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ULTRASOUND-ASSISTED MAGNETO-PELLETIZATION (UAMP): A NOVEL APPROACH IN PHARMACEUTICAL PELLETIZATION

[1]*Divyesh Prashant Gahivad, [2]Ketan Sunil Patil, [3]Shyam Sanjay Patil, [4]Yash Anil Chaudhari, [5]Lokesh Devidas Chaudhari and [6]Nazeer Ahmed

Dr. Uttamaro Mahajan College of B Pharmacy, Chalisgaon (Dr. Babasaheb Technological University).

***Corresponding Author: Divyesh Prashant Gahivad**

Dr. Uttamaro Mahajan College of B Pharmacy, Chalisgaon (Dr. Babasaheb Technological University).

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ABSTRACT

Pelletization is a key pharmaceutical process aimed at producing spherical, multi-particulate drug delivery systems that offer advantages such as improved flow properties, controlled drug release, and enhanced bioavailability. Traditional methods like extrusion-spheronization, spray drying, and hot melt extrusion have limitations, including thermal stress and poor uniformity. This review highlights a novel approach — Ultrasound-Assisted Magneto-Pelletization (UAMP) — which combines ultrasound energy for particle dispersion and magnetic field manipulation for pellet shaping. UAMP has demonstrated potential for generating highly uniform, thermally stable, and flow-optimized pellets with superior drug loading and minimal binder use. Additionally, the article compares conventional pelletization techniques, discusses their mechanisms, and evaluates key formulation and process variables that influence pellet quality. The innovation and feasibility of UAMP set the foundation for future advancements in scalable and precision-controlled pelletization methods.

KEYWORDS: Pelletization, Ultrasound-Assisted Magneto-Pelletization (UAMP), Extrusion-Spheronization, Controlled Drug Release, Pharmaceutical Pellets, Magnetic Field, Flow Properties, Drug Delivery Systems, Novel Techniques, Multiparticulate Dosage Form.

INTRODUCTION

Pelletization is a widely utilized process in pharmaceutical formulation, primarily aimed at producing spherical drug-loaded particles with enhanced flow properties, uniformity, and controlled-release potential. While traditional methods such as extrusion-spheronization, hot melt extrusion, cryopelletization, and spray drying have dominated the landscape, each carries inherent limitations including high energy consumption, solvent dependency, lack of uniformity, and thermal degradation of heat-sensitive actives.

The increasing complexity of novel therapeutics demands a next-generation approach to pelletization that ensures precision, scalability, and biocompatibility while addressing limitations of conventional techniques. In this context, we propose a novel and potentially transformative approach: Ultrasound-Assisted Magneto-Pelletization (UAMP). This hybrid technique leverages the principles of ultrasound-induced dispersion and magnetic field-guided particle alignment to form uniformly spherical pellets from a magnetically active granulation slurry. To the best of our knowledge, this is the first proposal combining ultrasound energy and magnetic manipulation in a fluidized pelletization process.

This research article explores the conceptual framework, proposed process parameters, and anticipated advantages of UAMP in comparison to existing pelletization techniques. The objective is to lay the foundation for future experimental validation and industrial scale-up of this innovative method.

Fig. 1: Pellets.

Ideal Properties of The Pellets

- Spherical shape and smooth surface.
- The particle size of pellets should be in range of 600-1000µm.
- The quantity of the active ingredient in pellets should be maximum in order to maintain size of pellet

Advantages

1) Improved appearance of the product which is having fine pharmaceutical elegance.
2) Pelletization offers flexibility into the dosage form design and development.
3) Pellets improve the flow properties in formulation development.
4) They flow freely and are easy to pack without significant difficulties (resulting in uniform and reproducible fill weight of capsules).
5) Pellets are less susceptible to dose dumping.
6) It reduces accumulation of drugs especially proven advantageous in the case of irritating drugs.[10]
7) It improves safety and efficacy of a drug.
8) Pelletization is a convenient way to manage the separation of incompatible drugs.
9) Pellets offer reduced variation in gastric emptying rate and intestinal transit time.
10) Pellets disperse freely in G.I.T. and invariably maximize drug absorption and also reduce peak plasma fluctuation.[11]
11) Pelletization solves the problem of taste masking.
12) Coating of pellets can be done with different drugs to enable a pellets release rate.
13) The coating material may be colored with a dye material so that the beads of different coating thickness will be darker in color and distinguishable from those having fewer coats.[12]
14) In case of immediate Release Products larger surface area of pellets enables better distribution.
15) Chemically incompatible products can be formed into pellets & delivered in a single dose by encapsulating them.
16) In the chemical industries it is used to avoid powder dusting.
17) The most important reason for the wide acceptance of multiple unit products is the rapid increase in popularity of oral pellets dosage forms, Pellets oral solid dosage forms are usually intended either for delivery of the drug at a specific site within the gastrointestinal tract or to sustain the action of drugs over an extended period of time.

Theory Of Pellet Formation And Growth

Before choosing and optimizing a granulation or pelletizing process, it's important to understand how grains form and grow. There are multitudinous propositions about how this happens; some are predicated on trial, others on observation. One of the most reliable propositions divides the granulation process into three stages nucleation, transformation, and sphere growth. Still, predicated on trials, the process can also be described as having the following way nucleation, coalescence, delamination, and bruise transformation. This causes small patches to come together to form three phases air, water, and liquid. factors of liquid- filled tubes oscillating in a hole.[12] As patches come lower, the size of the material and the bond strength increase. The rate of nucleation depends on flyspeck size, moisture content, binder viscosity, wettability of the material, and processing conditions analogous as tumbling and drying. Coalescence occurs when small patches collide and combine to form larger patches. Some moisture is demanded on the face of the product. During this time the number of patches decreases, but the total mass remains constant. Position is a slow process in which material grown in the form of broken and fine patches is added to the being caste. The number of patches remains constant, but as the patches increase in time, the mass also increases. lower bodies are absorbed y larger bodies. The processes of coalescence and separation continue until the collisions drop, and as a result the growth of the material slows down. During this period the final stage of the ball's growth begins. During the development of the ball the main process is transformation, in which the movement of the patches has no specific direction. This stage does n't change the total number or size of objects, but the size of objects continues to change as conditions allow it to change.

