

Filling and metering of milk and milk products

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**Liquids
and
pastes**

**Solids
and
powders**

Filling of liquids and pastes

Filling by gravity flow

- Mostly used for glass bottles (not distorted)
- The filling process is up to a pre-set filling height.

Filling by metering

- Also known as **volumetric filling** as definite volumes are filled.
- The shape and the distortion of the package does not matter since the amounts to be filled are fixed before filling.

Filling by gravity flow

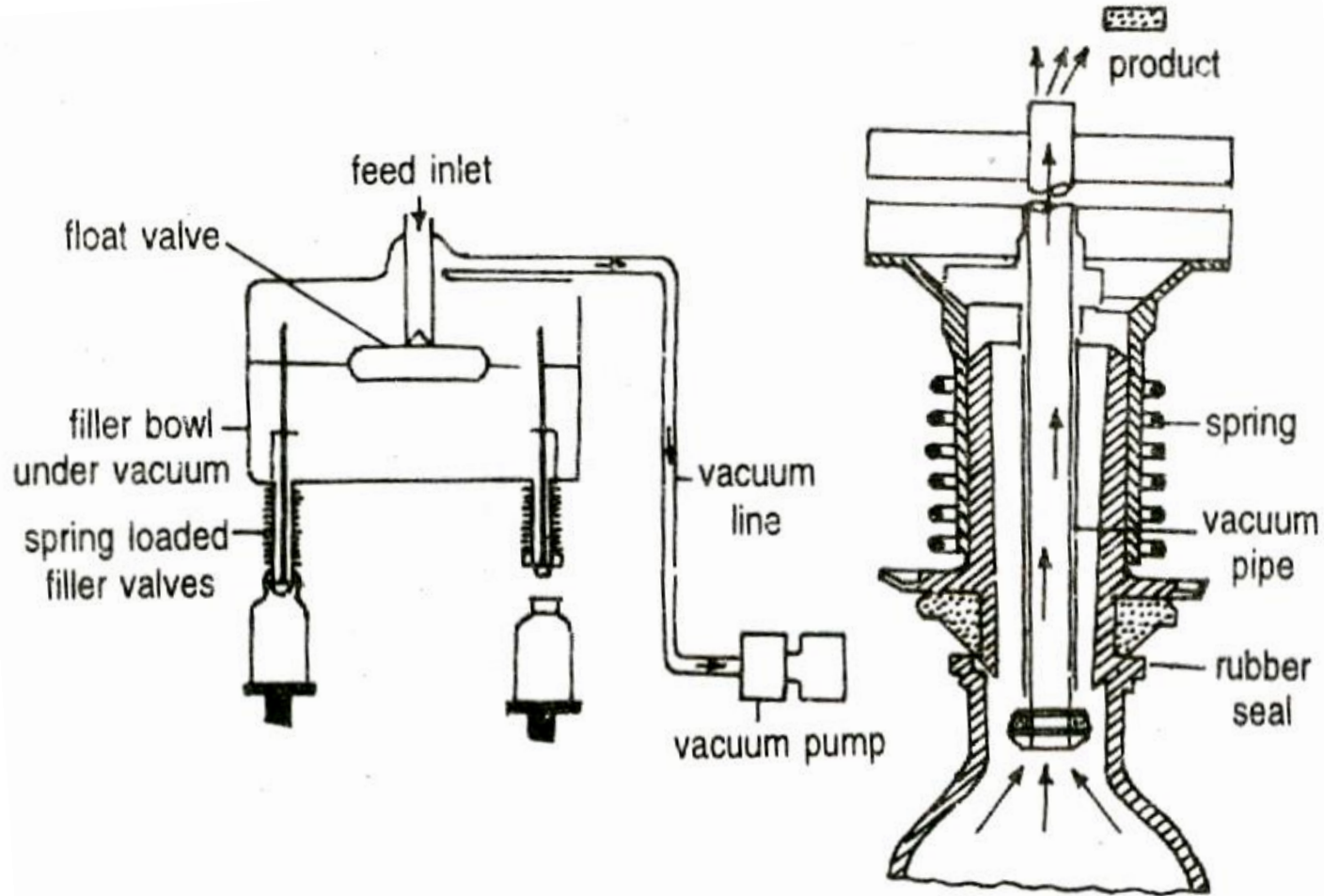


Fig. 12.2 Low vacuum filling system

Fig. 12.3 Vacuum filler valve

Source: Ahmed, T (1999)

Filling by gravity flow

Construction

- **Circular filler bowl under vacuum.**
- **Filler valves are mounted in the bottom of the bowl with vacuum pipes rising above the level of the milk.**
- **Empty bottles are lifted by a pedestal so that the rim of the neck of the bottle is pressed against filler valve rubber.**
- **Further lifting of the spring loaded filler valve rubber results in the formation of an annular orifice in the valve → the liquid enters the bottle through it.**

