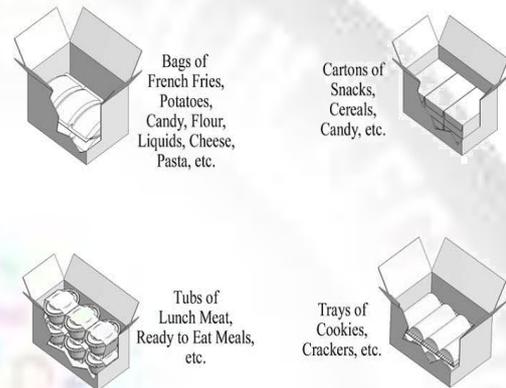


Figure 2 : Lay flat pack patterns (rigid, semi-rigid and flexible)

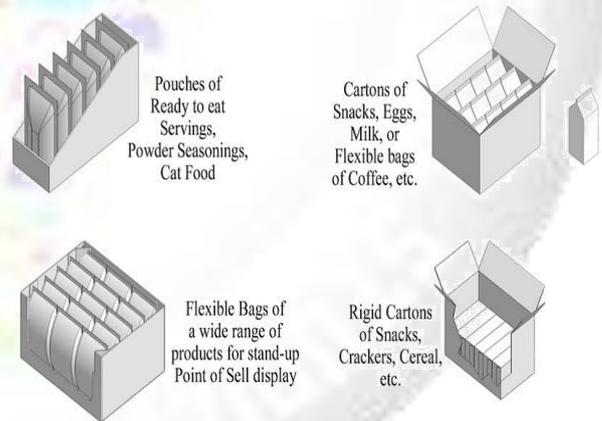


Figure 3: Vertical pack patterns (rigid and flexible)

- Pack Pattern
 - 1) Lay- flat packs (rigid, semi-rigid and flexible bags)
 - 2) Vertical packs (rigid and flexible bags)

It's probably true to say that a ROBOTIC PICK N'PLACE packer can load all those products shown in Fig. 2. However, the FLEXIBLE bags of Pasta/Candy in the simple pattern can be done at lower cost and greater simplicity with a gravity drop case packer. As the complexity of the pack increases then the Robotic is the way to go.

As shown in Fig. 3, at first sight all the packs look similar because all the packs are VERTICAL in their cases.

Generally speaking, those products which can stand up on their own (i.e. rigid cartons and stand-up flat bottomed doypacks) are much easier to load vertically than flexible pouches.

The paper helps for the selection between the devices available for various types of pack patterns, thus helping in developing automation system. The devices available are: robotic two-axis or multi axis pick and place case packer, gravity drop case packer and hard automation case packer.

III. DIFFERENT MECHANISMS FOR DISCRETE AUTOMATIC PACKAGING APPLICATIONS

The options available are: 1. Slider-crank mechanism 2. Direct piston actuation 3. Gear & rack actuation 4. Cam actuation 5. Screw actuation. The best suited mechanism as per DFA/DFM is to be selected. The selection of mechanism depends on different parameters and feasibility of it for particular task.

Granelli and Fulvio [3] developed a pick and place device for containers into packages or boxes. It comprises of a frame; feeding conveyor means for the containers; feeding transport means for said packages; reciprocating means comprising a first arm rotatably pivoted to the frame and a second arm glidingly supported by the first arm; picking means of the containers; cam means fastened to the frame and having at least one cam for guiding the cam follower fastened to the second arm fit to reciprocally rotate between a picking condition where the picking means hook a plurality of containers supported by the feeding conveyor means and a releasing condition of the containers in which the latter are released inside the related package supported by the feeding transport means.

The cam has a quite reversed 'u' shape so as to allow the picking means to translate along the same vertical line in correspondence of the picking condition and releasing condition so picking and placing respectively the containers at different or equal heights. The invention relates to plants for packaging inside boxes or grouped containers.

Drawbacks of known devices:

- 1) Can pick and place only at same level
- 2) Cannot pick and place containers of different heights

Objectives of innovation:

- Can remove the drawbacks of known devices and invent a cheap device to make, to install and to upkeep.

Carimando and Angelo Eboli [4] developed an automatic system for filling palletised boxes with pre packed goods equipped with a system for the feeding and positioning of the pre packed goods, an apparatus for the feeding and positioning of palletised boxes and a programmable Cartesian handler which permits the wished for movement of the products thus placing them inside the containers, which, according to the needs can be presented in the filling station on the same type of fixed dimension pallet as a single box or as two boxes placed side by side on the pallet or four boxes on the pallet.

Application:

- This invention regards an automatic filling system, in palletised boxes, which are of the same size as a pallet,

in progressive layers of pre packed goods in cushion packs or boxes of pasta, legumes, rice, potato crisps, sweets etc.

Drawbacks of manual filling:

- 1) Less efficiency of plant
- 2) Manpower requirements
- 3) Low cycle time as the process is manual

Meneghetti and Italo [5] developed a machine suitable for packing packets of sugar meal and the like that are displaced at first in rows and then in strata and finally stacked on a wooden pallet. The packets are disposed with the main dimension oriented in vertical direction for getting a better mechanical resistance of the bottom packet stratum by means of a half rigid cardboard sheet for making better the stacking of strata and the load stability.

Application:

- The above invention refers to the field of machines for carrying out the packing of paper, cardboard packets, plastic packets and the like onto a pallet.

Drawbacks of present machines:

- Loading of the pallets with packets in horizontal direction which leads to ungluing and tearing in the packets of the lowest stratum.

Objective of invention:

- Aim of fulfilling a packing machine for the above application that allows stacking of the packets to the strata in vertically that allows to get a load applied onto the lowest strata of the packing greater than the load obtained with conventional machine.

The invention also proposes the fulfilment of a machine with high productivity that allows changing easily the dimensions of strata for getting pickings of wished dimensions.

IV. CONCLUSION

Such packaging demands lead to the development of special purpose machines (SPMs) and to meet these demands or to develop such SPMs special mechanisms have to be developed or chosen among available mechanisms for automatic packaging of food after it has been processed and primarily packed.

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