INDUSTRIAL PHARMACY - I

UNIT 2 NOTES

TABLETS

- INTRODUCTION
- FORMULATION OF TABLETS
- TABLET COATING
- QUALITY CONTROL TEST

LIQUID ORALS

- SYRUP
- ELIXERS
- EMULSION
- SUSPENSION

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TABLETS

- Tablets are defined as solid unit dosage form of medicaments that contain an active drug with various other substances (excipients) to help with stability, flavours or ease of administration.
- They vary greatly in shape, size & weight
- Tablets are typically made by compressing powdered ingredients into solid shape which can be either circular, flat or oval shaped.

IDEAL CHARACTERISTICS OF TABLETS

- They should be uniform in nature that means they should contain an accurate, consitent amount of active drug.
- They should be easy to swallow & handle.
- It should be free from defects such as cracks, chips, contamination & discolouration etc.
- It should be physically & chemically stable.
- It should be hard enough to resist handling & transportation.
- It should disintegrate & dissolve at the desired rate to ensure better absorption.
- It should have an acceptable appearance in terms of shape, colour & taste.

Advantages

- Tablets are easy to administer & transport.
- It provides a precise dose of medication.
- They have a longer shelf life compared to liquids
- They are often cheaper to produce & purchase than other dosage forms.
- They are easy to take, making it simpler for patients to adhere to their medication regimen.
- They can be formulated in various strength, shape & sizes.
- Unpleasant taste or odour of drug in tablets can be masked by sugar or film coating.

Disadvantages

- Some patients, such as children or elderly, may find tablets difficult to swallow.
- Patients with vomiting or diarrhoe may not take it.
- They are not suitable for unconscious patients.
- Certain tablets may irritate the stomach lining or cause gastrointestinal discomfort.
- Drugs with hygroscopic nature cannot be formulated as tablet.
- Special tablets like extended release or enteric-coated can be more challenging and expensive to manufacture.

CLASSIFICATION OF TABLETS

Tablets can be classified as follows :

① Tablet Inserted Orally

- Compressed Tablets
- Multiple Compressed Tablets
- Enteric Coated Tablets
- Sustained Release Tablets
- Sugar Coated Tablets
- Film Coated Tablets
- Chewable Tablets

② Tablet Used In Oral Cavity

- Buccal Tablets
- Sublingual Tablets
- Troches & Lozenges
- Dental Cones

③ Administered By Other Routes

- Implantable Tablets
- Vaginal Tablets

④ Tablets Used To Prepare Solution

- Effervescent Tablets
- Dispensing Tablets
- Hypodermic Tablets
- Tablet Triturates

① TABLET INSERTED ORALLY

- A Tablet inserted orally is called an oral tablet or oral solid dosage form.
- It is designed to swallowed or chewed & then absorbed into the bloodstream through digestive system.
- They are further classified as follows

(a) Compressed Tablets
(b) Multiple Compressed Tablets
(c) Enteric Coated Tablets
(d) Sustained Release Tablets
(e) Sugar Coated Tablets
(f) Film Coated Tablets
(g) Chewed Tablets

Compressed Tablets

A compressed tablet is a type of tablet that is made by compressing a powder or granular material into a compact, solid dosage form using a tablet or compression machine.

Multiple Compressed Tablets

A Multiple compressed tablet, also known as a multi-layer tablet or multi-layer compressed tablet, is a type of tablet that contains two or more layers of material compressed together into a single tablet.

Enteric Coated Tablet

An enteric coated tablet is a type of tablet that prevent it from dissolving in the stomach. Instead, the coating allows the tablet to pass through the stomach unchanged & dissolve in the Intestine.

Sustained Release Tablets

Sustained Release Tablets, also known as sustained action tablets, or prolonged release tablets, are designed to release the medicaments slowly over a prolonged period of time, typically 8-24 hour. This is achieved through use of specialized formulations & technologies that control the release of active ingredients.

Sugar Coated Tablets

A sugar-coated tablets is a type of tablet that has a layer of sugar or sweet-tasting substance on the outside to mask the unpleasant taste or odor in the medication.

Film Coated Tablet

A film coated tablet is a type of tablet that has a thin layer of material, called a film, wrapped around the tablet. The coating is generally used to mask unpleasant tastes or odours, protect the tablet from moisture, light or oxygen or improve the appearance of tablet.

Chewable Tablets

Chewable Tablets are a type of tablet that is designed to be chewed & swallowed, rather than swallowed whole.

② Tablets Used In Oral Cavity

- Tablets used in oral cavity are designed to dissolve or disintegrate in the mouth, release their active ingredients to provide a therapeutic effect.
- They are of following types

(a) Buccal Tablets
(b) Sublingual Tablets
(c) Troches & Lozenges
(d) Dental Cones

Buccal Tablets

Buccal Tablets are type of tablet that is designed to be placed blw the cheek and gum, where they dissolved slowly & release the medications.

Sublingual Tablets

Sublingual Tablets are type of tablet that is designed to be placed under the tongue, where they dissolved quickly, releasing the medications into the bloodstream through mucous membranes.

Troches & Lozenges

Troches are small, soft & usually oval shaped tablets designed to dissolve slowly in the mouth, releasing the medication Lozenges are tends to be more solid & longer-lasting than troches.

Dental Cones

These tablets are used at the time of tooth extraction After the tooth extraction, a small cavity is formed, which may seriously be affected by pathogenic microorganisms & may develop infection, hence to prevent this, dental cones are placed in empty socket developed after tooth extraction.

③ Tablets Administered By Other Routes

- These are tablets administered by routes other than oral.
- They are of mainly two types:

(a) Vaginal Tablets
(b) Implantable Tablets

Implantable Tablets

Implantable Tablets are small, solid dosage form designed to be inserted into the body, where they release medication slowly over a prolonged period. They are typically made of a biocompatible material, such as silicone or polyurethane & are implanted under the skin or in a specific organ, tissue.

Vaginal Tablets

Vaginal Tablets are small, solid dosage forms designed to be inserted into the vagina, where they dissolve or disintegrate releasing the active ingredients to provide

(4) TABLETS USED TO PREPARE SOLUTION

- Tablets used to prepare an oral solution are designed to be dissolved in water or another liquid to create a solution for oral administration.
- They are of following types:

(a) Effervescent Tablet
(b) Dispensing Tablet
(c) Hypodermic Tablet
(d) Tablet Triturates.

Effervescent Tablets

Effervescent Tablets are a type of tablet that contains acid & base components that react to produce carbon dioxide gas when dissolved in water.

Dispensing Tablets

A tablet prepared by molding or by compression; used by dispensing pharmacist to obtain certain potent substances in a convenient form for accurate compounding.

Hypodermic Tablets

Hypodermic tablets are small, solid dosage form designed to be inserted under the skin (subcutaneously) or into a muscle (intramuscularly) using a hypodermic needle or syringe.

Tablet Triturates

Tablet Triturates are small, tablet-like dosage forms that are designed to be triturated (crushed) into a fine powder before administration.