Filling by gravity flow

Operation

- **As the bottle rises towards the valve, it is connected to vacuum. The air and foam are allowed to pass up and out through the hollow central vacuum tube.**
- **The valve rubber is then lifted compressing the spring → Milk flows down the annular passage into the bottle.**
- **As the bottle drops away from the valve. the milk line is sealed as the spring returns the rubber seal.**

Filling by gravity flow

Advantages

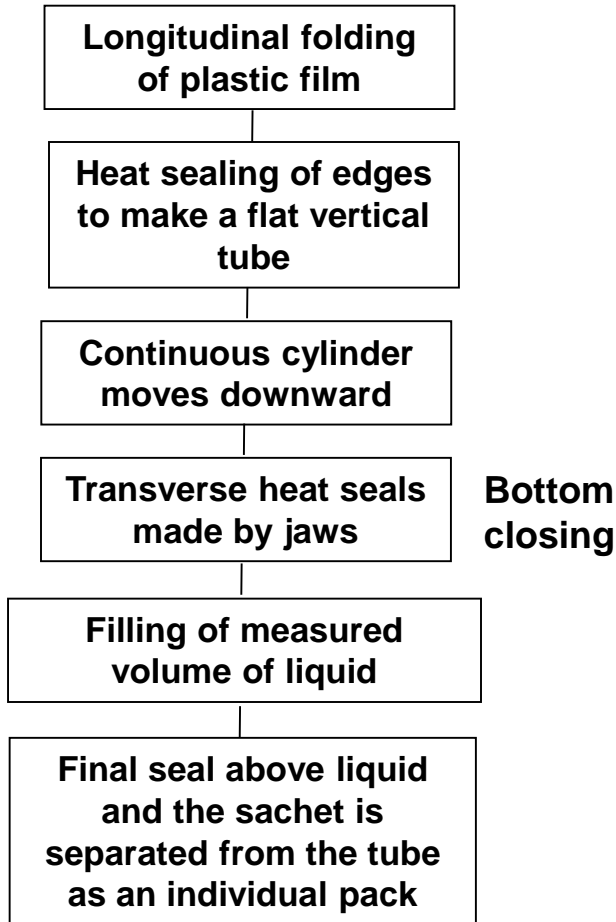
- The filler valves do not open unless a bottle is in proper position.
- The filler valves do not fill broken or cracked bottles because milk will only flow if the vacuum in the bottle is built up.
- The use of the vacuum speeds the rate of filling and also prevents milk from dripping from filler valves when a bottle is not under the valve.

Filling by metering- Sachet Form-Fill-Seal System



Filling by metering- Sachet Form-Fill-Seal System

Heat-sealable plastic film is fed continuously from a roll in the form of a strip.

