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A COMPREHENSIVE REVIEW ON TABLET COATING IN PHARMACEUTICAL INDUSTRY

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ABSTRACT

Tablet coating is one of the oldest pharmaceutical process still in existence. Coating is application of coating solution or suspension to a moving bed of tablet with concurrent use of heated air to facilitate evaporation of solvent, the distribution of coating solution is accomplished by movement of tablet inside a pan. Reason for tablet coating is test masking, order masking, physical and chemical protection, protect drug in stomach and most important is controlling release profile. Various technique of tablet coating are sugar coating, film coating and enteric coating. This review deals in details about history, coating process, equipment involved, specialised coating technique, material used in tablet coating and coating defect.

Keywords: Pharmaceutical solid dosage, sugarcoating, supercellcoating, magnetically associated impaction coating, coating defects

INTRODUCTION

Oral solid dosage forms are considered the most convenient dosage forms (DFs) available in the pharmacy. Their production was introduced over centuries ago. These DF have several advantages including their relatively easy going and convenient manufacture, coupled with high patient compliance. Tablet is a pharmaceutical dosage form. The tablet is composed of the Active Pharmaceutical Ingredient together

with various excipients which are usually in powder form, compressed into a solid dosage form. Tablet coating is application of coating solution or suspension to moving bed of tablet with concurrent use of heated ear to facilitate evaporation of solvent the distribution of coating solution is accomplished by moving of tablet inside pan. Coated tablets are tablets which are covered with one or more layers of mixture of various substances such as resins, gums sugar, plasticizer etc **[1]**.

History of coating techniques:

Panning" was the original word for the process of adding a coating to a tablet. The word panning is still a common term which is used in the confectionary business. In past years coating perform basically using a rotating drum (pan) on a stand. A coating solution was added, while the rotation of the pan distributed the solution throughout the bed of tablets. The main disadvantage of this technology was slow waiting for the coating solution to dry; and the trick was to get it to dry evenly. With the advent of film coating a film or thin membrane, usually representing 1-3% of the total tablet weight, was sprayed on using a perforated pan. To decrease the overall process time, holes were made through the pan so that treated air (hot or cold) could be pulled through the pan, much like a clothes dryer, allowing the tablets to dry more quickly. With this advent of improved drying came the ability to switch the film coating solution from a solvent based solution to a water based solution. Coating of pharmaceutical dosage forms has been practiced for many centuries **[2]**. The historical development of coating technique is mentioned below:-

LAST 40 YEARS:-

Features

- Introduction of the side- vented tablet coating pans (with perforations), **Figure 1**, Evolution was required for the introduction of aqueous based film coating polymers to the pharmaceutical industry
- Carbon steel construction except for pan Many screws, not welded in places
- Does not complies GMP.

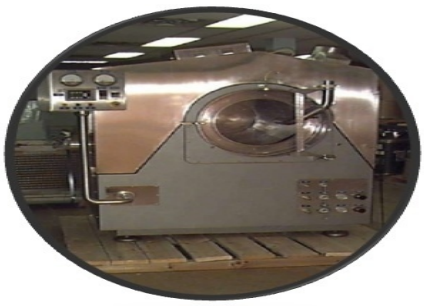

Figure 1: Side vented tablet coating pans

LAST 30 YEARS:

Introduction of reliable microprocessor based process control systems required to insure process control and repeatability.

Features

- Improved design spray nozzles for tablet coating
- Specific applications (all stainless steel)
- Improved air preparation systems required for consistent aqueous process drying improved GMP coater design, more cleanable, all
- Stainless steel **(Figure 2)**
- Improved tablet handling
- All required for the optimization of aqueous film coating process **[3]**.

LAST 20 YEARS:

Features

- Potable water storage tank.
- Washing nozzles (coater mounted).
- .Reduced cleaning time
- Cleaning of the areas, that are difficult to access
- Conservation of cleaning solution
- Standardization of the cleaning process
- Energy conservation (As shown in **Figure 3**) **[4]**.

