

INDUSTRIAL PHARMACY-I**UNIT III-CAPSULES****CLASS:17****TOPIC Filling, finishing and special techniques of formulation of hard gelatin capsules**

Filling of Hard Gelatin capsule:The several type of filling machine in use in the pharmaceutical industry have in common the following operation.

1. Rectification: The empty capsule are oriented so that all point the same direction, i.e body end downward. The capsule pass one at a time through a channel just wide enough to provide a frictional grip at cap end. capsule will always be aligned body end downwards regardless of which end entered the channel first.
2. Separation of cap from bodies: This process depend on the difference in diameter between the cap and body. The rectified capsule are delivered body end first into the upper portion of split brushing .A vacuum applied below pull the bodiesdown into the lower portion .the diameter of cap is too large to allow them to bodies into the lower portion
3. Dosing of fill material: various method like Auger principle, vibratory fill principle, piston- Tamp principleare employed for filling
4. Replacement of cap and ejection of filled capsule: The cap & body bushing portion are rejoined. Pins are used to push the filled bodies up into the caps for closure and to push the closed capsule out of the bushing. Compressed air also used to eject the capsules.

Fillingprinciples:

- a) Auger fill principle: The empty hard gelatin capsule are taken from hopper to the rectifying unit. the rectifier descend the the capsule such that caps are turned up and bodies are down.
5. When vacuum is applied capsule from rectifying unit are placed one by one in the filling ring kept on rotating mode. The ring consists of upper and lower ring having cavities for for placing capsule. When all the cavities of ring filled, the upper ring is lifted which causes separation of bodies from caps.
6. The lower ring is rotate with constant speed and the hopper containing powder is heldover the ring. The auger drive thepowdered drug into the capsule bodies. After bodiesare completely filled ,the hopper is set aside & rotating ring is stopped. Now ring holding caps are placed over ring holding the bodies which are then joined together.

b)Vibratory fill principle: in this type of machine ,the feed is placed in the feed hopper& capsule bodies are pass under it. A perforated resin plate (connected to vibrator) is placed in feed

hooper. Due to vibration of resin plate the powder flows freely through the pores into the capsule bodies.

Pins are present below the capsule bodies for support. Capsule bodies are filled when the pins are pulled down. but when there is overfilling, The capsule bodies are pushed up to reach the level of disc plate and excess the powder is forced out by scrapping

c)Piston-tamp principle: automatic capsule filling machines work on piston-Tamp principle by using piston or Tamping pins. The piston tapmps alter the shape of powder by compressing the powder to form plugs (slugs). These plugs are transferred into empty capsule shell with the application of little pressure. This piston pump principle can be explained by two type of machine

- i) Dosing-disctypemachine
- ii) Dosatorypemachine

d)Vacuum fill principle:The machine consist of an open ended cylinder. The upper end of this cylinder is fitted with piston. The lower end (open end) is placed in bulk powder. Vacuum is applied and the piston is moved upward by sucking the specific amount of powder,this result in filling of the cylinder, the powder is filled up to the piston height and the vacuum is held until the piston is positioned over empty capsule body. Now the vacuum and pressure in the form of compressed air is applied over the piston to transfer the powder into the capsule body.

CAPSULE FILLING The hard two – piece capsule can be filled with materials that have a wide range of physical properties.

Types of dosage forms for filling into hard capsules :- Solid Semi – Solid Liquid

- Powders
- Granules
 - Pellets
- Tablets
- Paste
- Thermo softening mixtures
- Thixo-tropic mixtures
- Non – aqueous solutions
- Oily liquids

• Powdered formulationsoften require excipients such as fillers, lubricants, glidants, to facilitate their encapsulation. This influences the rate of release. Addition of wetting agents is needed in case of hydrophobic drugs. • In case of powders that have a chance to liquefy , adsorbents like colloidal silica, magnesium carbonate must be used

Capsule Filling Machines

HANDOPERATED CAPSULE FILLING MACHINE

SEMI – AUTOMATIC CAPSULE FILLING MACHINE

AUTOMATIC CAPSULE FILLING MACHINE PUNCH METHOD

Hand Operated CapsuleFilling Machine Pharmacists that prepare capsules on a regular or extensive basis may use hand operated capsule machines.

These machines are also called Feton capsule filling machine. The machine has the following parts :-

- Capsule bed with 200- 300 holes
- Loading tray • Powder tray
- Pin plate with 200- 300pins
- Sealing plate with rubber top
- Lever

- Cam handle
- Tighten the cam handle and placed lever in the position. The machine is ready for capsule filling.
- Place the empty capsules onto the loading tray with the body end of the capsules oriented downwards and the cap oriented upwards.
- Placed the filled loading tray over the capsule bed.
- The cam handle is used to lock the body part of the capsules at their place while of the cap of the capsule is separated.
- Powder tray is placed in position, and the powder is placed on to the surface. Using a spatula, spread the powder uniformly to fill the bodies of the capsules. Remove the excess powder.