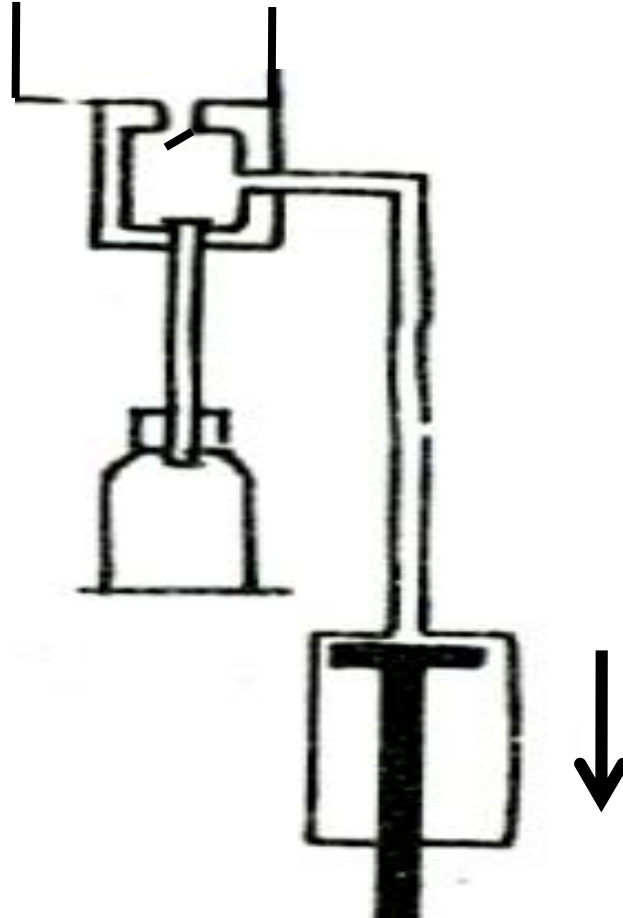


Steps of operation

Sachet Form-Fill-Seal System

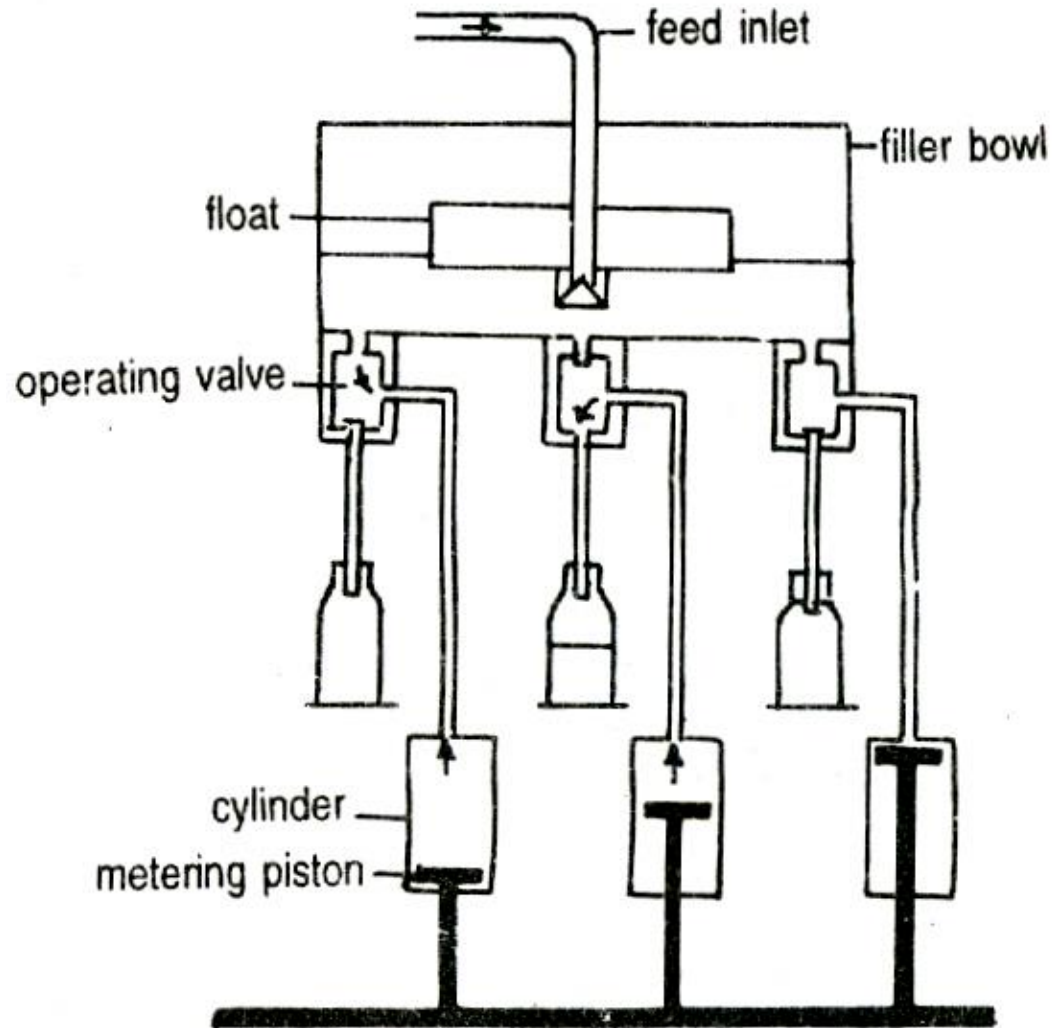
- The filling machine consists of a constant level tank with special float valve to maintain a constant head of liquid to be filled.
- The liquid milk dozing is based on the electronic time based digital circuit. After the requisite signal is received, the dispensing valve opens to allow the flow of liquid for a particular pre-set time.
- The flow of liquid is directly proportional to the time for which the valve is kept open.
- The total volume which can be dispensed in a calibrated time is a function of sp. gravity of liquid.

Piston Type Filling System- Filling by metering



The piston has just started moving downwards.

Piston Type Filling System- Filling by metering



Source: Ahmed, T (1999)