LAST 10 YEARS

- More advanced film coating spray nozzles with anti-bearding designs
- More reliable industrial automation for accurate andrepeatable control of process parameters i.e.: dewpoint,mass solution flow, air flow etc.
- The evolution of the improvements to the batch tabletcoater has allowed the recent advancements in continuoustablet coating **(Figure 4) [5]**.

Figure 2: Reliable microprocessor based process control system

Figure 3: Advanced automatic Coating in Place (CIP) and Washing in place (WIP) systems

Figure 4: More advanced automation in Coating System

Coating process:

Rotating coating pans are commonly used for coating purpose. Uncoated tablets are placed inside the pan and the liquid coating material is brought into the pan during the tumbling of tablets. 'Air is passed over the tumbling tablets so that liquid part of coating material gets evaporated leaving the layer of solid coating material **[6]**.

The coating method is normally such as the subsequent steps:

1. Batch identification and selection of type of coating. (film or sugar coating)
2. Dispensing (accurate dosing of all required raw materials)
3. Loading of tablets into pan.
4. Warming of tablets
5. Spraying (application of coating material and rolling of tablet are carried out simultaneously)
6. Drying
7. Cooling
8. Unloading.

Equipment of tablet coating:

There are three types of equipment

- Standard coating pan
- Perforated coating pan
- Fluidized bed or air suspension coater.

1) Standard coating pan:

It consists of circular metal Pan mounted angular on standard, it rotate in its horizontal axis by a motor heated air is directed into a pan and onto the tablet bed surface and is exhausted through the front of the pan coating solution are applied by spray which allows continuous application of solution in film coating.

a) Immersion sward system: IN these drying air is introduced through a perforated metal sward which is immerse in the tablet bed. The drying air flows upwards from the sward through the tablet bed. Since, the air is more intimately (through) mixed with the wetted tablet, a more efficient drying environment is provided. Coating solution are applied by an atomize spray system directed on to the surface of rotating tablet bed **[7]**.

b) Immersion tube system:

A tube is immersed in the tablet bed the tube over the heated air and spray nozzle located at the tip of tube spray the coating solution simultaneously with the heated air from immersed tube drying air flow upwards through the tablet bed and is then exhausted the system produce faster coating **(Figure 6)**.

2) Perforated coating pan:

The type of equipment consists perforated or partially perforated drum which rotate on its horizontal axis in enclosed housing.

a) **Accela-cota system:** In Accela-cota system drawing air is directed into drum or coating Pan is pass through the tablet bed and exhausted through the perforation in the drum **(Figure 7)**.