Working of Hand Operated Capsule Filling Machine

- The pin plate is then lowered to press the filled powder. Again raise the pin plate.
- Remove the powder tray after filling.
- The cap holding plate is then repositioned over the body.
- The capsules are rejoined then by manual pressure.
- Remove the loading tray and collect the filled capsules



Hand Operated Capsule Filling Machine

- semi Automatic CapsuleFilling Machine Semi automatic capsule filling machine are employed when smaller batches sizes are required. Production capacities can range from 6000 – 8000 capsules per hour. Semi automatic capsule filling machines always require an operator in attendance at all times of the operation. Semi automatic machines use the Auger Filling Principle.
- The machine hasthe following parts :-
 - A. Capsule fill
 - B. Stirrer
 - C. Auger

D. Capsule body holder

E. Turn table

F. Capsule ring • Peg ring • Capsule hopper • Turntables • Rectifier

Capsule ring Auger Peg Ring

• There are 3stages of how the capsule filling machine works :-

1. Orientation of capsule :- The capsule ring is placed on a turntable under the Rectifier (they orient the capsule in such a way that the body part is oriented downwards and cap part is oriented upwards).
2. Empty capsule shells in the capsule hopper are descended by the rectifier in to the capsule ring. As the ring rotates on the turntable, vacuum pulls the capsules bodies in to the lower part of the capsule ring, leaving the caps behind in the upper ring.

Working of Semi Automatic Capsule Filling Machine Powder fillingof capsule :- After capsule separation, the operator separates the rings of the capsule ring and places the body ring on another turntable that rotates beneath the foot of the powder hopper. The auger in the hopper rotates to provide constant downward flow of the formulation while the filling ring rotates. The amount of formulation delivered to the capsule bodies depends on the dwell time of the bodies under the foot of the hopper, i.e., the speed of rotation of the body ring.

• Capsule Closing:- Upper and the lower holding ring of the capsule ring is joined together and positioned in front of the peg ring holding pins. Pneumatic pressure is applied to the peg ring which finally pushes the caps and the bodies together inside the holes of the capsule ring. Filled capsules are then removed from the capsule ring

Automatic Capsule FillingMachine Automatic capsule filling machine are designed and developed to fill hard gelatin capsules with powders or pellets. It is an extremely durable and reliable machine that fills dosages to the highest accuracy. It can be applicable to the widest range of capsules at all sizes. Automatic filling machines employ pistons, or tamping pins that lightly compress the powder into slugs, and eject the plugs into the empty capsule bodies. Automatic machines use the Dosing Disc Principle and Dosator Principle

Dosing disc Principle Workingof a Automatic Capsule Filling Machine

The dosingdisc rotates continuously in a circular manner. The stop plate closes the holes on the dosing plate. The dosing disc rotates below the powder bed, the material flows into each hole. The pins which are in the station compress the powder to a controlled depth. • The process of filling and compression continues till reaching the last compressing pin, where the machine ejects a compressed powder through the dosing plate into the capsule. • This is a continuous process and the production speed will depend on the preset machine conditions.

Dosator Principle Working of a Automatic Capsule Filling Machine Diagram of a dosator or dosing tube system: (A) compression force platen; (B) piston; (C) dosing tube; (D) powder hopper; (E) plug ejection platen; (F) capsule body in bush; and (G) powder plug

• A dosator machine has two segments :-

powder bed on one side while the empty capsule body on the opposite side.

• As the dosing tube goes down, penetrates the powder bed, powder enters the open end of the dosator.

• A plug is formed inside the dosing tube with a movable piston that controls the dosing volume and applies a force to form the plug. • Dosage tube then moves up, takes a 180° rotation, and press powder plug into the capsule body to complete capsule filling.

Punch Method (Manual Filling) To hand fill capsules, the pharmacist generally uses the Punch Method.

• Ingredients are triturated and mixed. The powder is placed on a powder paper or ointment slab and smoothed with a spatula to a height approximately half the length of the capsule body. • The body of the capsule is held vertically and the open end is pushed or punched into the powder until the capsule is filled.

• The capsule is replaced to close the capsule.

• Each filled capsule is weighed after filling. Powder is added and removed until the correct weight has been placed in the capsule.

• All the capsule filling machines have the 4 steps in common.

• Rectification of the empty capsule shell :-

orientation of the capsule – body oriented downwards and caps oriented upwards.

• Separation of cap and body of empty capsule shell.