Piston Type Filling System

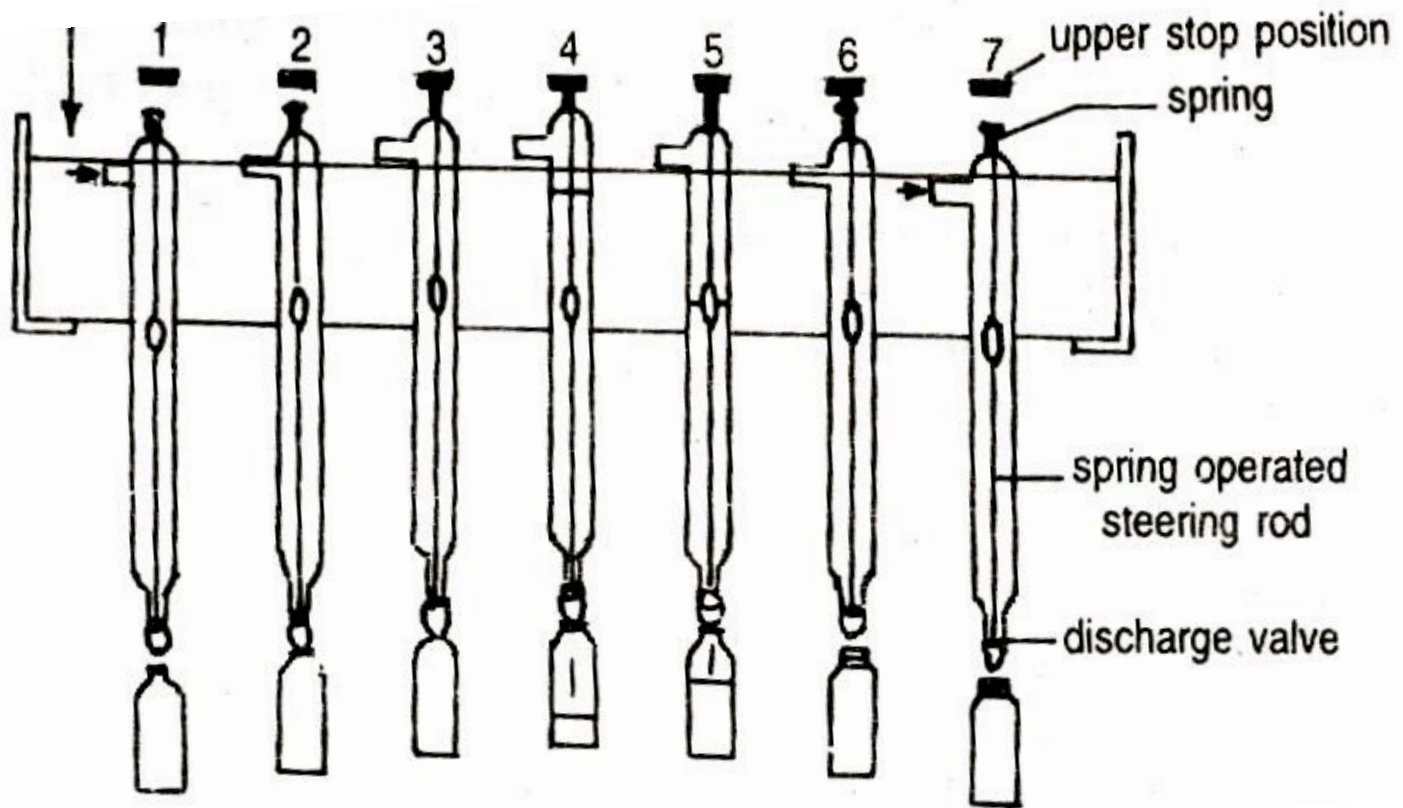
The operating valve opens by mechanical operation by metering piston.

Steps

- **The metering piston sucks the liquid to be filled into the cylinder.
The product enters from the filler bowl into the operating valve, and simultaneously closes the inlet from the operating valve to the container to be filled.**
- **When the cylinder is filled, the connection to the filler bowl is closed and the one to the container opened and the liquid is pushed into the container by the metering piston.**

Thin liquids as well as more viscous products can be filled with this filling system.

