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Introduction Of Powders For Pharmaceutical Dosage Forms

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Abstract

A powder is a solid state dry bulk composed of particle of varing shape, grain size and flow properties. Despite the desirable properties of being in fine size, bue it has manufacturing limitations such as difficully in following and clumping together There fore, the granular such course size is preferred to overcome such problems in manufacturing technologies. Powder have different classifications and different uses according to the route of administration which will be covered in this review.powder technology is used in the manufacture of many pharmaceutical products, and research on the physical properties of particles in the nano- to micro-particle range is important in the pharmaceutical field. The concept of precision medicine will require an increasing shift in pharmaceutical manufacturing toward the design of individualized products. This perspective article focuses on particle design and powder technology for advanced formulations that will be needed in the future for individualized drug formulations and on-demand production. Nanoparticles as drug carriers in drug delivery systems will require particle designs to meet the treatment requirements of individual patients with a particular disease. In pharmaceutical manufacturing, process intensification, such as continuous manufacturing and integrated drug production from drug synthesis to final formulation, has attracted increased attention. Digital design approaches, such as artificial intelligence based on computer-aided development, also will be increasingly used. Continuous production of pharmaceutical products enables downsizing of manufacturing equipment, and on-demand manufacturing equipment has been developed. In addition, additive manufacturing, such as 3D printing, is considered to be suitable for personalized formulations, and small-scale powder handling and predictive modeling of powder characterization will be important for individual preparations.Pharmaceutical powders are usually mixtures consisting of a powdered active pharmaceutical ingredient (API) plus a variety of excipients, such as diluents, disintegrants, polymers, and lubricants.

Keywords:- Pharmaceutical powders, powders, granules, classifications, types and used.

INTRODUCTION OF POWDERS

(1) A **powder** is a dry, bulk solid composed of many very fine particles that may flow freely when shaken or tilted. Powders are a special sub-class of granular materials, although the terms powder and granular are sometimes used to distinguish separate classes of material. (2) In particular, powders refer to those granular materials that have the finer grain sizes, and that therefore have a greater tendency to form clumps when flowing. (3)Granulars refers to the coarser granular materials that do not tend to form clumps except when wet.

Many manufactured goods come in powder form, such as flour, sugar, ground coffee, powdered milk, copy machine toner, gunpowder, cosmetic powders, and some pharmaceuticals.(4) In nature, dust,fine sand and snow, volcanic ash, and the top layer of the lunar regolith are also examples.

Because of their importance to industry, medicine and earth science, powders have been studied in great detail by chemical engineers, mechanical engineers, chemists, physicists, geologists, and researchers in other disciplines.(5)

Also, if powder particles are sufficiently small, they may become suspended in the atmosphere for a very long time. (5)Random motion of the air molecules and turbulence provide upward forces that may counteract the downward force of gravity. Coarse granulars, on the other hand, are so heavy that they fall immediately back to the ground.(6)Once disturbed, dust may form huge dust storms that cross continents and oceans before settling back to the surface.

This explains why there is relatively little hazardous dust in the natural environment.(7) Once aloft, the dust is very likely to stay aloft until it meets water in the form of rain or a body of water. (8)Then it sticks and is washed downstream to settle as mud deposits in a quiet lake or sea.(9)When geological changes later re-expose these deposits to the atmosphere, they may have already cemented together to become mudstone, a type of rock. For comparison, the Moon has neither wind nor water, and so its regolith contains dust but no mud stone.

Many common powders made in industry are combustible; particularly metals or organic materials such as flour.(10) Since powders have a very high surface area, they can combust with explosive force once ignited. Facilities such as flour mills can be vulnerable to such explosions without proper dust mitigation efforts.

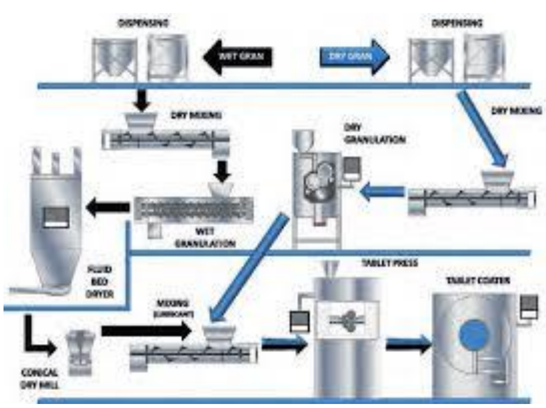

Fig:1 Introduction of powders

Who invented powder structure

Gunpowder, also commonly known as **black powder** to distinguish it from modern smokeless powder, is the earliest known chemical explosive. It consists of a mixture of sulfur, carbon (in the form of charcoal) and potassium nitrate (saltpeter). The sulfur and carbon act as fuels while the saltpeter is an oxidizer. Gunpowder has been widely used as a propellant in firearms, artillery, rocketry, and pyrotechnics, including use as a blasting agent for explosives in quarrying, mining, and road building.

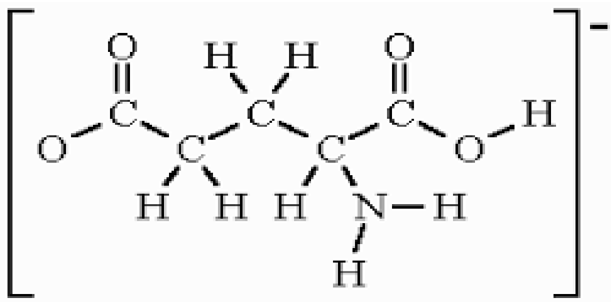

Fig:2 powder structure

Gunpowder is classified as a low explosive because of its relatively slow decomposition rate and consequently low brisance(11). Low explosives deflagrate (i.e., burn at subsonic speeds), whereas high explosives detonate producing a supersonic shockwave. (12) Ignition of gunpowder packed behind a projectile generates enough pressure to force the shot from the muzzle at high speed, but usually not enough force to rupture the gun barrel.(13)It thus makes a good propellant, but is less suitable for shattering rock or fortifications with its low-yield explosive power. (14)Nonetheless it was widely used to fill fused artillery shells (and used in mining and civil engineering projects) until the second half of the 19th century, when the first high explosives were put into use.