EXCIPIENTS

- Excipients are inert substances added to tablets to facilitate their manufacturing and enhance their performance.
- The main categories of excipients used in tablet formulations are as follows :

① Diluents (Fillers)
② Binders
③ Disintegrants
④ Lubricants
⑤ Glidants
⑥ Preservatives
⑦ Colouring Agents
⑧ Flavouring Agents
⑨ Sweetening Agents

DILUENTS

- Diluents are inert substances which are added to increase the bulk of tablets to ensure a manageble size for handling & consumption.
- Examples : Lactose, Microcrystalline Cellulose & Starch.

BINDERS

These agents promote cohesion among the active ingredients & other excipients.
Common Binders includu Cellulose derivatives, Starch, Gelatin etc.

DISINTEGRANTS

- These agents are added in tablet formulation to ensure disintegration of tablets into smaller particles when swallowed
- Examples : Sodium Starch Glycolate, Croscarmellose Sodium.

LUBRICANTS

- Lubricants reduce friction during tablet formulation & prevent adhesion of the tablet material to the surface of mold & punches.
- Example : Magnesium Stearate, Stearic Acid

GLIDANTS

- These agents enhance the flow properties of powders during manufacturing.
- Common Glidants include Colloidal Silica & Talc, Magnesium Sterate etc.

PRESERVATIVES

- In some cases preservatives are added to prevent microbial growth, especially in moisture sensitive formulations.

COLOURING AGENTS

- These are the agents used to color the tablet to promote its attractiveness
- Example: Food Dyes, Pigments etc.

SWEETENING AGENTS

- Sweetening Agents are excipients that are often used to mask unpleasant & bitter taste & improves patient acceptibility.
- Example : Sucrose , Lactose, Fructose.

FLAVOURING AGENTS

- Flavouring Agents are additive substances that give a tablet an additional taste or flavour
- Example : Natural or Artificial flavours (Spearmint, Orange)

Ideal Characteristics Of Excipients Used in Tablets

- It should not interact with the active ingredient or other excipients.
- It should be non toxic & safe for human consumption.
- It should not affect the pH of tablet or body.
- It should not absorb or retain moisture.
- It should be able to resist compression forces.
- The cost should be acceptably low.
- They should be physiologically inert.
- It should be soluble in water or other suitable solvent.
- It should not interfere with stability & bioavailibility of drug.

FORMULATION OF TABLETS

- Tablet formulation is defined as process of manufacturing of tablets on a larger scale.
- It involves mainly two methods:

① Granulation Methods
- Wet Granulation
- Dry Granulation

② Direct Compression Methods

① GRANULATION METHOD

- Granulation is a process in tablet formulation that involves creating granules from powder mixture to improve flow properties compressibility & uniformity.
- It is further subdivided into two types:

ⓐ Wet Granulation Method
ⓑ Dry Granulation Method

ⓐ WET GRANULATION METHOD

- Wet Granulation is a process used in tablet manufacturing to create granules from a mixture of powder ingredients & liquid binder.
- The process involves the following steps.

Steps Involved In Wet Granulation

- Weighing & Mixing of Formulation Ingredients.
- Preparing the damp mass
- Wet Screening
- Drying of Moist Granules
- Sizing the Granulation by Dry Screening
- Lubrication
- Compression.

① Weighing & Mixing

- It involves weighing of specified quantities of drug, bulking agent filler or diluent & then mixing together in a specific order, usually starting with active ingredient, followed by excipients like fillers, binders & lubricants.

② Preparation Of Damp Mass

- A liquid binder, such as water or solvent, is added to the powder mixture in a specific amount, usually based on powder's absorbency to prepare a damp mass

③ Wet Screening

- The wet massed powder blend is screened using 6-12 mesh screen to prepare wet granules.
- This can be done by hand or suitable equipment that prepare granules.

④ Drying

- The granules are then dried in a dryer, such as tray dryer or fluidized bed dryer or Hot Air Oven, to remove excess moisture.
- The temperature & duration of drying process depend upon nature of active ingredient & level of moisture.

⑤ Dry Screening

- The dried granules are then passed through a screen of smaller size than that used to prepare moist granules. to remove any oversize and undersize particle.

⑥ Lubrication

- A lubricant, such as magnesium stearate is added to the granules to improve flow properties.

⑦ Compression

- The final step is to compress the granules into tablets using a tablet press.

ADVANTAGES

- Improved Flow Properties
- Increased Density
- Enhanced Compressibility
- Better Content Uniformity

DISADVANTAGES

- Longer Processing Time
- Higher Cost
- Potential for Moisture-Related Issues

ⓑ DRY GRANULATION METHOD

- Dry granulation is a process in tablet formulation that involves compacting a powder mixture without adding a liquid binder.
- This method is also called Double Compression Method.

Steps Involved

- Weighing & Mixing
- Compression into Slugs
- Milling
- Sieving
- Mixing
- Compression into Tablets.

① Weighing & Mixing

The raw materials, typically powders of active ingredient & excipients are weighed & mixed in a powder mixer / blender until a uniform powder mix is achieved.

② Compression To Form Slugs

- In this step, powdered mixture are compressed using a slugging tool or a roller compactor to create a compacted slab or slug.
- This step is also known as precompression.

③ Milling

- Milling is the process of breaking of slugs into smaller granules using a hammer mill or other conventional milling equipment.

④ Seiving

- The milled granules then passed through a selve to achieve a uniform particle size distribution.

⑤ Mixing

- After screening, the remaining lubricants & other required excipients are added & mixed to improve flow properties

⑥ Compression To Form Tablets

The mixed granules are then compressed into tablets using either single or rotato

ADVANTAGES

- Suitable for Heat & Moisture sensitive materials
- Improved flow & compressibility
- Cost Effectiveness

DISADVANTAGES

- Uniformity Challenges
- May require additional lubrication

② DIRECT COMPRESSION METHOD

- Direct compression is a pharmaceutical tablet manufacturing process where powders are compressed directly into tablets without any prior granulation.
- This method is used when drug & excipients have such properties that allow for easy blending & compaction, forming a stable & cohesive properties.
- It involves following simple steps

ⓐ Material Selection

For direct compression, both the active pharmaceutical ingredient & excipient must have good flowability & compressibility.

ⓑ Blending

The API & excipients are carefully blended to ensure a uniform distribution of each component within mixture.

ⓒ Compression

The blended powder is then transferred into a tablet press, where it is compacted under high pressure using punches & dies to form tablets.