• Dosing of a fill material :- eg. Auger Principle, Dosing disc Principle, Dosator fill principle, Punch Principle etc.

• Replacement of the caps over the body and Ejection of the filled capsules.

Famous companies manufacturing different capsule filling machines :-

• Lilly and Parke – Davis

• Farmatic

• Hofliger and Karg

• Macofar

• mG2

• Osaka

• Perry

• Zanasi

CAPSULE FINISHING Filled capsules from the capsule equipment require dusting or polishing operation before the remaining operations of inspection, bottling, and labeling are completed. Dusting or polishing operations vary according to the type of the filling equipment used, the type of powder used for filling, and the individual requirements for the finished appearance of the completed capsules.

Capsule Finishing Machines PAN POLISHING BRUSHING CLOTH DUSTING

Pan Polishing Because of the unique design, especially primary in the area of airflow, the Accela Cota Tablet Coating Pan is used to dust and polish capsules. A polyurethane or cheese cloth liner is placed in the pan, and the liner is used to trap the removed dust as well as impart a gloss to the capsules.

Cloth Dusting In this method, the filled capsules are rubbed with a cloth that may or may not be impregnated with an inert oil. This procedure is a hand operation and gives a shine to the capsules. Also it results in a positive method for removal of resistant materials.

Brushing In this method, the filled capsules are fed under rotating soft brushes, which serve to remove the dust from the capsule shell. This operation must be accomplished by application of vacuum for dust removal.

There are mainly 3 commercial equipments :-

1. Rotosort :- is a mechanical sorting device that removes loose powder, unfilled joined capsules, filled or unfilled capsule bodies, and loose capsule caps. This machine can handle up to 15000 capsules per hour
2. Erweka KEA :- is designed to handle the output from any type of capsule filling machine. It moves the capsules between soft plastic tassels against a perforated plastic sleeve, under vacuum. Any residual powder is removed by the vacuum.
3. PM60 :- the equipment has two units that may be used in the finishing process of capsules, which may be used separately or combined. A belt is available that presents capsules for visual inspection, and it may include vacuum system that removes the unfilled capsules. The machine has lamb wool belts moving in opposite directions. Commercial Capsule Dust or Polish Equipments

SPECIAL TECHNIQUES OF FORMULATION OF HARD GELATIN CAPSULES

- Decreasing Solubility
- Formulating Incompatible Materials
- Filling of Semisolids
 - Filling of Liquids
 - HPMC Capsules
- Starch Capsules
- Cross Linked Dextran Capsules

Decrease of Solubility

- Solubility is retarded in this technique of formulating a special type capsule.
- Done in an attempt delay absorption of the active ingredient or to provide enteric properties.
- Solubility is assured in two ways here:-
 - a) Water resistance – failure to dissolve in water in 15 mins at 20- 30°C.
 - b) Acid solubility – dissolve in less than 5 mins in 0.5% aq. HCl at 36 - 80°C
- Two ways of formulating capsules with decreased solubility are :-

a) Formalin treatment :- exposure of the gelatin film to formalin vapours decrease the solubility of gelatin due to the cross linking of molecules in gelatin initiated by aldehyde.

b) Coating of the gelatin capsules with coating materials like shellac, cellulose acetate phthalate etc., by usual pan coating

Formulation of Incompatible Materials

- Formulation of Incompatible materials is carried out by the use of a two phase fill in the capsule
- One phase :- consists of a soft capsule, or smaller hard capsule or a pill that is filled into the capsule.
- Other phase :- powder fill is added in the usual manner. • Changes should be made to the equipment for the machine operation to allow the two filling.

Filling of Semisolids

• Semisolids are melted to allow the filling of the material in the capsules at ambient temperature.

Filling of Liquids

- Liquids in the form of thermosetting or thixotropic mixture are filled in the capsule.
- Gelatin banding is required for the sealing of the capsules to prevent leakage.
- Two bands of gelatin solution are applied around the centre of the filled capsules and this then dried using air at ambient conditions.

HPMC Capsules •

Developed as an alternative to hard gelatin capsules.

- Odourless and flexible, low moisture content, chemically inert, stable under low moisture conditions
- HPMC Capsules :- manufactured using 18-28% HPMC, carrageenan (0.01 – 0.09% w/w) and potassium or calcium ions (0.05-0.6% w/w)
- Carrageenan and potassium or calcium ions are used as co gelling agents to facilitate the gelling of HPMC.

Cross Linked Dextran Capsules

- Capsule shell are prepared by reacting dextran. Magnesium chloride, glutaraldehyde, and polyethylene glycol 400 in water. Starch Capsules
- Capsule shell are prepared by starch obtained from potato.
- Dissolution is independent of pH.
- Usually used for manufacture of enteric coated capsules.