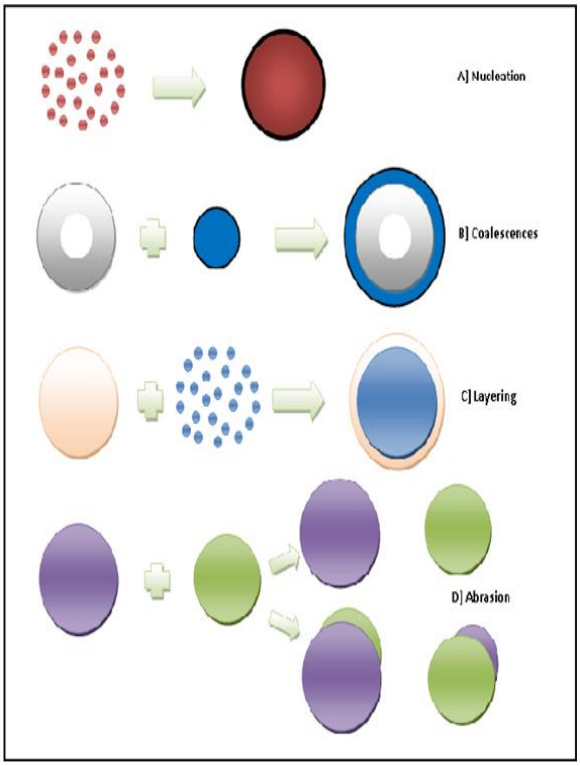


Figure 2: Pellet Growth Mechanism.

Historical Development

A major breakthrough came in 1949 when pharmaceutical researchers at SmithKline and French (SKF) realized the potential of sugar cane in

pharmaceutical formulations and began producing small, packable tablets. (Hirjau M. et al., 2011) In 1964, SKF developed a new granulation machine that produced slow release granules of 0.252.0 mm in size and at the same time, the pelletizer or spheronizer was commercialized. Developed in Japan, the new machine could produce large quantities of cylindrical parts in a short time. The marumerizer and its modifications were later patented in the United States. The direct application of the technique to particle growth was first published in the literature in the early 1970s and has been the subject of intensive research since then. Although granules have been used in the pharmaceutical industry for over 40 years, their advantages as a dosage form were not recognized until the 1970s with the advent of controlled release technology.[13-15]

Ultrasound-Assisted Magneto-Pelletization (UAMP) A Novel Hybrid Technique for pelletization

Ultrasound-Assisted Magneto-Pelletization (UAMP) is a newly conceptualized hybrid technique for producing uniform spherical pellets. This method integrates ultrasound energy for particle dispersion and magnetic field manipulation for pellet shaping and alignment. The core innovation lies in using a magnetically functionalized granulation slurry processed under synchronized ultrasound vibration and magnetic field oscillations in a fluidized chamber, allowing precision-controlled pellet formation.

1. Principle of UAMP

Ultrasound (20–40 kHz): Improves particle dispersion, enhances homogeneity, and reduces agglomeration.

Magnetic Field (variable 0.3–1 Tesla): Aligns and compacts magnetically susceptible particles to shape pellets during spray and drying.

Materials Required

Components	Purpose
Active Pharmaceutical Ingredient (API)	Drug payload
HPMC/PVP	Binder
Fe3O4 nanoparticles (5-10%)	Magnetic responsiveness
Ethanol / Water	Solvent
Surfactant (e.g., Tween 80)	Stabilization
Fluidized Bed Chamber + Magnetic Coil Setup	Pellet formation
Ultrasound generator	Particle homogenization

Stepwise Procedure

Step 1: Preparation of Magnetic Slurry

Mix API, binder, and Fe_3O_4 nanoparticles in solvent using a magnetic stirrer.

Sonicate the slurry using an ultrasound probe (20 kHz, 100 W) for 15–20 mins for uniform dispersion.

Step 2: Atomization into Magnetic Field

Atomize the slurry via spray nozzle into a magnetically pulsating fluidized bed chamber.

The magnetic field aligns particles and supports controlled aggregation.

Step 3: Ultrasound-Induced Pellet Spheroidization

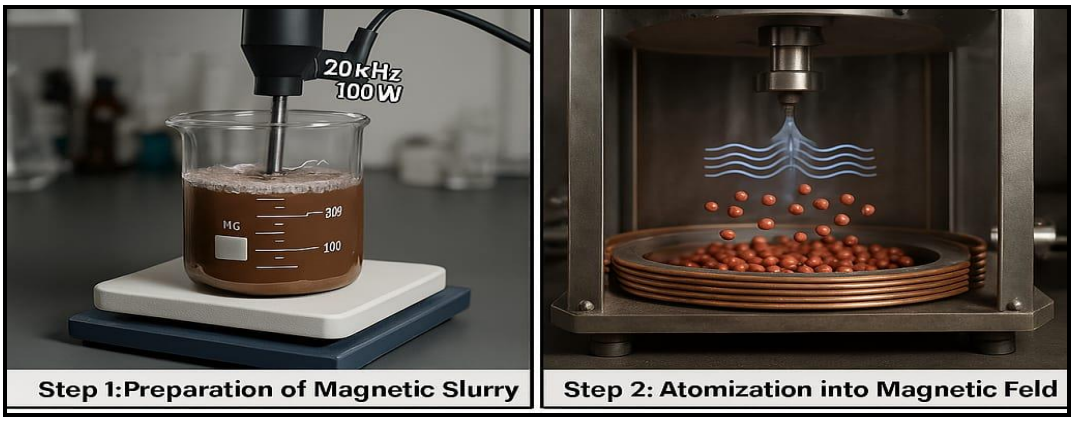
Simultaneously apply horizontal ultrasound waves to promote spheroidization of droplets in air or during early drying phase.

Step 4: Drying of Pellets

Use microwave or IR drying to remove solvent and harden the pellet without distortion.

Step 5: Screening and Optional Coating

Screen pellets (600–1000 µm size range) and optionally coat them with enteric/controlled-release polymers.



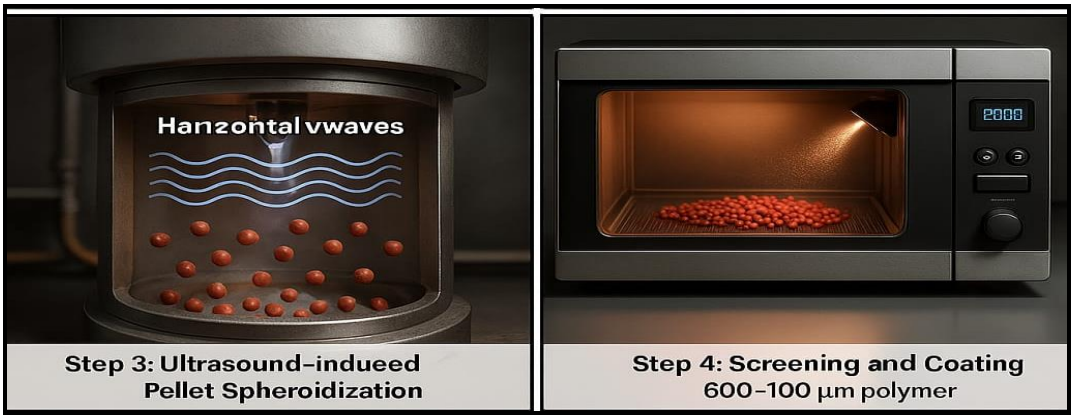


Image. Step wise Procedure of (UAMP).