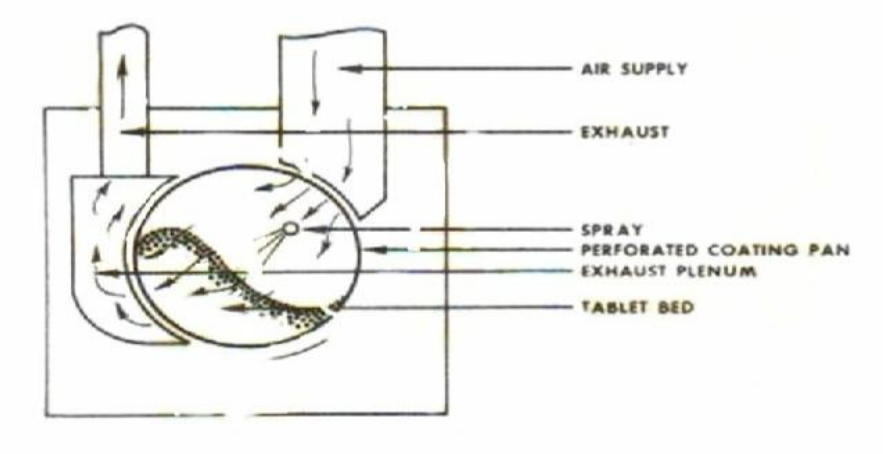

Figure 5: Immersion sward system

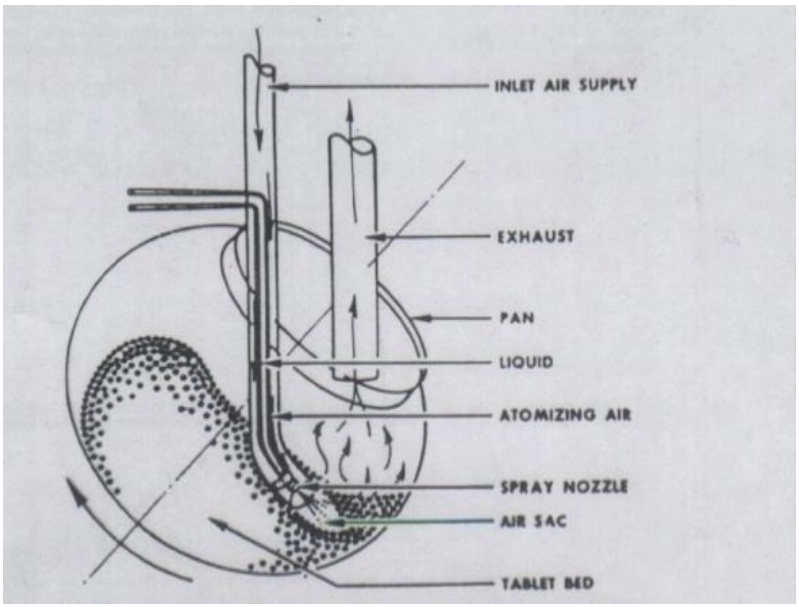

Figure 6: Immersion tube system

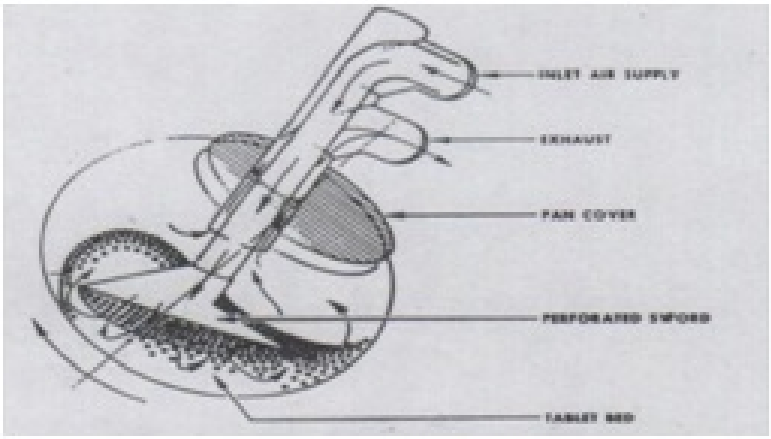

Figure 7: Accela-cota system

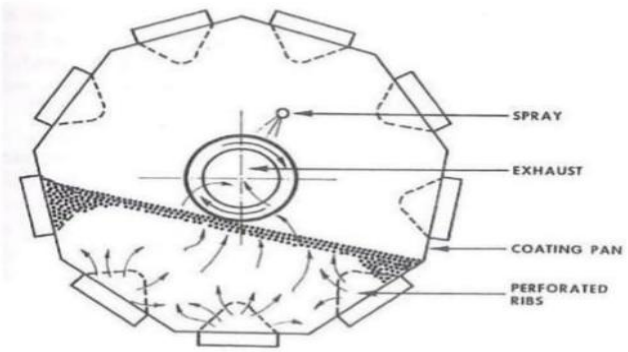

Figure 8: Diacoater

b) Driacoater:

Dry coated introduce drying air through hollow perforated ribs located in the inside periphery of drum.As the coating Pan rotated the ribs deep into the tablet Bade and drying air passes through and fluidises the tablet bed, exhaust is from back of the pan in all these perforated Pan system coating solution applied to the surface of the rotating tablet bed through spray nozzle that are located inside the drum.