ADVANTAGES & LIMITATIONS

- Simplicity & Efficiency
- Ideal for Heat Sensitive Drugs
- Limited to few Drugs only

TABLET COMPRESSION MACHINES

- Tablet Compression Machines are specialized equipments used in pharmaceutical industries to compress powders into tablets.
- These machines can vary widely in size & functionality, from small laboratory units to large industrial machines:
- They are of mainly two types:

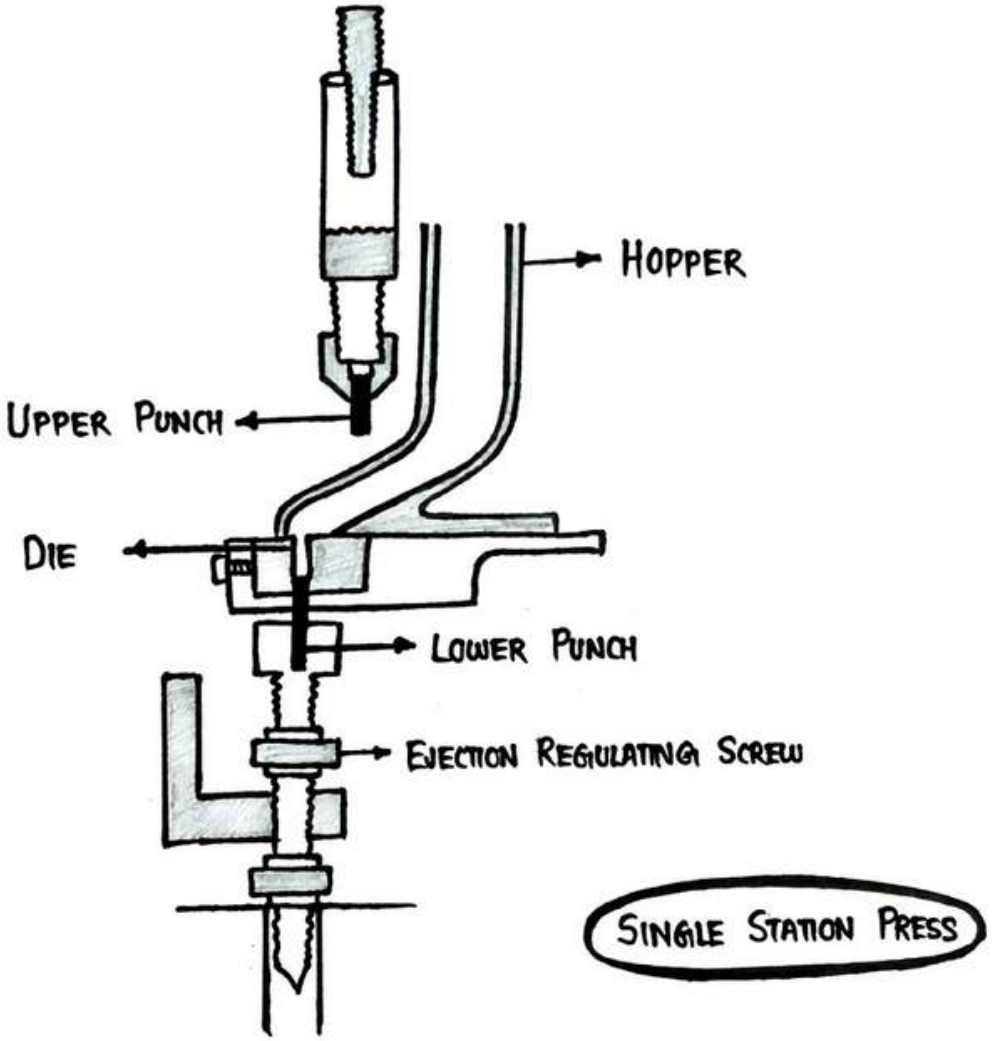
(1) Single Station Tablet Press
(2) Multi Station Tablet Press

① SINGILE STATION TABLET PRESS

A Single Station Tablet Press is a type of tablet compression machine designed to produce 1 tablet at a time, using single set of punches & dies.

KEY COMPONENTS

- DIE: It is a cylindrical cavity that shapes the tablet.
- PUNCHES: There are two upper & lower punches the compresses the granules into tablets.
- COMPRESSION CAM: It controls the movement of punches.
- HOPPER: It delivers powder to the die
- EJECTION SYSTEM: It removes compressed tablet from die.



SINGLE STATION PRESS

WORKING MECHANISM

- The feed system fills the die with the powder/ granules
- The upper punch moves down to compress the powder
- The lower punch rises forming a tablet.
- The ejection system removes the tablet from the die.
- The process repeats for each tablet.

Application

- Research & Development
- Small Batch Production
- Educational Purpose

Advantanges

- Flexibility
- Cost - Effective
- Ease of Use

Disadvantages

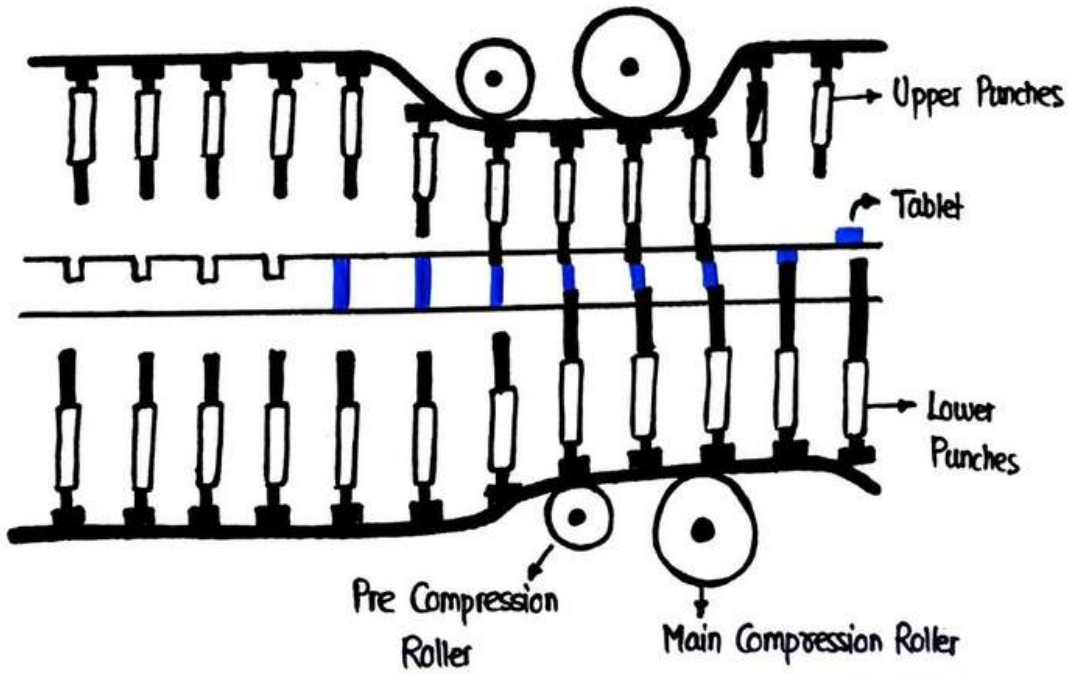
- Limited Production Capacity
- Labour Intensive

② Multi Station Tablet Press

A Multi-Station Tablet Press, often referred to Rotatory Tablet Press, is an advanced piece of machinery used primarily in pharmaceutical industries for large scale tablet production.

Key Components

- Hopper : It holds the powders & granules & delivers to die system.
- Dies : These are the molds that shapes the dies tablets., It has multiple die arrangements.
- Punches : There are two upper & lower punches for each station.
- Compression Cam : It controls punch movements.
- Compression Rollers : The main & pre compression rollers provide force to punches, pressing powder into compact form.
- Ejection System : Removes compressed tablets from dies.