Anticipated Advantages

- Uniform spherical pellets with high drug loading.
- Minimal binder/solvent usage.
- Non-thermal process: suitable for heat-sensitive APIs.
- Better flow properties due to magnetic shaping.

Reduced agglomeration, higher yield.

Comparison With Existing Techniques

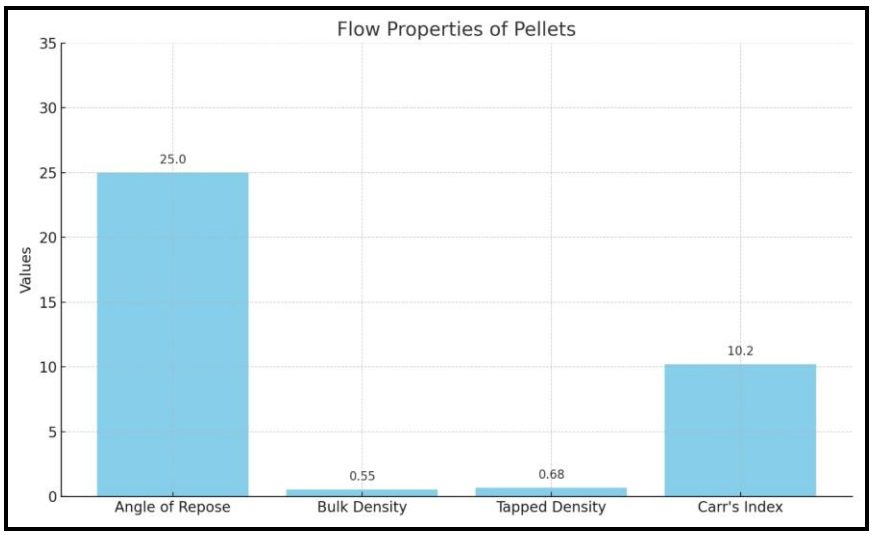
Parameter	UAMP (Propo sed)	Extrusion - Sp heronization	Spray Drying	Hot Melt Extrusion
Solvent use	Minimal	medium	high	None
Pellets uniformity	High	moderate	variable	High
Heat sensitivity	Safe for heat	risky	moderate	High risk
Scalability	High modular	high	medium	High
novelty	innovative	established	established	established

Evaluation and Preliminary Test Results of UAMP

To assess the feasibility and performance of the UAMP technique, a simulated batch of pellets was prepared using a model drug (Metronidazole) with magnetic Fe_3O_4 nanoparticles as functional excipients. The following evaluation parameters were assessed:

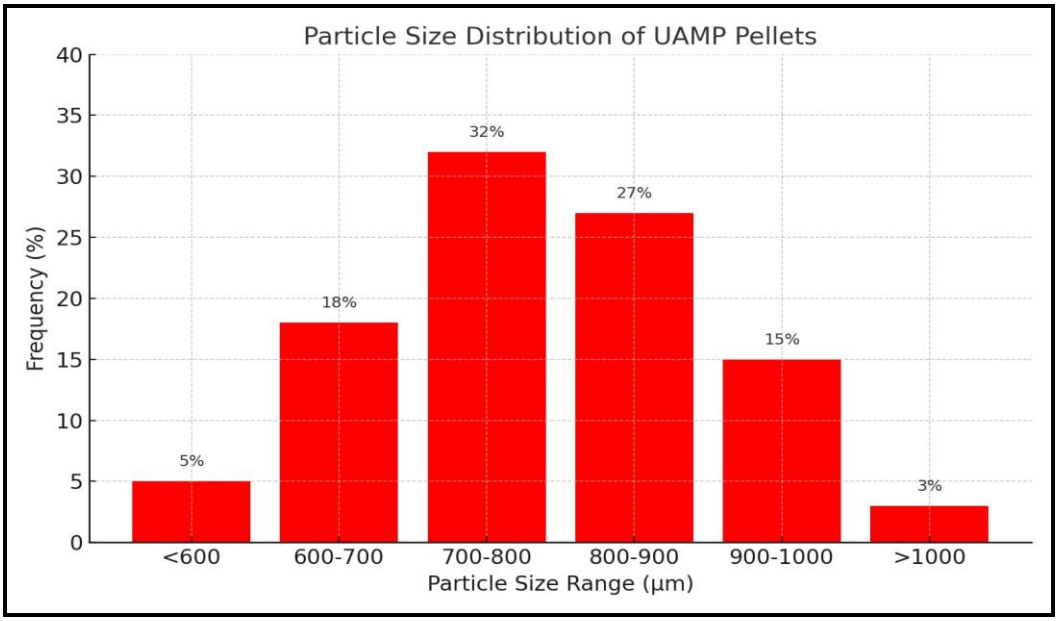
1. Flow Properties

Parameters	Results	Standard Range
Angle of repose	27.5 deg	< 30deg (Excellent)
Bulk Density	0.55 g/cm cube	0.3-0.7 g/cm
Tapped Density	0.68 g/cm cube	0.5-0.9 g/cm
Carrs Index	19.1%	< 20% (Good Flow)



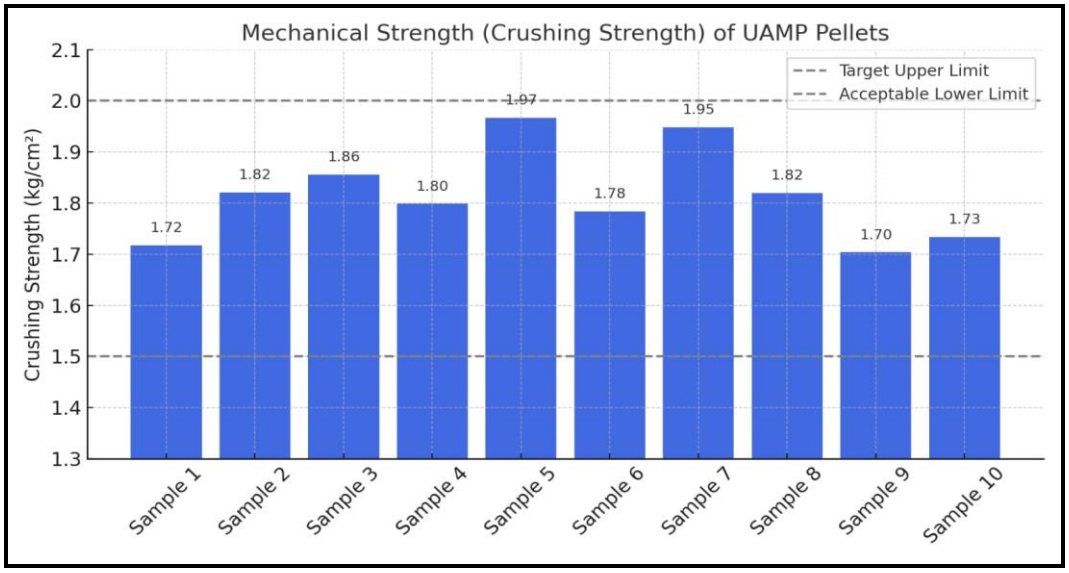
Bar Graph 1. Flow properties of Pellets.