Metering Cup Filling System



Source: Ahmed, T

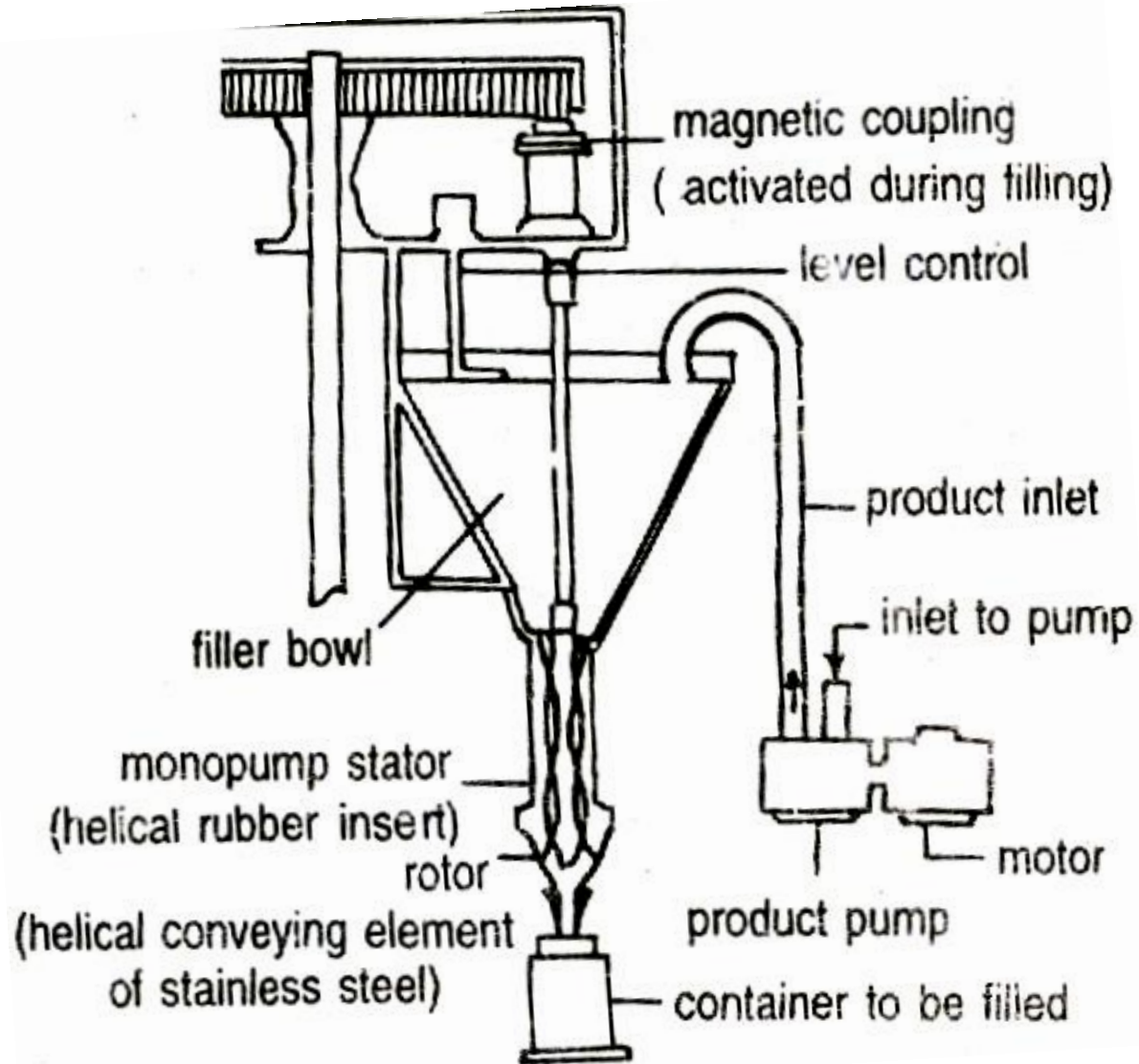
Metering Cup Filling System

Steps

- The calibrated cup is lowered until the filler tube dips into the liquid in the filler bowl and is filled.
- Then it moves upward by the bottle pressed against it from below. The bottle seals the cup and excess liquid flows back into the filler bowl until the predetermined mark is reached.
- The discharge valve at the lower end is opened by the steering rod (located at the axis of cup and opens by pressure from upper stop position) and metered amount of liquid flows into the bottle.
- Then, as the metering cup and the bottle are lowered, the discharge valve is closed.
- The calibrated cup is again filled with liquid while the filled bottle is removed from the filler.

Gives a high accuracy of filling.

Filling of Pasty Products



Source: Ahmed, T (1999)

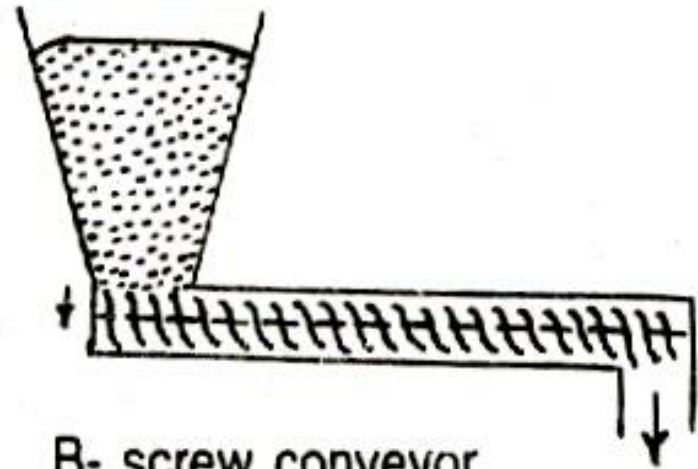
Filling of Pasty Products

- From the filler bowl, the product is pumped (with minimum damage to the product).
- The metering time or the revolution time of the rotor is controlled by a timing relay and a magnetic coupling.
- The filler bowl level is controlled.
- This filling system can be used for liquids of low or high viscosity and even for stiff pastes, which may contain solid particle.
- There may be a mixing device in the filler bowl to evenly distribute particles, which have a tendency either to sink or to rise.