Working Mechanism

- The powder blend is fed into the die stations, through hopper.
- Upper punches moves down compressing the powders.
- Lower punches, rises forming tablets.
- Ejection system removes tablets from dies.
- Process repeats for each station.

Application

- Pharmaceutical Manufacturing
- Neutraceuticals
- Food Production

Advantages

- High Efficiency
- Consistent Quality
- Versatility

Disadvantages

- Higher Initial Investment
- Maintainance Complexity.

Compression & Processing Problems In Tablets

- Compression & processing problems in tablets can significantly impact the quality, efficacy & safety of final product.
- Here are some common issues along with potential causes and solutions.

① Capping & Lamination

The upper layer of tablets separates from main body, causing uneven surfaces or tablet disintegration

Causes

- Poor granule flow properties
- High tablet hardness
- Insufficient binder

Solutions

- Improve granulation technique
- Adjusting binder levels
- Proper lubrication

② Sticking & Picking

Tablet material stick to the punches or dies, leading to defects.

Causes

- Insufficient lubrication

Solution

- Increase lubricants levels.

③ Weight Variation

- Non- uniform weights of tablets of one particular batch.
- Inconsistent tablet weight can lead to dosage inaccuracy.

Causes

- Inconsistent Powder Feeding
- Variability in granule size

Solutions

- Regular Calibration
- Consistent Granulation Methods.

④ Mottling

Mottling is the term used to describe an unequal distribution of colour on a tablet, with light or dark spots.

Causes

- Improper mixing of colouring solution.
- Difference in color of colouring agents & excipients.

Remedies

- Use of good colouring agents
- Change binder system

TABLET COATING

- Tablet Coating is the process of applying a thin, uniform layer of material to the surface of a tablet.
- Substances used for coating are usually applied as a solution or suspension under various conditions.

Advantages Of Tablet Coating

- Improving taste, odour & colour of tablet.
- Improve ease of swallowing
- Improves product stability
- Protection against gastric environment
- Provides a smoother finishing
- Ease of identification.

Types Of Tablet Coating

Tablet Coating are of mainly 3 types:

① Sugar Coating
② Film Coating
③ Enteric Coating

① SUGAR COATING

- Sugar Coating is a type of tablet coating that involves applying a sweet, coloured coating to a tablet to improve its appearance, mask taste & protect stability.
- It involves following steps.

ⓐ Sealing
ⓑ Subcoating
ⓒ Smoothing
ⓓ Colouring
ⓔ Polishing

① Sealing

- It is done for waterproofing of tablet which helps to maintain physical & chemical stability of finished product.
- Material Used : Shellac, Zein, Hydroxypropyl cellulose

② Sub-Coating

- It is the step from which actual coating starts.
- It involves application of large quantity of sugar coating
- It can increase the weight of tablet by 50-100%.
- Powder Used : Powdered Sucrose, Powdered dry gum acacia.

③ Smoothing

- It is done to cover & fill the imperfections in tablet surfaced caused by sub-coating process.
- It can be accomplished by applying a simple syrup solution.

④ Colouring

- It involves multiple application of syrup solution containing the required colour materials necessary to achieve desired shade

⑤ Polishing

- After colouring, tablets are polished to give desired shine to the tablet.

② Film Coating

- Film coating involves deposition of thin film of polymer surrounding the tablet core.
- Film coating solutions can be either aqueous or non-aqueous.

Film Coating Materials

- Film formers.
- Solvent system
- Plasticizer
- Colourants
- Glossants.
- Anti-Oxidants
- Surfactants

Ideal Characteristics of Film Coating Materials

- Adequate solubility in coating solvent & in GI fluid.
- Stability in presence of heat, light, moisture, air etc.
- Compatability to obtain a elegant product.
- They should be non-toxic
- They should be resistant against cracking
- They should not take over any colour, taste, odour.

③ ENTERIC COATING

It is a process of coating of tablet to protect from acidity of stomach and usually disintegrate the tablet in the intestine.

- Interic coating is done to :
- Protect acid labile drugs from GI fluid.
- Deliver drugs intended for local action in the intestines.
- Provide delayed release

Ideal Characteristics of Enteric Coating Materials

- Resistant to gastric fluids
- Compatability with coating solutions
- Formation of continuous film.
- Non- Toxicity.
- Low Cost.
- Ease of Application.

COATING MATERIALS

Tablet coating materials vary based on the type of coating and desired functionality.
Here are common materials used in various tablet coating types :

① FILM COATING

- Polymers : Hydroxypropyl methylcellulose
  Hydroxypropyl Cellulose
  Methyl methacrylate

- Plasticizers : Polyethylene Glycol
  Glycerin
  Triacetin
  Dibutyl Pthalate

- Colorants : Titanium Dioxide
  Iron Oxide
  Natural Colors

- Solvents : Water
  Ethanol
  Methanol

② Sugar Coating

- Sugars : Sucrose
- Polymers : Acacia
  Gelatin
  Povidone
- Colorants : Artificial & Natural colours.

③ Enteric Coating

- Polymers : Cellulose Acetate Phthalate
  Hydroxypropyl Methylcellulose Phthalate
  Polyvinyl Acetate Phthalate
- Plasticizers : Triethyl Citrate
  Dibutyl Phthalate
  PEG
- Other Additives : Talc
  Titanium Dioxide

EQUIPMENTS EMPLOYED IN COATING

Most coating processes use one of the three general types of equipment :

① Standard Coating Pan
② Perforated Coating Pan
③ Fluidised Bed Dryer

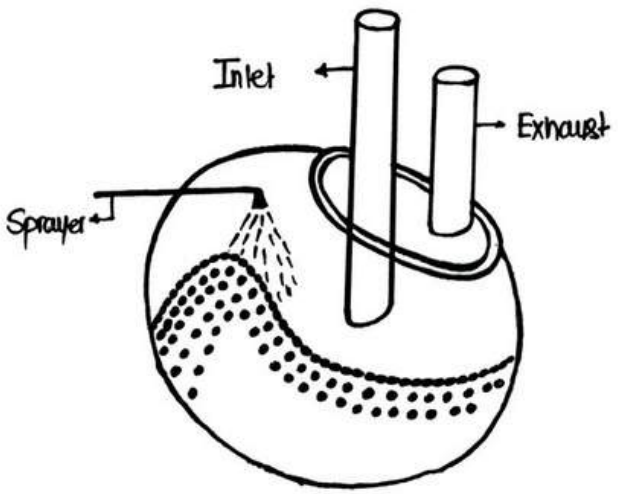
STANDARD COATING PAN

- A Standard coating pan is a type of equipment used in coating process to apply coating in tablets.
- The pan is typically made of stainless steel, and its dimension vary depending on scale of production