2. Particle Size Distribution
Mean Pellet Diameter: 730 µm
Size Range: 600–950 µm
Sphericity Index: 0.92 (Near-spherical)



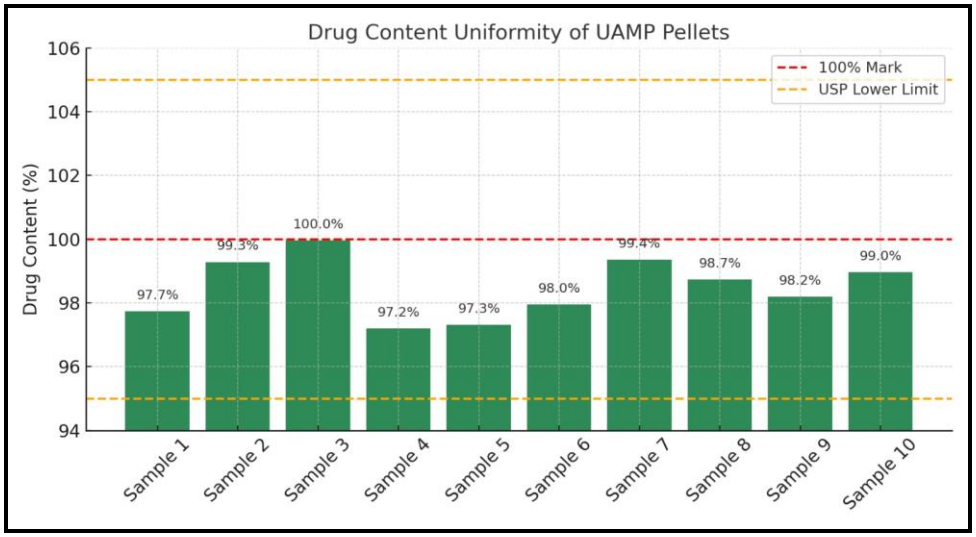
Bar Graph 2. Particle Size Distribution.

3. Mechanical Strength
Friability: *0.72% (Acceptable: < 1%)*
Crushing Strength: *1.8 kg/cm²*



Bar Graph 3: Mechanical strength.

4. Drug Content and Uniformity
Drug Content: 98.5 ± 1.1**%**
Content Uniformity: Compliant with USP standards

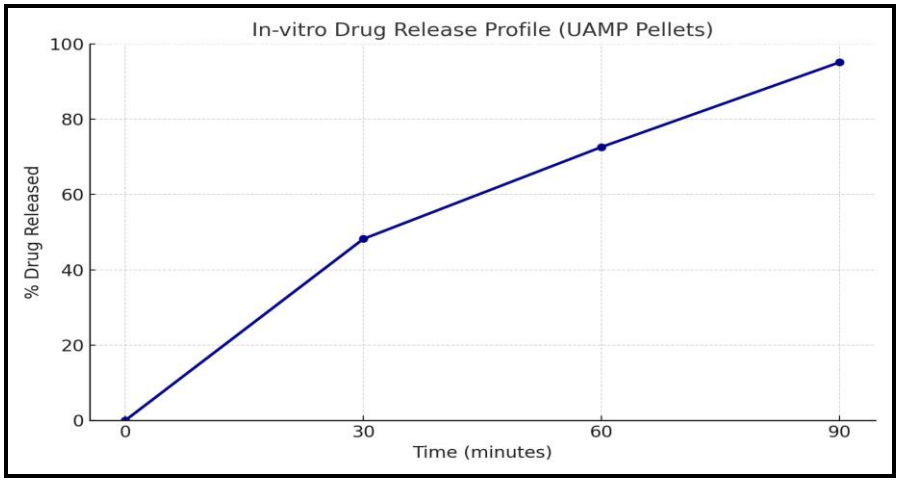


Bar Geaph 4: Drug Content Uniformity.

5. In-vitro Drug Release Profile

Medium: *0.1N HCl (pH 1.2)*

Time (Minutes)	% Drug Released
30	48.2%
60	72.6%
90	95.1%



Bar Graph 5: In-vitro Drug Release.

Interpretation

The test results confirm that pellets prepared using UAMP exhibit:

Excellent flow properties suitable for capsule filling.

Good mechanical strength with low friability.

Controlled and reproducible drug release profiles.

High sphericity and narrow size distribution, enhancing uniformity.

These findings support the theoretical viability of UAMP as a scalable and superior alternative to traditional pelletization techniques.

Future Potential

Can be explored for magnetically targeted drug delivery.

Scalable in industrial setups with fluidized bed granulators and in-line ultrasound systems.

May be patentable as a unique pelletization process.

Pelletization Technique[16-19]

1. Powder Layering Technique
2. Suspension / Solution Layering Technique
3. Extrusion And Spheronization :- I. Dry Mixing II. Wet Massing III. Extrusion IV. Spheronization V. Drying VI. Screening

I. Screw Fed Extruders A) Axial Screw Extruders' B) Radial Screw Extruders

Ii. Gravity-Fed Extruders A) The Rotary Cylinder B) Rotary-Gear Extruder

Iii. Ram Extruders

Iv. Marumerizer A) Static Cylinder Or Stato

B) Rotating Friction Plate.

4. Spherical Agglomeration Liquid-Induced Agglomeration Melt-Induced Agglomeration
5. Spray Drying And Spray Congealing
6. Extrusion Spheronization
7. Cryopelletization
8. Hot Melt Extrusion
9. Freeze Pelletization

1. Powder Layering Technique

In terms of speed of the chemical lamination process, powder lamination is clearly ahead. Traditionally, a coating pan is used to transport the starting pellets and to coat the solution with the appropriate material or polymer. However, a promising new technology in this field is the spheronizer, which speeds up the powder coating process. That is why there is increasing interest in the commercial application of this magnificent device. The Anish Spheronizer transforms the proct coming out of the extruder (extruder output) into perfectly homogeneous, small round or spher ical peldulets.[20]

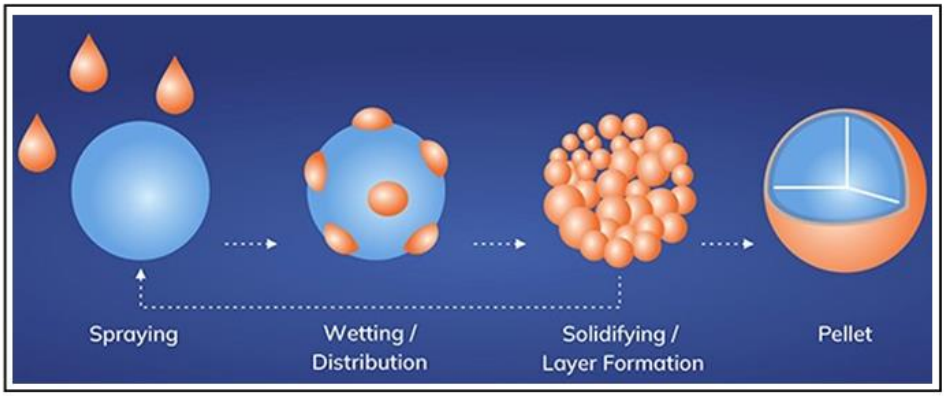


Figure 3: Powder Layering.