Gunpowder is one of the Four Great Inventions of China.[15]Originally developed by the Taoists for medicinal purposes, it was first used for warfare around 904 AD. [16]It spread across Eurasia by the end of the 13th century.[17] Its use in weapons has declined due to smokeless powder replacing it, and it is no longer used for industrial purposes due to its relative inefficiency compared to newer alternatives such as dynamite and ammonium nitrate/fuel oil.(18)

Who Discovered the powder

https://en.wikipedia.org/wiki/History_of_powder

Berthold der Schwarze. Berthold der Schwarze, also called Berthold Schwarz, (flourished 14th century), German monk and alchemist who, probably among others, discovered gunpowder.

Fig:3 Discovered the powder

What is powder ?

A “powder” is a collection of solid particles with individual sizes in the range of nanometres to microns. Each individual particle has physical properties, such as yield strength and melting point; these properties depend on the chemical composition as well as the nano- and micro structure of the particle.(19)

Powder is usually made by grinding a hard material until it's the consistency of flour, fine sand, or light snow — in fact, freshly fallen, fluffy snow is often called powder. (20) There's a fine line between a grain and a powder, but generally powders have the characteristic of clumping together, while grains are more loose and separate. When you powder something, you apply powder to it. The Latin root, pulverem, means "dust." (21)

Fig:4 Powder

A chemical structure determination includes a chemist's specifying the molecular geometry and, when feasible and necessary, the electronic structure of the target molecule or other solid.(22) Molecular geometry refers to the spatial arrangement of atoms in a molecule and the chemical bonds that hold the atoms together, and can be represented using structural formulae and by molecular models; complete electronic structure descriptions include specifying the occupation of a molecule's molecular orbitals.[23] Structure determination can be applied to a range of targets from very simple molecules. (e.g., diatomic oxygen or nitrogen), to very complex ones (e.g., such as protein or DNA).[24]

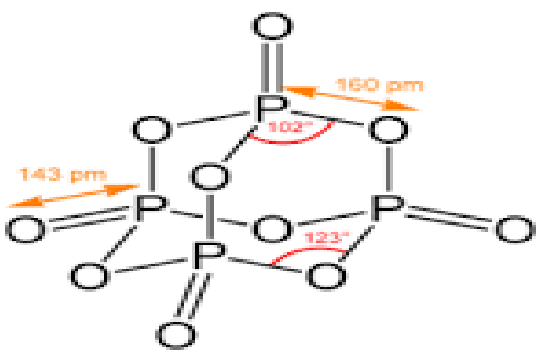

Fig:5 Formula of powder

Which country invented the Gun powder

Chinese

Gunpowder: Origins in the East. “Gunpowder,” as it came to be known, is a mixture of saltpeter (potassium nitrate), sulfur, and charcoal. Together, these materials will burn rapidly and explode as a propellant.**Chinese monks** discovered the technology in the 9th century CE, during their quest for a life-extending elixir….

Fig:6 Invented the Gun Powder

Chemical bonding:-

A chemical bond is a lasting attraction between atoms, ions or molecules that enables the formation of chemical compounds.[25] The bond may result from the electrostatic force between oppositely charged ions as in ionic bonds or through the sharing of electrons as in covalent bonds.[26]In general, strong chemical bonding is associated with the sharing or transfer of electrons between the participating atoms.[27]The atoms in molecules, crystals, metals and diatomic gases—indeed most of the physical environment around us—are held together by chemical bonds, which dictate the structure and the bulk properties of matter.[28]

All bonds can be explained by quantum theory, but, in practice, simplification rules allow chemists to predict the strength, directionality, and polarity of bonds. [29]The octet rule and VSEPR theory are two examples. More sophisticated theories are valence bond theory, which includes orbitalhybridizationand resonance,and resonance,[36] and molecular orbital theory[30] which includes linear combination of atomic orbitals and ligand field theory.[31] Electrostatics are used to describe bond polarities and the effects they have on chemical substances.[32]

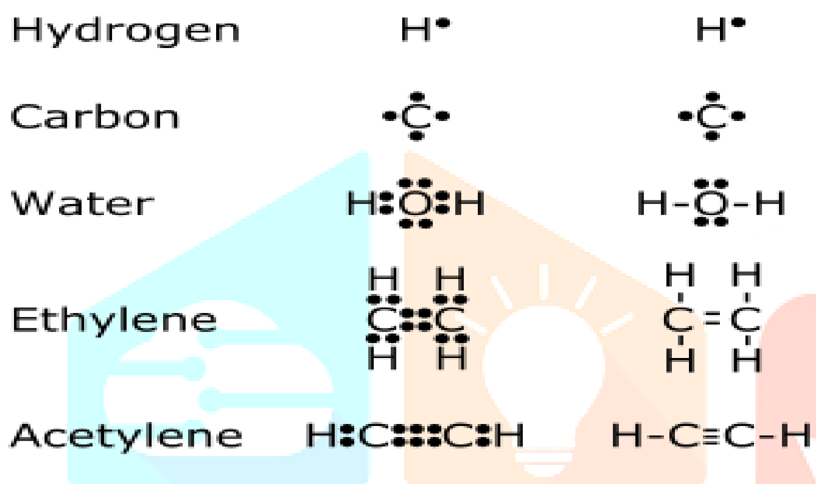

Fig:7 Formula of Chemical Bonding

Who Invented The Powder Equations :-

The earliest chemical formula for gunpowder appeared in the 11th century Song dynasty text, Wujing Zongyao (Complete Essentials from the Military Classics), written by Zeng Gongliang between 1040 and 1044.

Formula Of Gun Powder :-

A balanced, but still simplified, equation is:

$10\ KNO_3 + 3\ S + 8\ C \rightarrow 2\ K_2CO_3 + 3\ K_2SO_4 + 6\ CO_2 + 5\ N_2$.