Types

It is of mainly 3 types

- Pellegrini Pan System
- Immersion Swood System
- Immersion Tube System

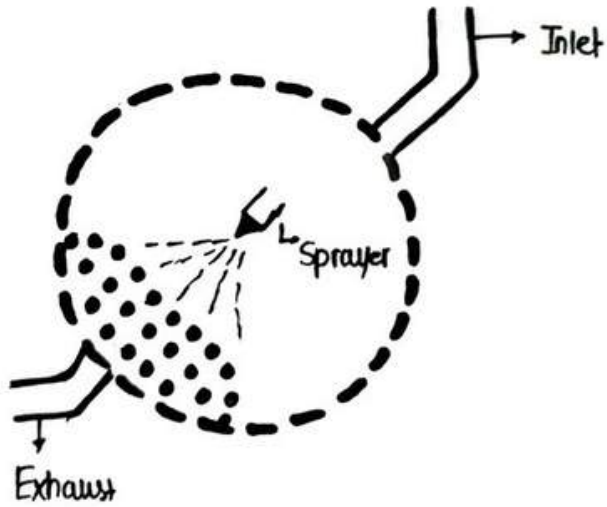


② PERFORATED COATING PAN

A perforated coating pan is a type of coating pan used in coating process, characterized by a drum or basket with perforations that allow air to flow through & facilitate the drying of tablets during coating process

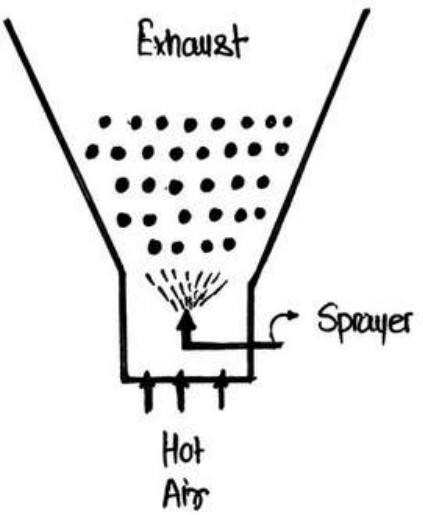
Types

- Accela Cota System
- Hi- Coater System
- Glatt Coater System
- Dricoated System



③ FLUIDIZED BED COATER

- A fluidized bed coater is a specialized piece of equipment used in various industries, particularly in pharmaceuticals & food processing.
- It functions by suspending solid particles in an upward-flowing stream of air or gas, creating a fluid like state.
- It allows uniform coating of materials.



DEFECTS IN TABLET COATING

- Defects in tablet coating can significantly affect the quality, appearance & performance of pharmaceutical tablets
- Here are some common defects, their causes and potential solutions:

① Blistering

- It occurs due to entrapment of gases in films as a result of overheating during spraying.
- For prevention coating should be carried out under mild drying conditions & moderate temperature

② Colour Variation

- In this cated tablets are of inconsistent colours.
- It occurs due to uneven distribution of colorants, improper mixing or variation in coating process.
- It can be prevented by uniform & proper mixing of colourants.

③ Cracking

- It occurs due to insufficient drying, mechanical stress during handling or brittle coating materials.
- It can be prevented by optimize drying conditions, using more flexible coating materials & implement gentle handling procedures.

④ Blooming

- In this coating becomes dull immediately or after prolonged use.
- It generally occurs due to migration of coating components or moisture absorption.
- It can be prevented by adjusting the formulations to minimize migration, using moisture resistant packaging & controlling storage conditions.

⑤ Roughness

- Tablets have uneven or rough surface finish.
- It occurs due to inadequate spray pattern, or formulation issues.
- It can be prevented by optimizing spray technique & ensuring proper formulation.

⑥ Capping / Lamination

- It is defined as separation of layers of tablets.
- It occurs due to high internal pressure or inadequate binding.
- It can be prevented by ensuring proper compression & using suitable binders.

QUALITY CONTROL TEST

- Quality Control Test for tablets ensure their safety, efficacy & consistency
- Here are key quality control test performed on tablets.

① Appearance & Physical Characteristics

- In this tablets are visually checked for defects such as cracks, chips, spots or discoloration.
- Tablet should be consistent in shape, size & thickness.
- Thickness is measured using vernier calipers or micrometers to ensure uniformity.

② Weight Variation Test

- The test is perform to ensure that each tablet contains a uniform amount of active ingredient.
- Procedure : Randomly select tablets from a batch, weigh them individually & compare each tablet's weight to average weight.
- Acceptance Criteria :

IP / BP	Limit	USP
• 80 mg or less	± 10 %	130 mg or less
• > 80 mg or < 250 mg	± 7.5 %	130 - 324 mg
• 250 mg or more	± 5 %	More than 324 mg

③ Hardness Test

- Purpose : Measures the force needed to break the tablet, it is critical for packaging, transport & handling.
- Procedure : A hardness tester (such as Monsanto Tablet Hardness Tester) applies pressure to the tablet until it fractures. Hardness is recorded in Newton
- Acceptance Criteria : Optimal hardness ranges from 4 to 8 kg for regular tablets but may vary depending on tablet type (e.g., chewable or effervescent tablet may require different hardness levels).

④ Friability Test

- Purpose : Test the tablet's ability to resist abrasion or crumbling, which affects handling & packaging.
- Procedure : Tablets are placed in a friabilator, which rotates them at 25 rpm for 4 minutes, after that they are weighed to check for weight loss.
- Acceptance Criteria : The tablets should not lose more than 1% of their weight.

$$F = \frac{W_{initial} - W_{final}}{W_{initial}} \times 100$$

⑤ Content Uniformity Test

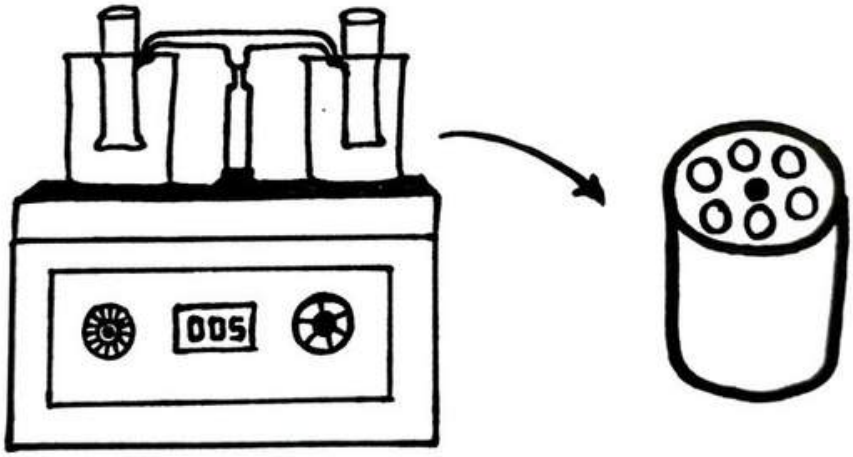
- Purpose : Verifies that active ingredient is uniformly distributed across all tablets in a batch.
- Procedure : Randomly 30 tablets are selected & 10 of these assayed individually to determine amount of API.
- Acceptance Criteria : Typically each tablet should contain 85-115% of label claim for active ingredient.