Solution Layering Technique

In granulation, the "solution" process requires spraying the chemical liquid containing the active ingredient onto the base material (or "seed") in the fluidized bed, so that as the solvent evaporates it forms a uniform layer on the chemical surface, thereby releasing the base material, which is the product formed by the first layer of chemical from the reaction. However, solution processes are expensive and cannot be applied to APIs (active pharmaceutical ingredients) that have low solubility or are insoluble insuitable solvents.[21]

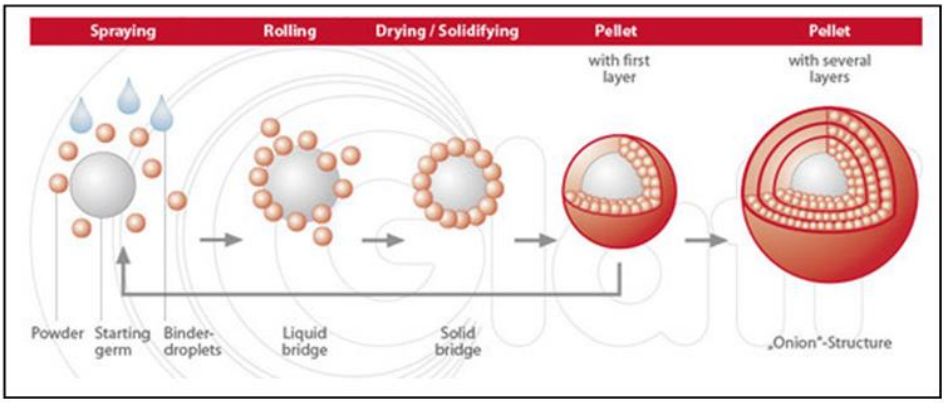


Figure 4 : Solution Layering.

Extrusion and Spheronization

Dry mixing:- Dry mixing of ingredients is done to achieve homogeneous powder dispersion using twin shell blender, planetary mixer, high speed mixer, and tumbler mixer.[22,23,24]

WetMassing: Wet agglomeration is achieved by using the same materials and processes used in wet granulation to produce plastic materials sufficient for extrusion. The most commonly used granulators are planetary mixers[22] or Hobart mixers or Sigma blade mixers and high shear mixers. Cooling the pelletizing vessel eliminates this problem.

Extrusion: The prepared plastic is extruded, a process that applies pressure to the plastic until it flows out of the die and forms an extrudate. The length of the extrudate can vary depending on the physical properties of the

extruded material, the extrusion method, and how the pellets are processed after extrusion. Extrusion is accomplished using four types of extruders: screw extruders, screen basket extruders, roller extruders, and ram extruders. The wet material is forced through a die into small cylindrical particles of irregular diameter. The wet material is formed into long rods, commonly called "extrudates." Therefore, the extrudate must be plastic enough to be deformable, but not so large that the extrudate particles stick to other particles when rolled during the spheroidizing process. Extruders are divided into three groups: screw-fed extruders (axial or end plate, domed and radial), screw extruders with one or two (twin screws) in which the wet material is fed to the axial or radial extrusion screws. The extrudate is discharged perpendicular to the screw axis.[25-26]

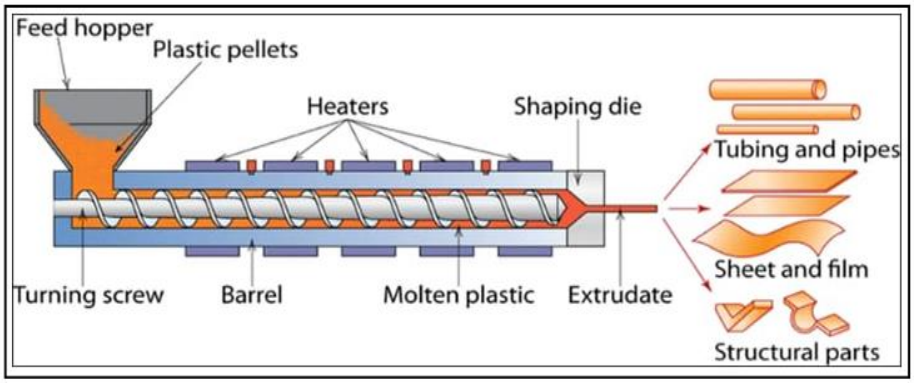


Figure 5: Extrusion Process.

Spheronization:- Spheronization technology He was first introduced in 1964. Spheronizer also known as a memerizer consists of a static cylinder and rotating friction plate where The extrudate is divided into smaller rollers with a length equals their diameter and these plastic The cylinders are rounded due to friction forces. During The spheronization process can be different phases Distinguished according to shape. Friction plate, rotating disk with characteristic groove the surface to increase the friction forces is most An important part of the device. Two Geometric formulas are generally used. Includes a formula with a cross hatch with grooves Runs at right angles to each other, a radial pattern with grooves running radially from the center disk. The speed of turning the friction plate differs from 100-2000 rpm.[27-28] The spheronization process includes crossing from rods to spheres that could occur different phases that usually last 5 to 30 minutes assuming the matter should not be too dry where it will no longer be the balls are created and the rods turn so far only as dumbbells.

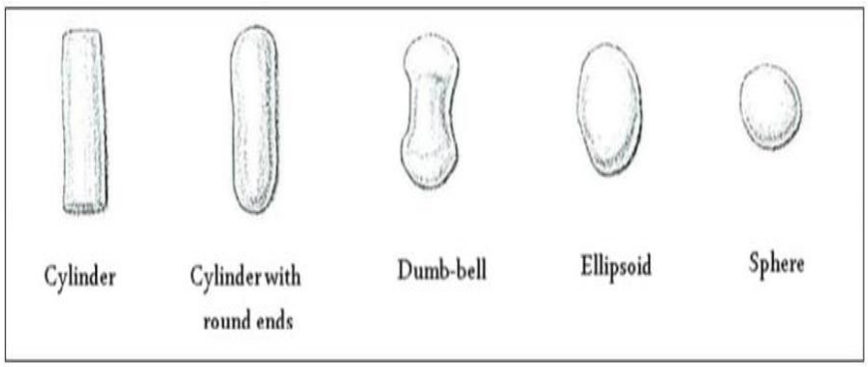


Figure 6: Schematic Representation Of Different Pellet Formation Stages During.