The exact percentages of ingredients varied greatly through the medieval period as the recipes were developed by trial and error, and needed to be updated for changing military technology.[40]

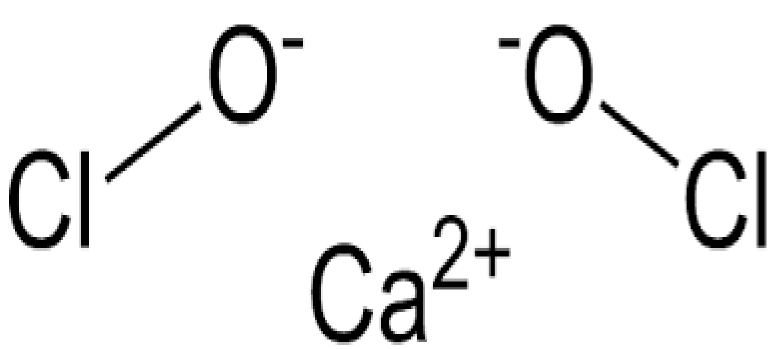

Fig:7 Powder Equation

WHO INVENTED THE POWDER FORMULA:-

German chemist, **Justus von Leibig**, develops the first baby formula—a powdered mix of wheat flour, malt flour, potassium bicarbonate and heated cow's milk. This is a hit in Europe and by 1869, becomes available in the US for $1.[41]

Fig:8 Powder formula

Today most metal powder products are produced through compaction and sintering. That hasn't always been the case, though -- just look at the ancient Egyptians.[33]

Arguably, the process we know today only emerged around a century ago. Before that, metal powder products were made through a process more like forging.[34]

The technological improvements in powder metallurgy have come in waves. Are we in for another one soon?

Let's first look at the history of powder metallurgy to this point. Then we can sort out how the future is shaping up for both supplier and customer.[44]

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The 7 Best Types of Protein Powder

Protein powders are very popular among health-conscious people.

There are numerous types of protein powder made from a wide variety of sources.

As there are so many options, it can be difficult to determine which will provide optimal results.

Here are 7 of the best types of protein powder.

Protein powders are concentrated sources of protein from animal or plant foods, such as dairy, eggs, rice or peas.

There are three common forms:

- **Protein concentrates:**
  Produced by extracting protein from whole food using heat and acid or enzymes. These typically supply 60–80% protein, with the remaining 20–40% composed of fat and carbs.[37]

- **Protein isolates:** An
  additional filtering process removes more fat and carbs, further concentrating the protein. Protein isolate powders contain about 90–95% protein.[38]

- **Protein hydrolysates:**
  Produced by further heating with acid or enzymes — which breaks the bonds between amino acids — hydrolysates are absorbed more quickly by your body and muscles.[39]

Fig:9 Protein Powder

Types of Powder

- Types of powders.
- Loose powders.
- Pressed Powder. A pressed powder is ideal for a gal on the go or someone who wants a bit more precision and a wider shade range. ...
- Translucent Powder. ...
- Coloured Powders. ...
- Setting powder.
- Finishing powder.
- Color Correcting Powders.

Powders are solid dosage form containing dry mixtures of finely divided drug substance(s) and excipients intended for internal or external use. [40]Although the use of powders as a dosage form has been replaced largely by the use of tablets and capsules in modern medicine, they represent one of the oldest dosage forms and present certain advantages that have led to their continued use as pharmaceutical dosage forms.[41]

Methods of Powders

Solid-State Reduction

In solid-state reduction, selected ore is crushed, typically mixed with carbon, and passed through a continuous furnace.[42]In the furnace, a reaction takes place, reducing the carbon and oxygen from the powder,[43] that leaves a cake of sponge metal which is then crushed, separated from all non-metallic material,and sieved to produce powder.[44]Since no refining operation is involved, the purity of the powder is dependent on the purity of the raw materials.[45]The irregular sponge-like particles are soft, readily compressible, and give compacts of good pre-sinter ("green") strength.456]

Atomization

In this process, molten metal is separated into small droplets and frozen rapidly before the drops come into contact with each other or with a solid surface. [47]Typically, a thin stream of molten metal is disintegrated by subjecting it to the impact of high-energy jets of gas or liquid. In principle, the technique is applicable to all metals that can be melted and is used commercially for the production of iron; [48] copper; alloy steels; brass; bronze; low-melting-point metals such as aluminum, tin, lead, zinc, and cadmium; and, in selected instances, tungsten, titanium, rhenium, and other high-melting-point materials.[49]

Electrolysis

By choosing suitable conditions, such as electrolyte composition and concentration, temperature, and current density, many metals can be deposited in a spongy or powdery state.[50] Further processing—washing, drying, reducing, annealing, and crushing—is often required, ultimately yielding high-purity and high-density powders.[51]

Copper is the primary metal produced by electrolysis but iron, chromium, and magnesium powders are also produced this way.[52]Due to its associated high energy costs, electrolysis is generally limited to high-value powders such as high-conductivity copper powders.

Chemical

The most common chemical powder treatments involve oxide reduction, precipitation from solutions, and thermal decomposition.[53] The powders produced can have a great variation in properties and yet have closely controlled particle size and shape.[54]Oxide-reduced powders are often characterized as "spongy," due to pores present within individual particles.

Solution-precipitated powders can provide narrow particle size distributions and high purity. Thermal decomposition is most often used to process carbonyls.[55] These powders, once milled and annealed, exceed 99.5% purity.

Methods Powder

Read further to answer questions like:

- What is powder metallurgy?
- The types of powder metallurgy processes
- Parts and products made using powder metallurgy
- Metals used in powder metallurgy

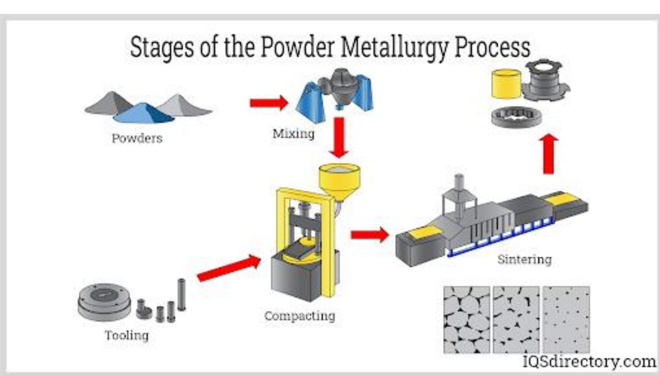

Fig:10 Stages of the Powder Metallurgy Process

What is Powder Metallurgy?