⑥ Disintegration Test

- The disintegration test is performed to find out that within how much time a tablet disintegrates.
- The test is designed to assess the tablet's ability to disintegrate and release the medication in the body because dissolution rate depends upon disintegration time which ultimately affects absorption rate of drugs.

Procedure

- Tablets are placed in a disintegration test apparatus in a water bath at 37°C.
- The time taken for each tablet to completely disintegrate is recorded



Acceptance Criteria

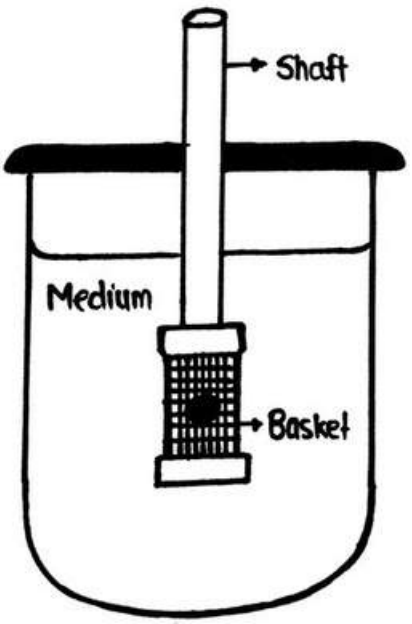
- Tablet should disintegrate within a specified time (usually 15 minutes for uncoated tablets) as outlined by relevant pharmacopoeia.

⑦ Dissolution Test

- The dissolution test for tablets is a quality control test that measures the rate at which a tablet releases its active ingredient.
- The test assesses the tablet's ability to dissolve and release the medications in the body.

Procedure

- Tablets are placed in a dissolution apparatus containing a dissolution medium at body temperature (37°C)
- Samples are taken at specified intervals and concentration of API is analyzed using techniques like HPLC or UV spectroscopy.



Acceptance Criteria

The amount of drug release should meet pharmacopoeial specifications often expressed as percentage of total drug concentration within a certain time (80% dissolved in 30 minutes)

LIQUID ORALS

- Liquid Orals refers to liquid dosage form intended for oral administration, meaning they are designed to be taken by mouth.
- According to our syllabus, they are of 4 types:

① Syrups
② Elixers
③ Suspensions
④ Emulsions

① SYRUPS

Syrups are viscous liquids that typically contain a high concentration of sugar dissolved in water along with API, added flavours and colours.

Types Of Syrups

Syrups are of mainly 3 types:

ⓐ Simple Syrups
ⓑ Medicated Syrups
ⓒ Flavoured Syrups

Simple Syrups

Simple syrup is a basic combination of water & sugar that are dissolved & heated to creak a clear, syrupy liquid.

Medicated Syrup

Medicated Syrup is a liquid preparation that contains one or more active pharmaceutical ingredients dissolved in a sweetned syrup base.

Flavoured Syrup

Flavoured Syrup is a sweetened liquid preparation that contains added flavours, such as artificial or natural flavours.

Common Characteristics Of Syrups

- Thick, Viscous Consistency
- Sweet Taste
- Liquid formulation
- May contain active ingredients
- Often used orally.

PREPARATION METHOD OF SYRUPS

There are following methods of syrup preparation

- Solution with Heat
- Agitation without Heat
- Addition of Medicated or flavouring liquids to Syrup
- Percolation

① Solution With Heat

- This method is suitable for heat stabile or nonvolatile substances.
- In this, sucrose is accurately weighed & then dissolved in pure water.
- After that, other required heat-stable components are added to the hot syrup, the mixture is allowed to cool & its volume is adjusted to proper level by addition of purified water.
- If there is any heat-labile or volatile substance, then they are incorporated into syrup after cooling to room temperature.

② Agitation Without Heat

- This method is used for preparation of syrups containing volatile substances.
- In this process, active substance is added in solution & agitated in glass-stoppered bottle.
- It involves following steps :
  - Sucrose & other ingredients are weighed properly.
  - Dissolved in purified water
  - kept in a bottle of about twice the volume of syrup followed by continuous agitation.

③ Addition Of Medicating or Flavouring Liquid To Syrup

- This method is used when fluid extracts or other liquids are to be added to syrup
- Alcohol is added to dissolve non-aqueous substances.
- Alcohol acts as a preservative also.

④ Percolation Method

- The percolation method of syrup preparation involves circulation of hot water through a percolator for extraction of active & flavouring ingredients such as herbs, spices, fruits etc.
- This method is often used to make flavoured syrups such as:
- Herbal Syrups
- Spiced Syrups
- Fruit Syrups etc.

② ELIXERS

- Elixers are sweet, flavourful liquids. containing dissolved active ingredients, typically used for medicinal purposes.
- They are often confused with syrups, but they have different characteristics : they are made with high proportion of API & alcohols (4-40%) & are usually more potent.

Characteristics

- Sweet & flavourful
- Liquid formulation
- High proportion of API compare to syrup
- Often contains alcohol
- Often used as medicinal agent

Method Of Preparation

- Alcohol soluble & water soluble components are generally dissolved separately in alcohol & water
- Aqueous solution is added to alcoholic solution
- Mixture is made up to required volume by specific solvent or vehicle
- Filters the preparation
- Pour it in a clean bottle & lable the bottle.

EMULSION

An emulsion is a biphasic liquid dosage form in which two immiscible liquids are mixed together with the help of an emulsifying agent. Emulsion generally contain two phases in which one is 'dispersed phase' and other one is 'continuous phase' or 'dispersion medium'.

Examples : Milk (oil in water)
Butter (water in oil)

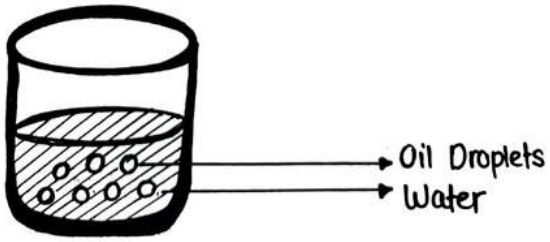
Types of Emulsion

They are of basically three types

① Oil in Water (O/W) Emulsions
② Water in Oil (W/O) Emulsions
③ Multiple Emulsions

Oil in Water (O/W) Emulsions

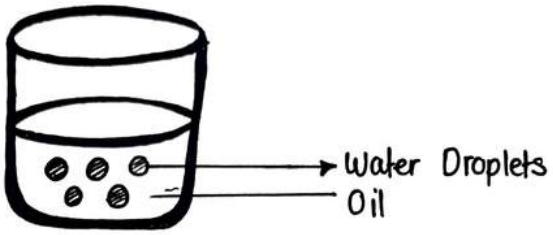
These are emulsions in which oil is present as 'dispersed phase' and water is present as 'continuous phase'/ dispersion medium.