Metering and Filling of Dry Product



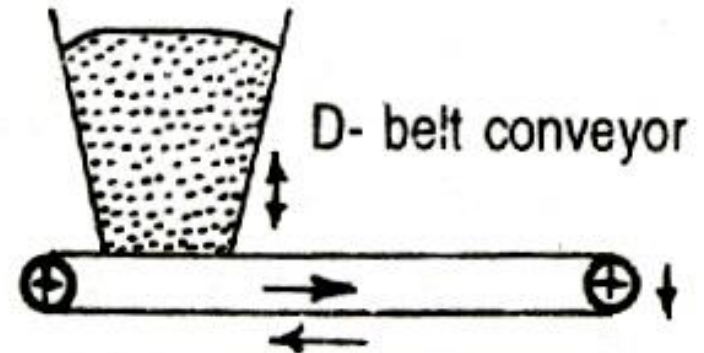
A- bucket wheel



B- screw conveyor



C- vibrating conveyor



D- belt conveyor

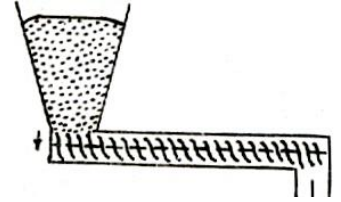
Metering and Filling of Dry Product

Some points of concern

- Filling of equal volumes lead generally to considerable deviations in weight, since there are deviations in bulk density.
- High mechanical pressure should be avoided to prevent the damage of product and also to prevent formation of lumps.
- A dry product which is sticky, because of high moisture content or because it is thermoplastic at too high temperature, is not suitable for continuous metering.
- The hopper should be roughly pre-dosed to a certain uniform level to obtain a uniform stream of product.

Metering and Filling of Dry Product

Screw metering devices



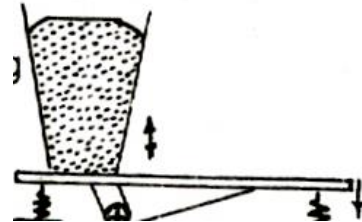
- **Either horizontal or vertical axis**
- **Care should be taken to ensure that the screw is properly filled with the product. This is achieved by increasing the pitch and the diameter of the thread in the direction from the outlet to the hopper, as well as installing revolving spiral bands which loosen the dry product and allow it to flow into the screw threads.**
- **The product mass flow rate is regulated by the number of revolution of the screw conveyor.**
- **The mass flow of the product is more accurate and uniform if the diameter of screw threads is smaller and the number of revolutions of the screw is higher.**

Metering and Filling of Dry Product



Bucket wheels

- Bucket wheels are suitable only for metering dry products into large packs since they are **relatively inaccurate**. Metering is not strictly continuous since the content of a whole bucket of the rotating wheel is emptied at once.