Powder metallurgy is a manufacturing process that produces precision and highly accurate parts by pressing powdered metals and alloys into a rigid die under extreme pressure.[56]With the development and implementation of technological advances, powder metallurgy has become the essential process for the production of bushings, bearings, gears, and an assortment of structural parts.[57]

Fig:11Powder Metallurgy

The key to the accuracy and success of powder metallurgy is the sintering process that heats parts and places them under pressure to bond the powder particles.[58]The temperature in sintering is slightly below the melting point of the primary metal such that the bonds of the powdered particles are bound together.[59]

Chapter Two - The Powder Metallurgy Process

The process of powder metallurgy is an ancient, unique method for forming shapes and designs from ferrous and non-ferrous metals. [60]Powder metallurgy has been used for thousands of years as a way to produce household items and tools.[61] It began as a method for mass producing products and parts in the middle of the first industrial revolution.

Until the early part of the 20th Century, the process was used sporadically but was not considered to be a viable production method.[64] With the development of electricity and technological advances, powder metallurgy has found a place as a highly efficient and productive method for producing parts with high tolerances and minimal waste.[65]

Process of the Powder Metallurgy

The four basic steps to the powder metallurgy process are powder preparation, mixing and blending, compacting, and sintering.[67] These steps have been used over the centuries to produce a variety of products.

As with any manufacturing process, powder metallurgy has variations to accommodate the requirements of individual parts.[68] The different methods and techniques have grown from the development of technological advances and engineering specifications.[69]Four of the variations are conventional, injection molding, isostatic pressing, and metal additive manufacturing, which is the newest advancement.[70]

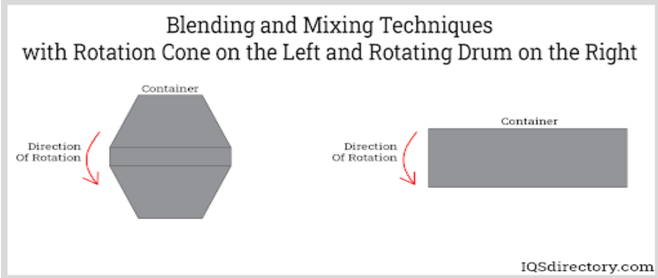

Fig:12Process of the Powder Metallurgy

Four Basic Steps of Powder Metallurgy

Powder Preparation

Properties of products produced using powder metallurgy are dependent on the characteristics and properties of the powder.[71]One of the processes used to produce powder for powder metallurgy is melt atomization.[72] In this process, liquid metal is broken into tiny droplets that cool and solidify into minute particles.

Though atomization is the most common method for producing powder, other processes include chemical reduction, electrolytic deposition, grinding, and thermal decomposition. Regardless of which process is used, all metals and alloys can be converted into a powder.[73]

Prior to mixing and blending the powder, it is evaluated and tested for its appropriateness for the powder metallurgy process. The factors that are considered are flow rate, density, compressibility, and strength.[74]

Mixing and Blending

In the mixing and blending process, powders are combined with other powders, binders, and lubricants to ensure the final part has the necessary characteristics. Blending and mixing can be completed wet or dry depending on the type of powder metallurgy process and the requirements of the part.[75]

The four most common blending and mixing techniques are rotating drum, rotating double cone, screw mixer on the interior of a drum, and blade mixer on the interior of a drum. The image below shows a rotating double cone and rotating drum with three examples of blended powder below.[76]

Fig:13 Blended Powders

Compacting

Compacting involves pressing and compressing the powder mixture into the desired shape or die. When done properly, compacting reduces potential voids and significantly increases the density of the product. The compressed and pressured form is referred to as a green compact, an indication that the part was formed by compacting.[77]

Compacting pressure is between 80 MPa and 1600 MPa. Each type of metal powder requires a different amount of compacting pressure depending on its properties.

In soft powder compacting, the pressure is between 100 MPa and 350 MPa. For more resilient and harder metals, such as steel and iron, the pressure is between 400 MPa and 700 MPa.

Fig:14 powder metallurgy press machine

Sintering

Though the green compact has been stressed and pressed at extreme pressure, it is not strong enough to be used.[78] In order to produce a permanent bond between the metal particles, the green compact is sintered or heated at high temperature. In essence, sintering produces the final usable product or part.

Sintering is a heat treatment wherein large numbers of parts, in compacted form, are subjected to temperatures that are sufficient to produce enough pressure to cause the loose particles to unite and bond, forming a solid piece. The required temperature fluctuates in accordance with the type of metal but is always slightly lower than the metal's melting temperature.[79]

Compacting presses the particles of the green compact to form a shape. Regardless of the pressure applied during compacting, there are still minute porous spaces in the green compact. During sintering, the material is squeezed and pressured under high temperatures to close the porous spaces and strengthen the part.

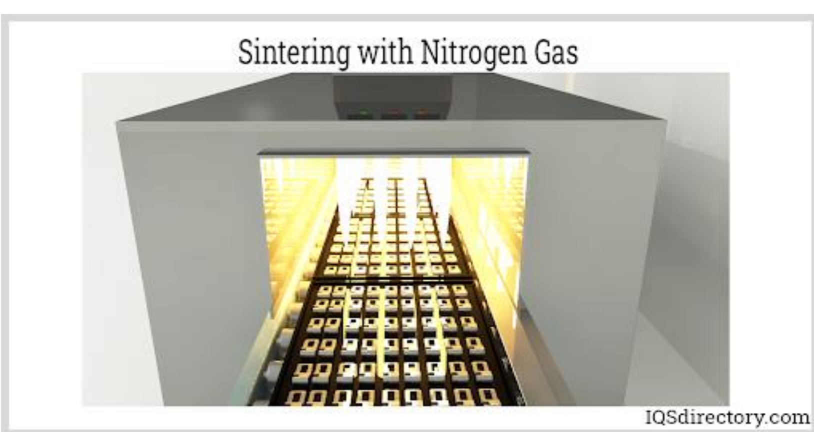

Fig: 15Sintering with nitrogen gas

Conventional

Conventional powder metallurgy follows each of the steps of basic powder metallurgy where the powder and alloy are mixed, compacted, and sintered. It is much like the ancient method of powder metallurgy with the added benefit of modern technology.[80]