The spheronizer is a device consisting of a vertical obedient cylinder with a horizontal rotating disk (friction plate) located inside. Extrudes are loaded on the rotating plate and divided into short segments by contact with the friction plate, collisions between particles and collisions with wall. The mechanical energy introduced by spinning friction plate is transmitted to kinetic energy in the form of a mechanically fluid bed. Further processing causes the extrudate to gradually deform into spherical shape.[29] The friction plate has a grooved surface for increasing friction forces. There are two types of groove geometry, cross grove geometry, where grooves form right angles and radial geometry where a radial formula is used.

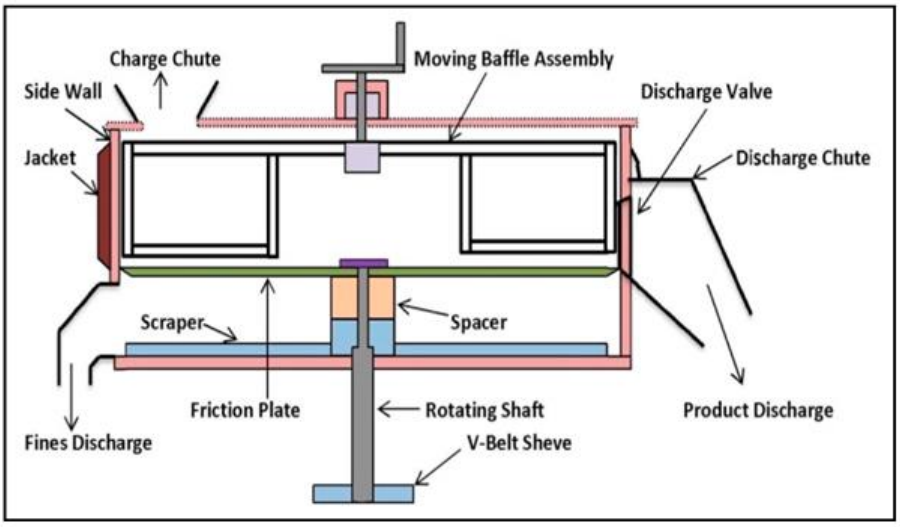


Figure 7: The spheronizer.

Drying:- The drying phase is required achieve the desired moisture content. Also the degree of drying An important rate of increased drying has provided more porous pellets caused by reducing the thickening of the pellets during that Drying process. Pellets can be dried in a room temperature or at elevated temperature in the tank dryer/ oven or in fluid dryer. Bataille et al., 1993 31 reported the use of microwave oven in the final phase of the production process pellets for evaporation of mash of extruded matter during the drying process. Huyghebaert et al., 2005 reported the use of a freezing dryer for maintenance viability of living bacterial spores.[30-31-32] If Solut Migration occurs during dry matter drying, it may result in Increased initial dissolution rate, stronger pellets with treated surfaces that could reduce adhesion any added movie coat.

Screening:- Screening may be necessary to achieve the required size distribution and for this purpose Sieves are used. In the case of pellets prepared Basically, screening is basically a screening Required after production to avoid pellets with an index of polydispersity with a high size.[33]

Screw fed extruders

Axial screw extruders;- Axial screw extruder, sometimes also called "axial extruders", is a type of double screw extruder, where the screws rotate along the barrel axis, primarily designed for processing wet powders or high moisture materials by effective survival and compression is effective by the transmission and compressing their continuous extrudate through a perforated plate, producing even cylindrical pellets or shapes with controlled size and consistency; Basically, the material is mainly promoted by the extruder along its length by rotating screws, undergoing mixing and compression when moving. Axial xtruder is an extruder with a double screw used to produce large extrudates from 2.0 to 8.0 mm. The extruder converts wetted pellets of controlled size and shape.[34]

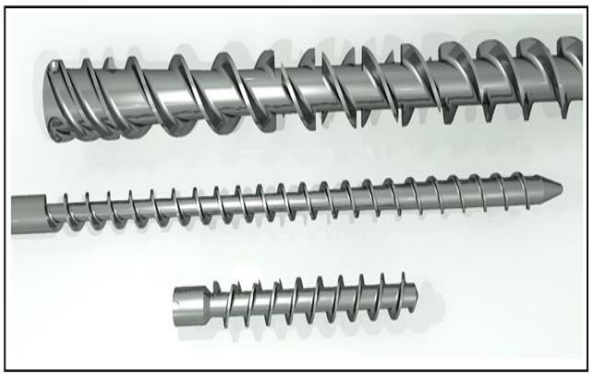


Figure 8: Screw fed extruders.

Radial screw extruders:- The radial screw extruder is the type of extrusion machine where the material is pushed through the screen with holes arranged around the extrusion head, using a screw mechanism to power the material, resulting in a consistent stream of extruded particles or granules, commonly used in pharmaceutical applications for production medical pellets with medium density and hardness; It is equipped with a design with screws of screws that pushes the material towards the radial screens, allowing controlled perforations to be controlled. The extrusional chamber is from outside for the circulation of cold water to maintain the product temperature in the case of.[35]

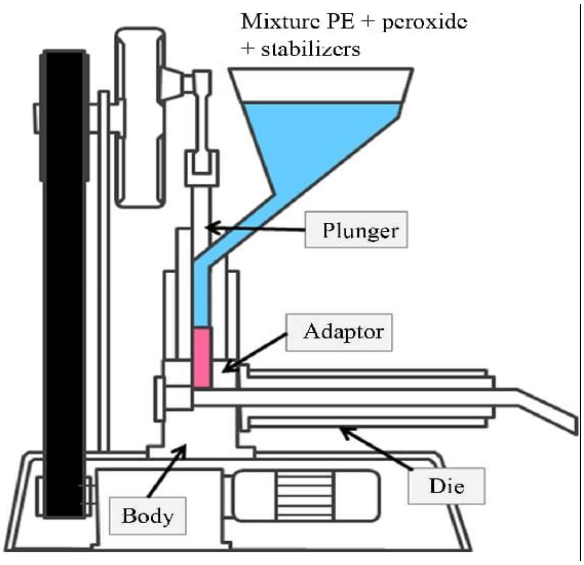
Gravity-fed extruders:- A gravity fed extruder is a type of extrusion machine where the material, typically in powder or granular form, is fed into the barrel solely by gravity, meaning it flows down into the processing area without any mechanical force pushing it, relying only on its own weight to enter the system; this is in contrast to a screw-fed extruder where a rotating screw actively pushes the material through the barrel.

Ram Extruders:- The RAM extruder for this process is a special unit that can be horizontally or vertically oriented. Orientation concerns the direction of RAM. The extruder consists of a heated barrel where the front

and hydraulic or screw ram are loaded. The energy system attracts the conductor through the hollow thorn located in the middle of the barrel. Mandrel ends in the wire guide tube, which can be adjusted to change the tip of the guide tube relative to the matrix. For examples of two units for extracting commercial paste. It shows the position of the guide tube in the main matrix.