Vibrating conveyor chutes and conveyor belts

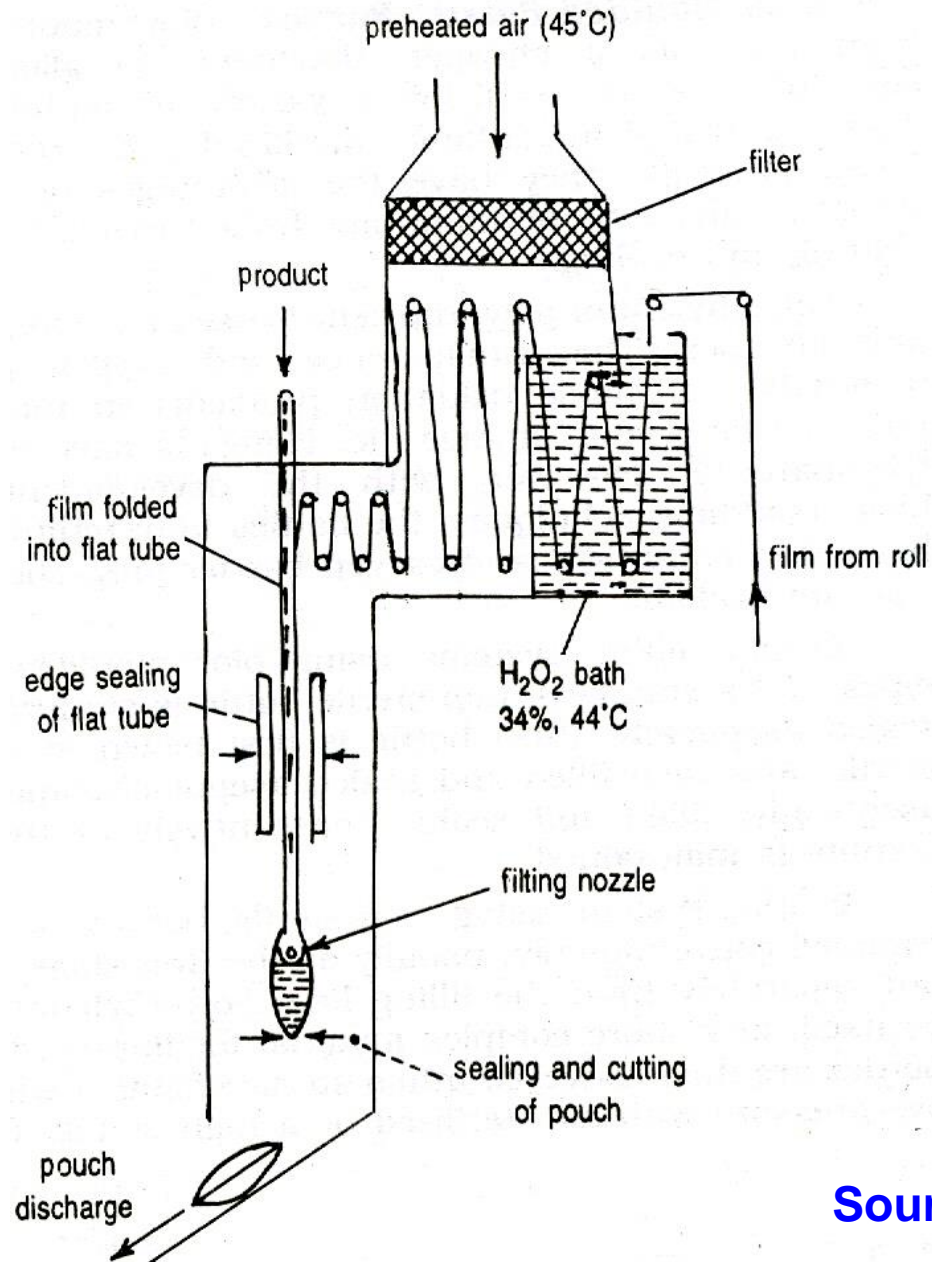
- Suitable for continuous and accurate metering.
- By adjusting the dimensions of the orifice outlet, by installing side-walls and by regulating the frequency of the vibrations or the speed of the conveyor belt, the mass flow rate can be accurately adjusted.

ASEPTIC FILLING

Requirements in an aseptic filling system :

- **Container and method of closure must be suitable for aseptic filling, and must not allow the passage of organisms into the sealed container during storage and distribution.**
- **The container part which comes into contact with product must be sterilized after it is formed and before being filled.**
- **Filling must be without contamination.**
- **The closure must be sterilized immediately before it is applied and sealed in place while the container is still within a sterile zone to prevent the passage of organisms.**

ASEPTIC FILLING for plastic pouches



Source: Ahmed, T (1999)

ASEPTIC FILLING for plastic pouches

- The packaging material is fed as a continuous strip from a roll.
- The pouch forming, filling, and sealing operations take place within a sealed chamber supplied with sterilized air.
- The air is sterilized by a bacterial filter which is capable of removing 99.9% of particles of 0.3 μm diameter.
- The film enters the chamber through a bath of H_2O_2 solution, where it remains for a minimum of 20s when 1-litre pouches are being filled. (With smaller pouches. the film feed rate is lower and the sterilizing time is increased.)
- At the outlet of the bath. the film passes through mechanical scrapers which removes surplus liquid.

ASEPTIC FILLING for plastic pouches

- The film then passes through the flow of sterile air supplied to the filling chamber at a temperature of 45°C. The air removes the peroxide from film (Final H₂O₂ concentration in the filled pouch < 1 ppm).
 - The film is moved forward by grippers **intermittently** to produce a single pouch.
1. First folding longitudinally and heat sealing by vertical sealing jaws → a flat tube formed over the length of a pouch.
 2. The transverse seal of the previous pouch closes the bottom of the tube.
 3. The product is filled in fixed and controllable volume through a vertical tube and filling nozzle.

ASEPTIC FILLING for plastic pouches

- **The filler is usually of piston type.**
- **Volume of filling ← travel of the piston**
- **For low viscosity products, the filler is supplied by gravity from a balance tank.**
- **Pump for more viscous products.**
- **When filling is complete. the tube is moved down by the length of a pouch. and the top is sealed and cut so that the filled pouch is detached and the bottom of the next is made at the same time.**

- **The filler consists of two filling heads with a single aseptic chamber and each can operate independently of the other and can fill different sizes of pouch at the same time.**