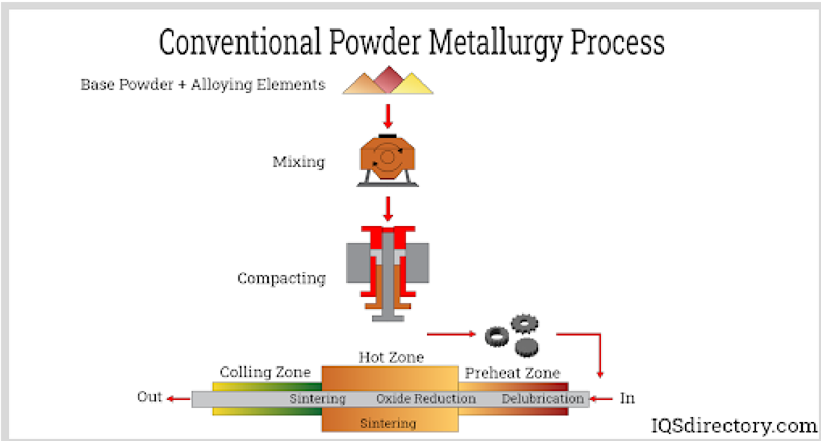

Fig:16 Conventional Powder Metallurgy process

Injection Molding

The unique benefit of injection molding is its ability to produce complex shapes in large quantities. The powders for injection molding are specially formulated with a binder, such as wax or a thermoplastic. The mixture, referred to as feedstock, is fed into the mold cavity of a normal injection molding machine. When the green compact is discharged from the mold, the binder is extracted by thermal processing or solvent. Any remaining binder dissipates during sintering.

The injection molding powder metallurgy process is very similar to plastic injection molding and high pressure die casting and produces the same intricate and complicated shapes of those processes. The difficulty with powder metallurgy injection molding is the amount of secondary finishing that is necessary. Its benefit is its ability to produce good dimensional tolerances in unlimited shapes and with unique geometric features.

Isostatic Pressing

Isostatic pressing is an equal pressure process wherein the same amount of pressure is applied to the entire surface of the work piece. By applying pressure equally from all directions, every angle, curve, line, and depth of the part has the same density and micro-structure. Isostatic pressing can be performed either cold or hot depending on the requirements of the piece being produced.

Cold isostatic pressing produces parts where pressing dies are not an option or the parts to be produced are very large and complex. A wide variety of materials can be used for isostatic processing. The amount of required pressure begins at a little under 5000 psi and goes as high as 100,000 psi. The powder is molded in elastomeric molds that may be wet or dry.

Hot isostatic pressing combines high temperatures with isostatic pressure. The combination of the two factors eliminates porosity, increases density, improves mechanical properties, and makes finished parts workable. Hot isostatic powder metallurgy reduces microshrinkage.

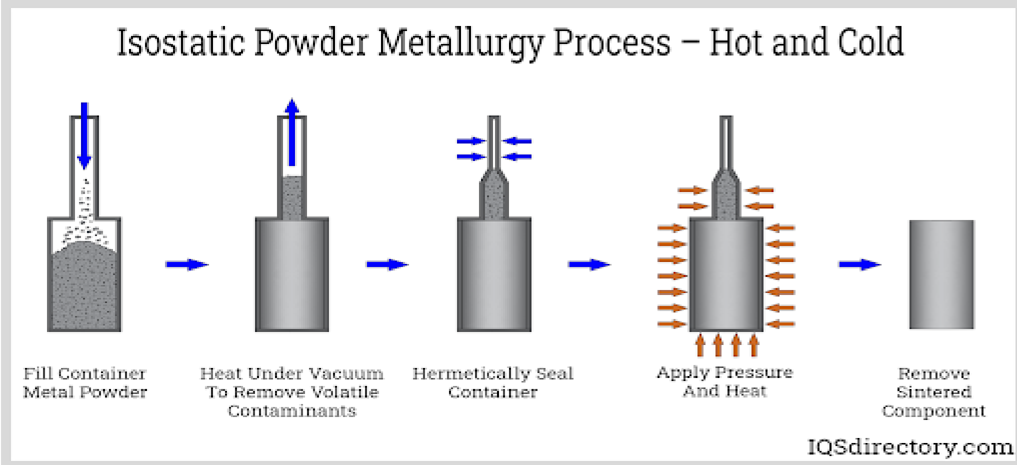

Fig:17 Isostatic powder metallurgy process

Metal Additive

Metal additive manufacturing is a huge step forward in production processes and the next method for producing items we need. Sometimes referred to as three dimensional printing, it is a process that has been used for years to make prototypes for proposed components. Additive manufacturing builds parts layer by layer from a digital representation.

The process of metal additive manufacturing encompasses several technological advancements, is highly efficient, and does not produce any waste. It begins with a powder bed that is 20 µm (micrometers) to 100 µm thick. One or more lasers are applied to the bed to melt away the various layers. The process of melting continues layer by layer until the part is completely formed.

Advantages

1. Powders are more physically and chemically stable when compared to the liquid dosage form.
2. The drug product in the powder dosage forms is less prone to microbial contamination.
3. It is an ease mode of drug administration when the dose is very large.
4. It is well accepted by pediatric and geriatric patients.
5. The rate of dissolution and absorption is faster in powder dosage form when compared to anyother SDF.

Disadvantages

1.Powders are bulky dosage form and causes difficulty in handling and transport.