O/W Emulsion

Water in Oil Emulsions (w/o)

These are emulsions in which water is present as dispersed phase and oil is present as dispersion medium/ continuous phase.



w/o Emulsion

Multiple Emulsions

They are of two types

① Oil in water in oil (o/w/o)
② water in oil in water (w/o/w)

Advantages

- Easy masking of unpleasant taste (caster oil, cod-liver oil)
- Emulsion increase the absorbtion of oil when taken internally.
- Used for many external preparations.
- They are generally cost effective

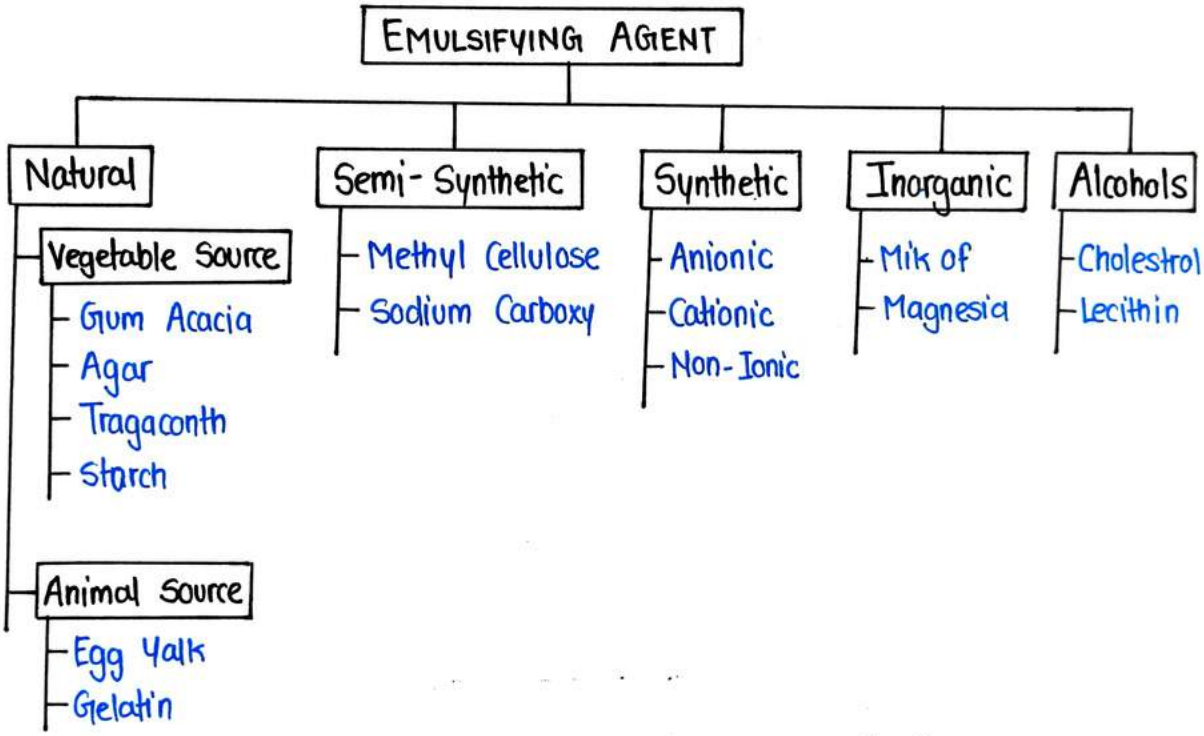
Disadvantages

- Packing, handling and storage is difficult
- Thermodynamically unstable
- Leads to creaming and cracking
- Leads to phase inversion

EMULSIFYING AGENTS

Emulsifying agents are those chemical compounds which reduces the interfacial tension between two immiscible liquids (oil and water) and make them miscible to form a stable emulsion.
Emulsifying Agents are also known as 'Emulsifiers'

Classification



Properties of Emulsifying Agents :

- It should be chemically stable.
- It should be compatible with other ingredients of the emulsion
- It should be Non-toxic
- It must be capable of reducing interfacial tension.

PREPARATION OF EMULSIONS

Emulsions are usually prepared by using three methods :

- Dry Gum Method
- Wet Gum Method
- Bottle Method

Dry Gum Method

- The ratio of Oil : Water : Gum is 4 : 2 : 1
- It requires Mortar and Pestle
- First Oil is mixed with Gum and triturated
- Little amount of water is added and trituration continued till a 'clicking' sound is heard and thick cream is formed.
- Once primary emulsion is formed, remaining water is added to form the final emulsion.

Wet Gum Method

- The Ratio of Oil : Water : Gum is 4 : 2 : 1
- It also requires mortar and pestle
- First water is mixed with Gum and triturated
- Required amount of oil is added and trituration continues to form the primary emulsion
- Once primary emulsion is formed, remaining water is added to form the final emulsion.

Bottle Method

- The ratio of Oil : water : Gum is 2 : 2 : 1
- The method is basically used for volatile and Non - viscous oils
- First oil is mixed with gum and shaken throughly
- Required amount of water is added and shaking continued to form a primary emulsion
- Once the primary emulsion has been formed remaining quantity of water is added slowly to form the final emulsion.

SUSPENSIONS

- A suspension is a biphasic liquid dosage form in which finely divided solid particles dispersed into the liquid.
- In suspensions, Dispersed phase → Solid particles
  Continuous phase → Liquid

- The size of solid particles in the suspension ranges from 0.5 µm to 5 µm.

Classification of Suspensions

Suspensions can be classified on the basis of 3 categories

① On the basis of general classes
② On the basis of proportion of solid particles
③ On the basis of electrokinetic nature of solid particles

On the Basis of General classes

- Oral Suspensions
- Topical Suspensions
- Parentral Suspensions
- Opthalmic Suspensions

Oral Suspensions :

These suspensions are administered orally (by mouth)
example : Paracetamol Suspensions

Topical Suspensions :

These are suspensions that are used for external purposes. They are mainly applied on the skin.

Parentral Suspensions :

These suspensions are administered via intravenous or intramuscular routes through injections. Particle size of solid particles in these suspensions should be very less.

Opthalmic Suspensions :

These are the suspensions in the form of eye drops. Its particle size should be very fine, nor irritating, sterile and isotonic.

On the basis of proportion of solid Particles

- Dilute Suspensions
- Concentrated Suspensions

Dilute Suspensions :

The ~~size of~~ solid range of solid particles in dilute suspensions is 2 - 10 % per volume. example : Cortisone Acetate Suspension.

Concentrated Suspensions :

The range of solid partides in concentrated suspensions is 50 % per volume. example : Zinc oxide suspensions.

On the basis of electrokinetic nature of solid Particles

- Flocculated Suspension
- Defiocculated Suspension

Advantages of Suspensions

- Suspension improves the chemical stability of certain drugs such as procaine, penicilin G
- Easy masking of unpleasant taste.
- Used for both internal and external preparations
- Drugs in the suspension form shows higher rate of bioavailibility. (Solution > Suspension > Capsule > tablet)

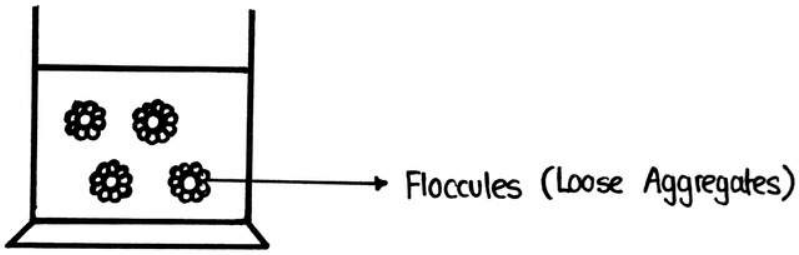
Disadvantages of Suspensions

- Require shaking before use
- Inaccuracy of dose
- Packing, handling and storage is difficult
- Sedimentation of particles.