3) Fluidised bed coater or air suspension coater:

These are highly efficient drying system fluidization of tablet is achieved in a columnar chamber by the upwardflow of pressurise driving air the movement of the tablet is upward through the centre of the chamber, tablet then falls towards the Chamber wall and move downward to re-enter the coating chamber at the bottom. coating solution are applied continuously from the spray nozzle located at the bottom of the chamber **[8]**.

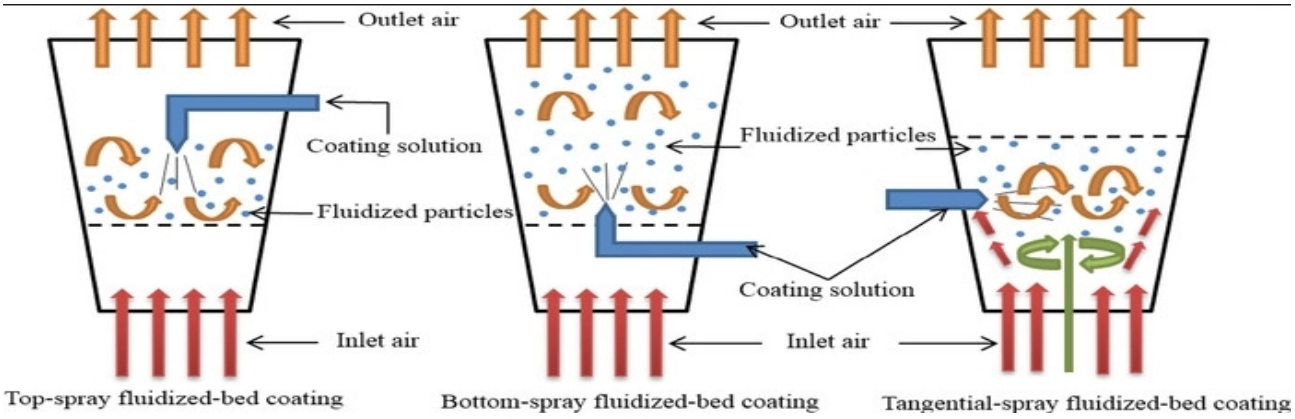

Figure 9: Fluidised bed coater

TYPES OF COATING PROCESSES

Three main types of coatings used in the pharmaceutical industry are

1. Sugar coating
2. Compression coating
3. Film coating.

Sugar coating:

Sugar coating involved successive application of sucrose solution to a moving bed of tablet it is traditional method of tablet coating but it is still used in some cases because in produce elegant and highly gloss tablet.

STEPS IN SUGAR COATING:

1. Seal coating
2. Sub coating
3. Syrup coating/Smoothing
4. Polishing.

1) Seal coating:

Seal coat prevent moisture penetrationinto tablet for this is specially required in Pan ladling process in which localised overwetting of tablet can occur therefore without seed coat the overweight tablet can absorb excess moisture leading to Tablet softening and or disintegration thus affecting physicochemical solubility of final product.

2) Subcoating:

It is applied to round the ages and build up the tablet size. Sugar coating increases tablet weight by 50-100% in this step a surface coating suspension containing Binder and insoluble powder (calcium carbonate or caoline) is sprayed into the tablet bed until tablet edges have been cover and Desire thickness is achieved.

3) Syrup coating:

Purpose of this step is to cover and fill the infections in tablet surface causes by sub coating state and to impart Desire colour to Tablet initially simple syrup containing in soluble powder are applied till tablet surfaces

are smooth when tablet are quite smooth then syrup containing colour are applied until final size and colour is achieve.

4) Polishing:

Desired glass is imparted in the step by applying powder wax or warm solution of the wax in suitable volatile solvent.

Film coating:

It involved deposition of thin and uniform film of polymer around thecore. Film coating are applied continuously to moving bed of tablet by spray method.

Antlike sugar coating, film coating is a flexible process that allows broad rang of product like tablet, powder, granules, pellets to be coated where sugar coating is mainly applicable for the tablet.

Types of film coating

- Immediate release
- Modified release.