2. They are not easily transferrable from a container and may spill.

3. The method of preparation and packaging is time-consuming.

4. Drug substances that are having an unpleasant taste are not suitable to administer in powder form.

5. The substances that are hygroscopic, deliquescent, volatile, and oxygen-sensitive are not suitable to be administered in powder form

Classification of Powders

The classification of powders is as follows:

1. Aerosol powders:

Medicated powders that are taken or administered by inhalation with the help of a dry powder inhaler are aerosol powders. The products delivered by this route are intended for the treatment of asthma or bronchial disorders. The particle diameters, which are delivered by this route, are in the range of 1–6 µm. These products also contain inert propellants and pharmaceutical diluents to protect the powder from humidity, to aid in flow property and for the metering uniformity.

2. Bulk powders

Medication in bulk powder forms is limited to non-potent substances. Examples of powders taken in the bulk forms are medicated topical anti-infectives such as polymyxin B sulfate, tolnaftate, etc., douche powders for vaginal use such as Massengill powder, reconstituted antacid preparation such as sodium bicarbonate, laxative such as psyllium, etc.

3. Divided powders

These are properly blended by using geometric dilution method and then based on the amount to be taken at a single time are divided as single dosing units. The divided powders are packed in small piece of paper folded to enclose the medication. Examples: Powdered laxatives, douche powder and analgesic powders.

4. Effervescent powders

These powders when mixed with water shows effervescence with the liberation of carbon-di-oxide. The effervescence also helps in masking the bitter taste of active ingredients. The usual content of these powders are sodium bicarbonate, organic or inorganic acids such as citric acid, tartaric acid, etc.

5. Explosive powders

Substances such as an oxidizing agent and reducing agent when triturated in a mortar and pestle there are chances of explosion, which may occur due to the heat generation and may lead to serious consequences. To handle such type of powders each ingredient should be separately triturated and lightly mixed without applying any pressure. Alternatively the powders can be individually triturated and can be separately packed and dispensed with suitable directions to the patient regarding its use.

6. Medicated powders for internal use:

These powders are available to be used both internally and externally. Internally used powders are added in water or directly taken internally. Internal medicated powders can also be inhaled for both local such as analgesics and systemic use such as laxatives. Medicated powders taken systemically will have faster rate of dissolution and absorption when compared to any other SDFs. These powders are also available in reconstituted form.

7. Insufflations

These powders are usually applied with an applicator known as insufflators. Insufflations are finely divided powder form introduced into different body cavities such as nose, ear, vagina, tooth sockets, etc. When the insufflator is compressed, a current of air distributes the powder particles in a stream of gas through the nozzle into the delivery site. Uniform dose delivery may not be obtained by insufflations.

8. Dusting powders

Dusting powders are used externally for local application, not intended for systemic action. The desirable characteristics of dusting powders are non-irritability, homogeneity, free flow, good spreadability and covering capability, the fine state of subdivision, and capacity to protect the skin from chafing and irritation caused by friction, moisture, and chemical irritants. The formulation usually contains substances such as kaolin, talc, zinc oxide, starch, and boric acid.

These powders are micronized by passing through sieves #85 or 120. It should be preferably dispensed in sifter-top containers. Such containers provide protection from air, moisture, and contamination as well as convenience of application. It should contain a label as “FOR EXTERNAL USE ONLY.” The categories of drugs dispensed are lubricants, protectives, adsorbents, antiseptics, antipruritics, astringents, and antiperspirants.

Dusting powders can be classified into the following two types:

(a) **Medicated dusting powders:** These are the bulk SDFs, which are intended to be applied on the intact skin for local action.

(b) Surgical dusting powders: These are the bulk SDF, which are intended to be applied into the deep layers of the skin. These preparations need to be sterile as it comes in contact with open wounds and deep layers of the skin.

9. Dentifrices

Dentifrices are bulk powders for external use to clean teeth. They mainly contain an abrasive agent such as precipitated calcium carbonate or hydrous dibasic calcium phosphate. It also contains a surfactant, mild soap or detergent and sweetening agents.

10. Douche powders

These powders are most commonly used for vaginal use and intended for the action of cleansing agents or used as an antiseptic. They may also be used for nasal or ophthalmic route. The main criteria for these preparations are to ensure complete mixing and to maintain the micronized particle size by passing through sieve.

Preparation of Powders

Fig:18 Preparation of powder

1. Trituration

In this method, particle size reduction of coarse granular substances or lumps is carried out using a mortar and pestle or mill. Sometimes even dry powder substances are mixed using this method.

2. Pulverization

Soft and gummy substances are difficult to powder in mortar and pestle. Such substances are powdered by adding an inert material that helps in powdering and are removed afterward. A typical example is a camphor, which is powdered by moistening in presence of alcohol and after the preparation, alcohol is allowed to evaporate.

3. Levigation

In this method, a solvent is added to the dry powder to form a paste. The solvent is known as the levigating agent. The powder-solvent paste is then triturated using mortar and pestle. In the preparation of semi-solid dermatological preparations, ophthalmic ointments, and suspensions, this method is used, which prevents the gritty feeling in these formulations. A typical example of a levigating agent is liquid Paraffin.

4. Spatulation

In this method, the powders are blended in small amount by movement of a spatula on an ointment tile or on a small sheet of paper. The process is only suitable for small quantities of powder. Powders having potent substances or with a large quantity are not blended by this method, because the process does not ascertain a homogenous blending. Solid substances that form eutectic mixtures are suitable for blending with spatulation because compacting of the powders results from these. Examples of substances that can be blended by this method are— camphor, menthol, phenol, thymol, aspirin, etc.

5. Tumbling

Special motorized powder blenders are used in this process, whereby the powder is mixed by tumbling in a rotating chamber. The process is time consuming.

6. Sifter mixing

Powders are mixed by passing through sifters, which results in light and fluffy products. The process is not suitable for the incorporation of potent drugs into a powder mix.

Incorporation of Ingredients into powders

In the preparation of powders, some special modifications are followed for incorporation of some of the substances. The modified procedures are as follows:

1. Hygroscopic and deliquescent powders

Substances such as sodium bromide, zinc chloride, etc., have strong affinity to absorb moisture from the atmosphere. When the moisture absorption crosses the limits, these substances even liquefy. Such substances are usually used in the granular form rather than powder form to expose the lower surface area to the atmosphere. These types of powders should be double wrapped.