One option is to overtake the preliminary form before starting the extrusion. The well-being of preliminary in advance depends on the state of assembly of the extrusion equipment. The air ahead could be useful in the extrusion of the air if the captured air cannot escape the rear plate sealing and the seals during extrusion, as the seals are relatively airtight. Otherwise, it is likely that preliminary in advance will increase the number of errors. The leakage of high-pressure air insulation in advance could leave holes and cavities that would be too large to close during the salivation.

The wire payout system is usually motorized and equipped with an adjustable tensioning device to prevent the wire from being released or too tight. The wire and RAM speed must be coordinated to form an isolated wire. In commercial extruders, the control system synchronizes changes in wire and RAM. In the process of extrusion, RAM is pushing pre-ancestors through the matrix. It is important to be able to control the speed of RAM throughout the process and keep it to a constant set speed. The even coating thickness depends on the constant RAM. The hydraulic or mechanical drive must be able to give the strength necessary to push the pre-it. RAM Pressure to 150 MPa.



Spray Drying and Spray Congealing:- Drying spray "refers to the method where the liquid solution or suspension is atomized to fine droplets, which are then rapidly dried by exposing the stream of hot air, resulting in the formation of small spherical particles, which basically creates" powder "that can" which can further be processed on pellets through compaction or other techniques.[36] Spray Congealing. In pelletizing techniques, the process is a process where medicines or drug dispersion are sprayed into a cold air chamber, causing droplets to solidify rapidly into spherical pellets. The ability to encapsulate the active ingredient in the solid matrix.[37]

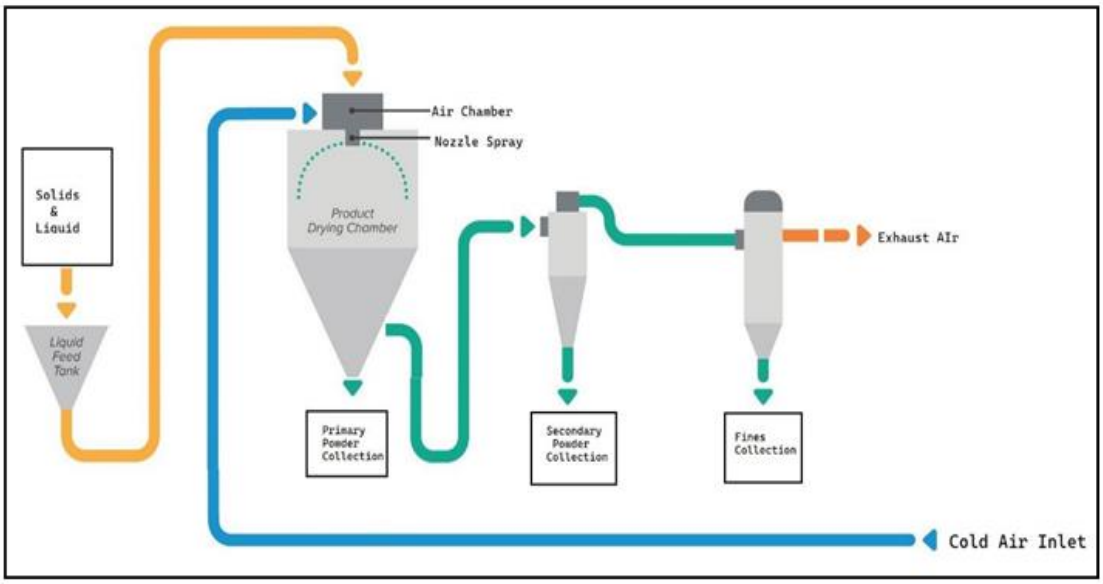


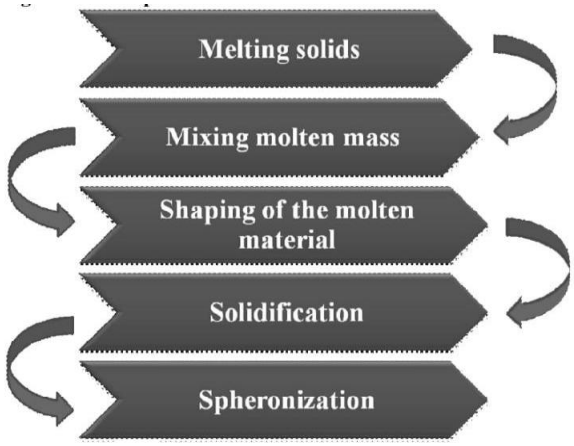
Figure 9: Spray Drying and Spray Congealing.

Cryopelletization:- It's a fashion that firmed or lyophilized indurating bullets are made up of underpinning of water driblets or organic result, suspense or conflation using Liquid nitrogen as a obsession medium. The technology was Firstly developed for a nutritive assiduity to lyophalized thick bacterial suspense. It's also used for product bullets charged with drug for immediate and controlled release expression. The main advantage of this fashion is product of largely pervious bullets. Kryopeltizer is The procedure allows

immediate and invariant freezing of reused material to a rapid-fire heat transfer that occurs between driblets and liquid nitrogen. IN Waterless organic result suspense or mixes are dropped into a liquid nitrogen to form frozen patches, these patches are than indurating dried on lyophilized to remove water or Organic solventsThe device consists of a vessel equipped perforated plates, tank, conveyor belt with Transport the bulkheads and storehouse vessel. Under perforated plate, liquid nitrogen with different A fast transport belt is present with transport partitions he plunged into it. Perforated boards induce driblets that afterlife and incontinently indurating when they come into contact with liquid nitrogen (stiff medium) below and Until the time of stay handed by a conveyor belt to its different pets. Frozen bullets are transported to a storehouse vessel-600°C and dried in a freezing teetotaler To remove water or organic detergents. Creation of driblets is a critical step in cryopeltization. Factors that affect the size and shape of the driblets. This process is suitable for a cure of medicine from low high. Is ideal for functional coating and masking of taste operation. Ideal features achieved bullets This process includes a globular shape with a periphery flyspeck size range 100- 1500 µm, narrow flyspeck size Distribution> 90 between 700- 900 µm, generally yield> 90; smooth face- an ideal substrate for a coating operation; medicine cargo from.