Advantage of film coating over syrup coating

1) Minimum increase in tablet weight. Film coating increase only 3 to 5% of tablet weight but sugar coating result in increased 50-100% weight of tablet.
2) Since film coating applied continuously with a single step process this reduces process step and hence time.
3) Film coating has increased process efficiency and output.
4) Film coating is flexible process since broad range of product like tablet granules powder can be film coated **[9]**.

Tablet Coating Defects:

Table 1: Tablet coating defects

Sr. No.	Tablet defect	Meaning	Remedies
1.	Sticking and picking	Overweighting or excesive film tackiness cause tablet to stick each other or to the coating pan on drying at the point of contact a piece of the film may remain adhered to the pan or to another tablet living a picked appearance to the tablet surface and resulting in small expose area of the coat.[24]	-Reduce liquid application rate -Increase drying air temp and air volume. -excesive tackiness may be indication of poor formulation.[2]
2.	Roughness	Rough or gritty tablet surface. When coating applied by a spray some of droplet may dried to rapidly before reaching the tablet bed. Resulting in deposition of spray dried particle on the surface of the tablet instead of droplet of coating solution these causes roughness	-Reduce degree of atomization to increase droplet size. -move the spray nozzle classer to the tablet bed.
3.	Orang peel defect	Inadequate spraying of coating solution before drying results in deposition of thick film on the tablet surface.sprayding is prevented by to rapid drying or by high solution viscosity.	Thinning of coating solution with additional solvent.
4.	Bridging and filling	During drying film may shrink and pull away from sharp corner of bisect resulting in bringing of surface preparation. These mainly represent problem with formulation.	Increase concentration of plasticiser or changethe plasticiser.
5.	Filling	It cause when too much coating solution is applied resulting in thick film that fill and narrows monogram or bisect, if the coating solution is applied too fast overwetting may cause the liquid to quickly fill can be retained in the monograms.	Decrease liquid application rate.[7]

6.	**Blistering**	**When coated tablet are ferther dried in oven too rapid evaporation of the solvent from tablet core and effect of high temperature on elasticity and adhesion properties of the film results in blistering**	**Used milder dried condition.**
7.	**Hanging/dull film**	**Occurred when too high processing temperature are used for drying.specialy when cellulosic polymer are applied out of aqueous media at high temperature. It can also occurs when coated tablet are exposed to high humidity condition.**	
8.	**Mottling**	**Non uniform distribution of colour -Improper mixing -uneven spray pattern -insufficient coating may result in coloured variation. -migration of soluble dies, plasticiser and other additive during drying can also result on mottling.**	**Used lack instead of dyes**
9.	**Cracking**	**Cracking occurs when internal stores in the film exceed or is more than the tensile strength of the film**	**Tensile strength of the film can be increase by using high molecular wt. polymer or by adjusting the conc of plasticiser.**

Recent trends in tablet coating technology:

1. Supercell coating technology
2. Electrostatic dry coating
3. Magneticaly assisted impaction coating **[10]**

CONCLUSION

In recent decades, coating of pharmaceutical dosage forms been subject of remarkable developmental efforts aiming to ensure and enhance the quality of tablet dosage form. In recent decades, coating of pharmaceutical dosage forms has been subject of remarkable developmental efforts aiming to ensure an enhance the quality of tablet dosage form. Magnetically assisted impaction coating and electrostatic dry coating avoids major disadvantages of solvents-based coating methods produce uniform coating but only with specialized instrumentation. Electrostatic dry coating requires special type of powder coating composition. Electrostatic dry coating enables coating of tablet with different colours on either side along-with printing on tablet on pharmaceutical dosage form. In recent years, Pharmaceutical formulation in Tablet coating gains remarkable development, efforts are there to ensure durability as well as to improve the quality of the finished product. Significant development and improvement of this technology regarding energy consumption, distribution of film, drying efficiency, has taken place. Still there is a lot of scope for betterment of coating technique in future. More work can be done to get better coating solvent, drying technique and spaying methods.

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