2. Volatile substances

Agents containing volatile oils undergoes volatilization in the atmosphere upon incorporation in the powder. The examples of such agents are camphor, menthol, etc. These agents should be packed by double wrapping with an inner waxed paper and outer bond paper cover by using heat sealed plastic bags.

3. Eutectic powders

Substances having low melting point when triturated and mixed together will form a powder blend with low melting point as compared to individual melting points and whose temperature would be less than the room temperature and hence liquify. Examples ofeutectic substances are thymol, menthol, camphor, phenol, aspirin, etc.

The components of these powders should be dispensed separately with directions like powder of each kind should betaken as a dose. Another alternative method is by addition of double the proportion of an inert high melting point diluent such as magnesium carbonate, light magnesium oxide, kaolin or talc, etc., and mixing together with the eutectic substances without applying pressure.

4. Efflorescent powders

Crystalline substances, which liberate water of crystallization when present, cause a powder to liquefy. Examples of these substances are citric acid, ferrous sulfate, caffeine, etc. Employment of anhydrous salt of these substances is a remedy.

5. Liquids

Incorporation of liquids into a powder substance is done by trituration of the liquid (small concentration) with an equal volume of powder and then addition of the remaining powder in several portions with trituration.

Equipment used for Powder Dosage Forms

Mixing of powders is probably one of the most widely performed unit operation in pharmaceutical manufacturing. This fact is still reflected in the design of most of the industrial mixers nowadays. Their basic design has sometimes been developed 50 or more years ago. And although most mixing operations still can be performed with relative simple equipment a trend is developing towards more complex mixing requirements.

Besides blending of components, modern mixers also have to coat and granulate, and also more stringent mixing quality requirements are demanded in the market.

Fig:19 Equipment used in the mixing of powder Powder

Equipment used in the mixing of powders

1. The mortar and pestle

The mortar and pestle represent one of the most commonly used small scale mixing equipment. The mortar and pestle method combines comminution and mixing in single operation. Hence, it is very useful when some degree of particle size reduction, as well as mixing, is required.

Mortars can be made of different materials and shapes, and pestles are made of the same materials as the mortars. Conventional mortars include glass mortars, Wedgwood mortars, and porcelain mortars, and there is an increasing use of a newly developed mortar, called the
electronic mortar and pestle (EMP), among pharmacists.

Different types of mortars have specific utility in compounding different materials. For example, glass mortars are suitable for preparing solutions, suspensions, and ointments;

Wedgwood mortars are designed primarily for size reduction for most of the materials in modern pharmacy
practice; porcelain mortars are similar to Wedgwood mortars, but they are more preferable for comminution of soft aggregates, crystals, and mixing of powders with uniform.

particle size; EMP is specifcally designed for blending of creams, ointments, and oral liquids. The EMP uses a spinning blade and a moving arm to mix products. The largest benefit of EMP is that the materials can be weighed, mixed, and dispensed all in the same container.

2. Tumbling mixers/blenders

Tumbling mixers/blenders are most commonly used for powders with similar densities. There are different types of tumbling mixers, including V-shaped, rotating cube, cylindrical, double-cone, oblique, and Y-cone mixers.

Tumbling mixers are likely to mix powders with good flowability and granules, rather than cohesive or powders with poor flowability, because shear force provided by these mixers is not enough to separate the individual particles from agglomerates.The regular loading ability of tumbling mixers ranges from approximately 50 g to 100 kg. For this equipment, segregation tends to occur, if particle size differs significantly.

4. Planetary mixer

Planetary mixer, commonly called beater consists of an anchor type of paddle/agitator revolving in a cylindrical pot with a hemispherical base. The paddle rotates on its axis and the axis equally rotates around. The bowl (cylindrical pot with a hemispherical base) is used for feeding and discharging of the product.

The bowl can be raised to the position of the mixing blades for the actual mixing process. The mixing blades or paddles are located off the center of the mixer. They rotate around their center and simultaneously rotate around the center of the mixer. This double rotating process can cause a more complete mixing of the entire equipment, so “dead spots” are avoided.The bowl can be raised to the position of the mixing blades for the actual mixing process. The mixing blades or paddles are located off the center of the mixer. They rotate around their center and simultaneously rotate around the center of the mixer. This double rotating process can cause a more complete mixing of the entire equipment, so “dead spots” are avoided.

Planetary mixers can break agglomerates easily.

5. Nauta mixer

The Nauta mixer, also called orbiting screw blender or vertical cone screw blender is composed of a bottom discharger with a rotating screw-fastened to the upper end of the rotating arm. The screw conveys the product to the top, where it can flow back to the powder feed. Hence, for this equipment, the vertical impeller and horizontal rotating arm are combined together to induce a combination of convection, shear, and diffusive mixing.

6. Fluid-bed mixer

The fluid-bed mixer is usually used for powder mixing, prior to granulation in the same bowl. Therefore, the fluid-bed mixer is part of a fluid-bed granulator system.

Fluidization of the powder particles can be achieved by blowing heated and filtered air into the equipment. Efficient mixing is achieved by circulation of the fluidized powder.

After mixing, granulation liquid is pumped from the liquid receiver/holder through a spray nozzle and onto the fluidized powder bed to facilitate granulation. When sufficient liquid has been sprayed to achieve appropriate granule size, the nozzle is turned off and the wet granules are dried by the fluidizing heated air.

Equipment used in the mixing of powders

- The mortar and pestle. The mortar and pestle represent one of the most commonly used small scale mixing equipment. ...
- Tumbling mixers/blenders. Tumbling mixers/blenders are most commonly used for powders with similar densities. ...
- Ribbon mixer. ...
- Planetary mixer. ...
- Nauta mixer. ...
- Fluid-bed mixer.

Equipment used for mixing of liquids

In industrial process engineering, mixing is a unit operation that involves manipulation of a heterogeneous physical system with the intent to make it more homogeneous. Familiar examples include pumping of the water in a swimming pool to homogenize the water temperature, and the stirring of pancake batter to eliminate lumps (deagglomeration).

Mixing is performed to allow heat and/or mass transfer to occur between one or more streams, components or phases. Modern industrial processing almost always involves some form of mixing.[1] Some classes of chemical reactors are also mixers.