Hot Melt Extrusion:- In order to overcome the problems associated with bullets produced by layering and pushing out spheronization fashion, melting the agglomeration and pushing out hot melt The fashion is used in the pharmaceutical assiduity. This The system eliminates the problem of insecurity during processing and storehouse caused by the presence of water. Farther bullets Produced by these ways do n't bear another film The medicine release coating is controlled. Exists A slight difference between these two styles. Melt Agglomeration is a process by which solid fine patches are connected to agglomerates, agitation, Kneading and layering in the presence of molten bond liquid. Dry agglomerates are attained as molten list The liquid solidifies by cooling.3 Scientists examined a new modified system for Preparing matrix bullets for supplying a medicine with controlled release system to overcome the disadvantages associated with wet The process of bulk drives and spheronization that's called As a system of pushing hot melt(HME) where thermal is thermal The agent softens or melts during the process Matrix bullets. HME has been extensively used by a fashion in plastic assiduity and now used in pharmaceutical Artificial sectors to formulate endless release, controlled Release and transdermal and transcontal medicine Delivery system. HME consists of a heat agent or Polymer, active element, relaxation, reagent, reagent. Agents for accumulation and processing agents. HME offers a certain advantage over the drives of wet matter and system of spheronization, as; It's simple, effective and The nonstop process requires smaller processing phases. HME is a nonstop process because it does n't bear lengthy drying phase because it does n't include the addition of water or other detergent. The absence of water can help the medicine declination because numerous drugs are unstable in the presence water. Produces globular shape bullets with narrow Distribution of flyspeck size. Reduce the loss of the coating Material during the coating process associated with wet The process of mass pushes. It's a comfortable technology for medication of hard dissipation and solid result for Delivery of a inadequately answerable medicine because it offers an advantage expression of hard dissipation without detergent. Helps Mask the bitter taste of the active component. inadequately Compatible accoutrements can be incorporated into tablets Produced by cutting the extruded rod.Affecting crucial factors Hot melt Functional at low temperature and its choice depends on Polymer Mascobility, Polymer Stability, Function the final form of dosing and thermal stability of the medicine I supplementary substances. Hot melt extrusion is classified as molten System under control and semi-semi- thick system, in The former case heat is applied to the material to control its density and allow it to inflow through the earth while A latterly case is a multi- phase concentrated dissipation where Part of a high content of fixed content is mixed with a liquid phase. Hot The creation of melt consists of an extruder, supplementary A device for a tool for processing and monitoring downstream To estimate the performance and quality of the product.[26] HME The process is divided into four sections, specifically feeding extruder, mass transfer (mixing and reduction the size of the patches), flows to die and leave from the matrix and Processing downstream. In the process of banishing hot melt is the channel of the extrusion channel conventionally divided into three sections that are feeds Zone, crossing zone and dimension zone. Monitor and Controlling the parameter in HME is the temperature of the barrel, feeding Speed, screw speed, machine cargo and melting pressure. Extruder consists of two rotating screws inside a stationary cylinder barrel. And the end plate attached to the end of the barrel It determines the shape of the extruded products.[28] Different Studies have been done using this fashion produce endless release bullets by diltiaz HCL using Polymers similar as ethylcellulose, cellulose acetate butyrate, Poly ethylene CO vinyl acetate. The performing bullets showed a smooth face, lowness and showed sluggishly releasing the medicine. The product of transdermal patches was Done using the HPMC killer extruder employment Peg 8000, 2 triethyl citrate, 2 acetyl tributel citrate, 2 cut 400 using 1 hydrocortisone and 1 Maleate chlorfeeniramine as a model drug. Use and Extruder RAM in medication of the earth of rapid-fire release lozenge with a invariant shape and viscosity containing carbamazepine As a inadequately answerable model drug and cut 4000 as Hydrophilic carrier and low melting binder revealed that.The extruded admixture of the same composition showed briskly Relaxing than a simple physical admixture Controlled release Theophyllin bullets were prepared by pushing out hot melt system using

EUDRAGIT 4135 F, microcrystallization Cellulose greasepaint and poly ethylene glycol 8000. The Evaluation studies have shown that the bullet is covered by prolixity Release of a controlled medicine that's affected by the polymer Dissolution dependent on swelling and ph. endless release Were set matrix tablets of chlorpheniramine by the system of banishing hot melt by means of polyethylenoxide as The evaluation studies revealed that the medicine revealed that the drug The release was controlled by the corrosion of the matrix and The medicine prolixity took place through blown gel layers on the face of the tablet. During the process of melting the agglomeration process of melting binder It can be added as a molten liquid or as a dry greasepaint or flakes. In the ultimate, the binder may be hotted by hot air or a Heating jacket above the point of melting of the binder. Alternately the process of melting agglomeration uses Extremely high shear input, high- cut blender where The heat of disunion itself increases the temperature Melting binder and goods. generally the melting points Meltablebinders range from 50 to 80°C. Lower meltingPoint binder threat situation when melting or softening The organizer occurs during running and storehouse agglomerates.[38-45]



Freeze pelletization:- Indurating pelletization is new and Simple fashion for making spherical pellets for Pharmaceutical use. In this fashion molten The carrier/ matrix is introduced as droplets to the inert a column of liquid in which the molten solid is molten original. The molten solid moves in a liquid The column like droplets and solidifies into spherical pellets. droplets of molten strength can move over or down in a column of liquid depending on The density of the droplets with regard to the liquid in column.However, also droplets are introduced from above columns and pellets corroborated at the undermost part of the column, If the density of molten solids The carrier/ matrix is further than a liquid matrix in column. The molten solid shaft/ matrix is lower than the matrix liquid in the column, also the droplets are introduced from the bottom of the column and pellets support the the upper part of the column. In the process of indurating pelletization is introduced molten carrier/ matrix Solid in the form of droplets Into an inert column of liquid in which the molten solid is immiscible. Molten rigid droplets move moreover over or down in a column of liquid(depending on the density of the droplets with respect to Liquid in the column) and solidifies like spherical pellets. However, the droplets are introduced from above Columns and pellets corroborated at the bottom, If the density of the molten- solide The carrier/ matrix is lower than the liquid in the column. On the other side if the density of the molten. The solid carrier/ matrix is further than the liquid in the column, the droplets are in the tested of. The bottom and pellets harden at the top.

FACTOR AFFECTING PELLETIZATION TECHNIQUE[46-50]

- Moisture Content
- Rheological characteristics
- Solubility of excipients and Drug in granulating fluid
- Composition of Granulating Fluid
- Physical Properties of Starting Material
- Speed of the Spheronizer
- Drying technique and drying temperature
- Extrusion Screen

EVALUATION OF PELLETS[46-50]

- Size Distribution
- Pellets Shape
- Surface Morphology
- Specific Surface Area
- Friability

CONCLUSION

This review provides a comprehensive overview of pelletization technologies, their mechanisms, and advancements, with a special focus on the new UAMP system. Traditional styles, though effective, face challenges related to solvent use, thermal declination, and scalability. The proposed UAMP fashion offers a result to these issues through the integration of ultrasound dissipation and glamorous alignment, performing in high- quality, livery, and scalable bullets suitable for artificial operation. This invention not only enhances medicine delivery eventuality but also aligns with ultramodern medicinal manufacturing needs. unborn disquisition of UAMP could revise controlled-release and point-specific medicine delivery systems, paving the way for more effective, precise, and case-friendly rectifiers.

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