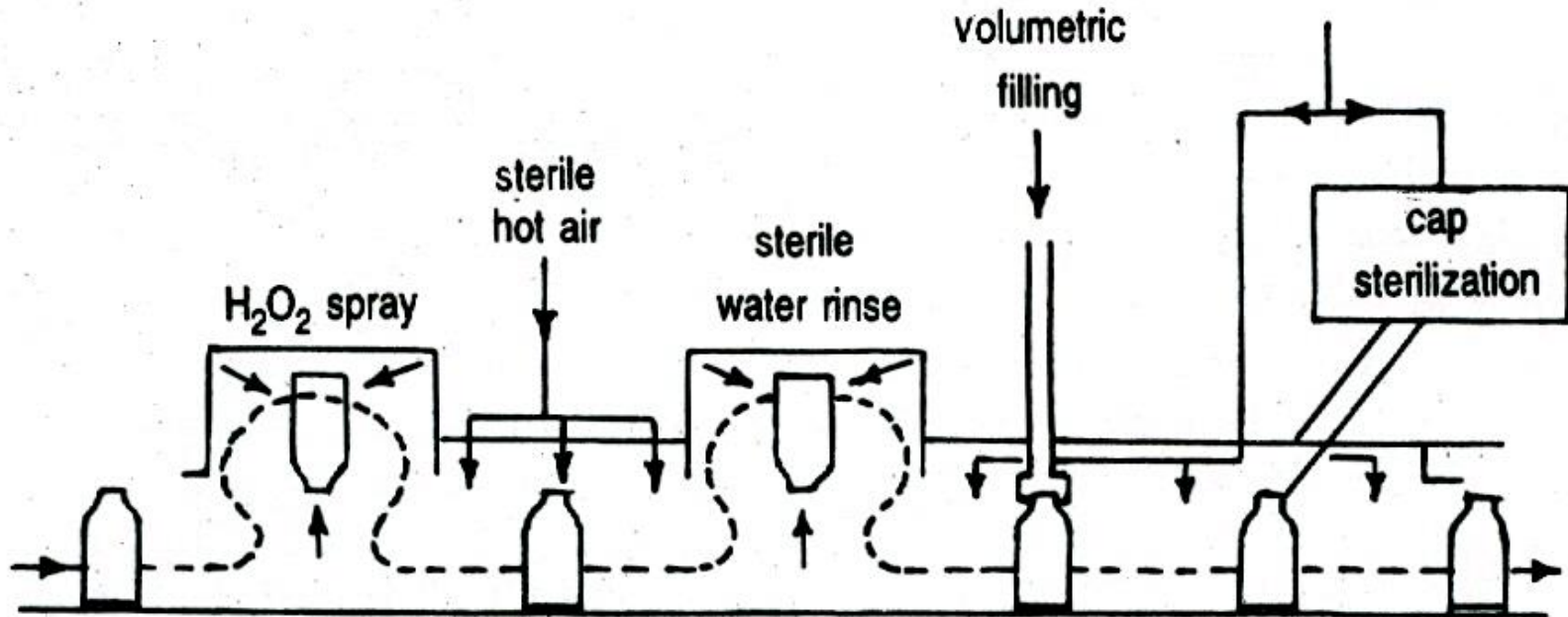
ASEPTIC FILLING for blow moulded plastic bottles

Aseptic filling systems using blow-moulded bottles are of three types:

- 1. A standard non-sterile bottle is sterilized and then filled and sealed aseptically.**
- 2. A bottle is first blown in such a way that it is sterile. and then filled and sealed aseptically.**
- 3. A bottle is blown aseptically, filled and sealed consecutively at the same time so that sterility is maintained.**

ASEPTIC FILLING for blow moulded plastic bottles

System using non-sterile bottles



Source: Ahmed, T

ASEPTIC FILLING for blow moulded plastic bottles

System using non-sterile bottles

- 1. Bottle is blown and trimmed conventionally usually as the first stage of the aseptic process, but separately from the filling line.**
- 2. The bottles are then conveyed into a sterile chamber, which is kept at a slight overpressure with air sterilized by a high quality filter.**
- 3. The bottles are inverted and sprayed inside and outside with H_2O_2 solution.**
- 4. The bottles are then erected, which pass through a hot air tunnel in which the peroxide is evaporated and the vapours removed.**
- 5. Bottles are then re-inverted, rinsed inside and out with sterile water and erected again.**

ASEPTIC FILLING for blow moulded plastic bottles

System using non-sterile bottles

- 6. The bottles are filled using a rotary volumetric filler.**
- 7. The headspace is filled with an inert gas if necessary.**
- 8. The bottles are then heat sealed with chemically sterilized plastics film or other heat-sealable closure, and an outer plug or screw cap can be applied.**
- 9. The sterile air is supplied from above in a laminar flow system to the parts of the sterile chamber where the bottles are finally rinsed, filled and sealed.**
- 10. The bottles then leave the sterile chamber and is ready for distribution.**

Thank You