Flocculated And Defllocculated Suspensions

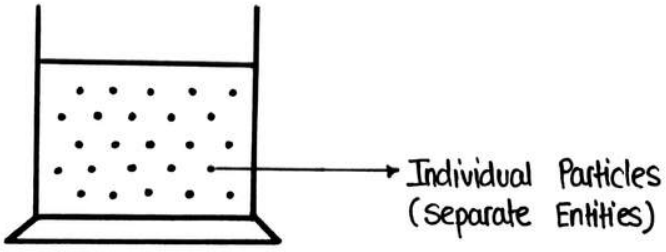
Flocculated Suspension

- A flocculated suspension is a suspension in which particles of the suspension has undergone flocculation.
- In flocculated suspension solid particles of dispersed phase combine together and make 'floccules'.
- In flocculated suspension rate of sedimentation is very high due to the heavy size of floccules.



Deflocculated Suspension

- A deflocculated suspension is a suspension in which no flocculation takes place
- In deflocculated suspension solid particles exist as separate entities.
- In deflocculated suspension rate of sedimentation is slow due to smaller size of dispersed solid particles.



Sedimentation

Sedimentation is the settling down of solid particles of suspension to the bottom of the liquid (suspension)

Difference between Flocculated and Deflocculated Suspension

FLOCCULATED SUSPENSIONS	DEFLOCCULATED SUSPENSIONS
• Particles form loose aggregates • Rate of sedimentation is high • Sediment form rapidly • Doesn't form hard cake • Sediment easily redispersed • Unpleasant appearance • More stable Pharmaceutical Suspension	• Particles exist as separate entities • Rate of sedimentation is Low • Sediment form slowly • Form hard cake • Sediment difficultly redispersed • Pleasant appearance • Very less stable Pharmaceutical Suspension

PREPARATION OF SUSPENSION

- The preparation of suspension involves creating a heterogenous mixture in which solid particles are dispersed in a liquid medium
- Here's a detailed overview of method of preparation of suspensions.

Ingredients

- API
- Suspending Agent
- Liquid Vehicles
- Preservatives
- Flavouring Agents
- Colouring Agents.

Preparation Method

- Measure the required amount of API & other ingredients.
- In a small amount of liquid vehicle, mix the API with a suitable suspending agent to form a smooth paste.
- Slowly add smooth paste to main volume of liquid vehicle with continuous stirring to ensure even dispersion.
- If desired add colouring & flavouring agents at this stage.
- Pour the suspension into sterilized & airtight containers.
- Store it in a cool & dark place.

General Formulation And Manufacturing Consideration Of Oral Liquids

Formulating oral liquids requires careful selection of excipients & techiques to ensure stability, palatability, safety & efficacy.

Factors	Consideration	Example / Solutions
Solubility of drug	Drug should dissolve or disperse uniformly in vehicle.	Co-solvents (ethanol, glycerin, propylene glycol), pH adjustment, salt formation.
Palatability & Taste Making	Many Drugs are bitter/ unpleasant; must be masked for patient	Sweetners (Sucrose, sorbitol, aspartame), flavours (orange, pippermint), colours.
Stability	Prevent degradation & ensures shelf-life	Physical: Prevent precipitation/ sedimentation. Chemical: avoid hydrolysis / oxidation. Microbial: Preservatives.
Vehicle selection	Must be safe, inert, palatable.	Aqueous (purified water, syrups), hydroalcoholic mixtures.

Factor	Considerations	Example / Solutions
Viscosity & Texture	Prevent sedimentation, improve mouthfeel & dose accuracy.	Viscosity enhancers: Methyl-cellulose, acacia, tragacanth.
Preservation	Protect against microbial contamination.	Preservatives: Parabenes, sodium benzoate, sorbic acid.
Packing & storage	Protect drugs from environmental factors, ensures safety	Amber bottles for light-sensitive drugs, plastic/glasss containers, "shake well" labels.
Dose uniformity	Ensure each drug dose has same amount of drug.	Proper mixing, stable suspension/ emulsion, accurate filling.

Filling And Packaging Of Liquid Orals

Filling & Packaging are important steps in the manufacture of liquid oral preparations to ensure accuracy, stability & safety of the product.

① Filling

- Performed after filtration and quality checks.
- Automatic or semi-automatic fillings machines are used to ensure uniform volume.
- Containers are usually filled leaving a small headspace to allow for expansion.
- Clean & sterile conditions are maintained to prevent contamination.
- Viscous liquids (like syrups) require position or vaccum filters, while less viscous liquids use gravity or overflow fillers.

② Packaging

- Containers: Usually made of glass or plastic bottles, depending on the formulation & storage needs.
- Closures: Screw caps, child-resistant caps, or droppers ensure safety and prevent leakage.
- Labels: Include product name, composition, dose, storage conditions, manufacturing & expiry dates.
- Outer Packaging: Cartons are used to protect bottles from light & physical damage.

PRECUATIONS

- Containers must be clean & dry before filling.
- Fill level should allow for temperature expansion.
- Avoid leakage & microbial contamination.
- Use preservatives if needed for long shelf life.

STORAGE

- Store in cool, dry place, protected from light & moisture.
- For suspensions or emulsions : labeled "Shake well" before use".

Evaluation Of Liquid Orals Official In Pharmcopoeia

Evaluation of liquid orals involves various pharmaceutical quality control tests to ensure that the formulations are safe, effective, stable, & uniform throughout their shelf-life.

① Appearance & Colour

- The preparation should be uniform in appearance, free from any visible particles, and have an acceptable colour, taste & odor.
- Checked vissually as per pharmacopoeial standards.

② pH Determination

- The pH measured using a pH meter to ensure it is within the specified range for stability, solubility & palatability.
- Example: Syrups usually have a pH of 4-8.

③ Specific Gravity / Viscosity

- Determines the density and flow properties of the formulation.
- Important for uniform dosing & packaging.
- Measured using pycnometer or viscometer.

④ Assay Of Active Ingredient

- Quantitative estimation of the drug content to confirm it meets the pharmacopoeial limit (usually ±10% of label claim).
- Performed using titration, spectrophotometry, or chromatography.

⑤ Uniformity And Sedimentation (For Suspensions / Emulsions)

- Suspension or emulsion should redisperse easily upon shaking & show uniform distribution of particles.
- Evaluated by visual inspection & redispersebility tests.

⑥ Microbial Limit Test

- Ensures the preparation of free from pathogenic microorganisms and within acceptable microbial limits.
- Especially important for aqueous sugar-based preparations like syrups.

⑦ Stability And Storage Test

- Checked under accelerated & real-time conditions for changes in odor, color or precipitation.
- Ensures product remains stable during its shelf-life.

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