With the right equipment, it is possible to mix a solid, liquid or gas into another solid, liquid or gas. A biofuel fermenter may require the mixing of microbes, gases and liquid medium for optimal yield; organic nitration requires concentrated (liquid) nitric and sulfuric acids to be mixed with a hydrophobic organic phase; production of pharmaceutical tablets requires blending of solid powders.

The opposite of mixing is segregation. A classical example of segregation is the brazil nut effect.

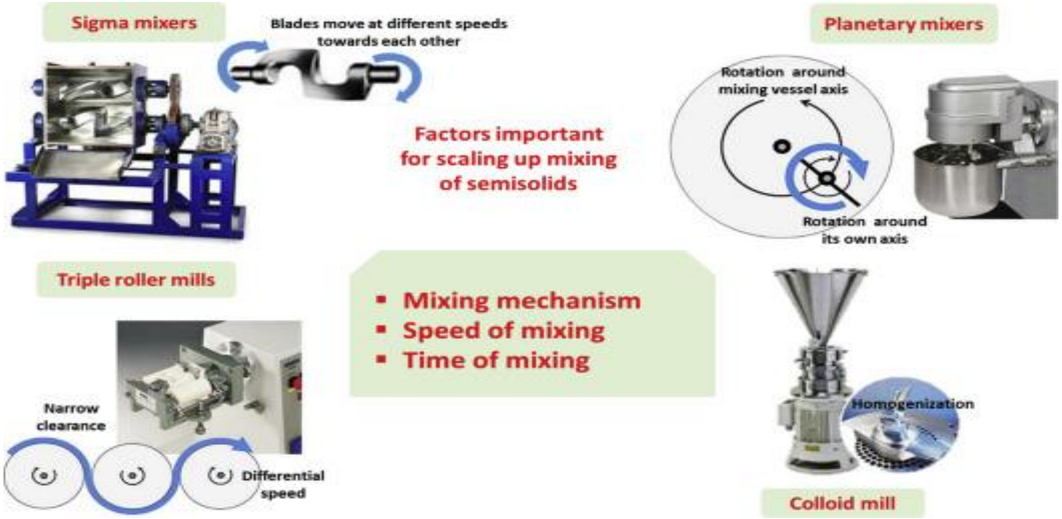

Fig:20 Mixing of solids

Mixing of Classification

The type of operation and equipment used during mixing depends on the state of materials being mixed (liquid, semi-solid, or solid) and the miscibility of the materials being processed. In this context, the act of mixing may be synonymous with stirring-, or kneading-processes.[1]

Liquid - Liquid Mixing

Mixing of liquids occurs frequently in process engineering. The nature of liquids to blend determines the equipment used. Single-phase blending tends to involve low-shear, high-flow mixers to cause liquid engulfment, while multi-phase mixing generally requires the use of high-shear, low-flow mixers to create droplets of one liquid in laminar, turbulent or transitional flow regimes, depending on the Reynolds number of the flow. Turbulent or transitional mixing is frequently conducted with turbines or impellers; laminar mixing is conducted with helical ribbon or anchor mixers.[2]

Single-phase blending

Mixing of liquids that are miscible or at least soluble in each other occurs frequently in engineering (and in everyday life). An everyday example would be the addition of milk or cream to tea or coffee. Since both liquids are water-based, they dissolve easily in one another. The momentum of the liquid being added is sometimes enough to cause enough turbulence to mix the two, since the viscosity of both liquids is relatively low.

If necessary, a spoon or paddle could be used to complete the mixing process. Blending in a more viscous liquid, such as honey, requires more mixing power per unit volume to achieve the same homogeneity in the same amount of time.

Solid-Solid Mixing

Blending powders is one of the oldest unit-operations in the solids handling industries. For many decades powder blending has been used just to homogenize bulk materials. Many different machines have been designed to handle materials with various bulk solids properties. On the basis of the practical experience gained with these different machines, engineering knowledge has been developed to construct reliable equipment and to predict scale-up and mixing behavior.

Nowadays the same mixing technologies are used for many more applications: to improve product quality, to coat particles, to fuse materials, to wet, to disperse in liquid, to agglomerate, to alter functional material properties, etc. This wide range of applications of mixing equipment requires a high level of knowledge, long time experience and extended test facilities to come to the optimal selection of equipment and processes.

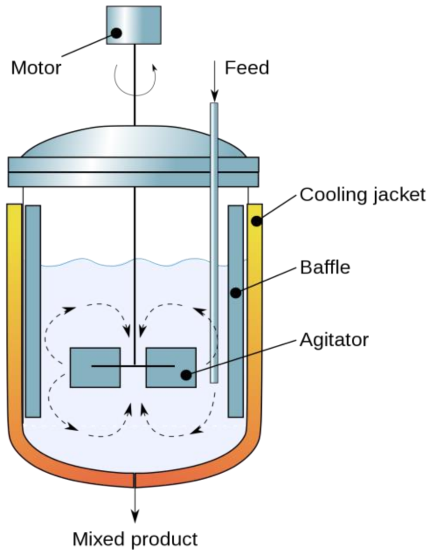

Fig:21 Solid mixing

Solid-solid mixing can be performed either in batch mixers, which is the simpler form of mixing, or in certain cases in continuous dry-mix, more complex but which provide interesting advantages in terms of segregation, capacity and validation.

One example of a solid–solid mixing process is mulling foundry molding sand, where sand, bentonite clay, fine coal dust and water are mixed to a plastic, moldable and reusable mass, applied for molding and pouring molten metal to obtain sand castings that are metallic parts for automobile, machine building, construction or other industries.

Mixing mechanisms

In powder two different dimensions in the mixing process can be determined: convective mixing and intensive mixing.[4] In the case of convective mixing material in the mixer is transported from one location to another. This type of mixing leads to a less ordered state inside the mixer, the components that must be mixed are distributed over the other components.

With progressing time the mixture becomes more randomly ordered. After a certain mixing time the ultimate random state is reached. Usually this type of mixing is applied for free-flowing and coarse materials.

Possible threats during macro mixing is the de-mixing of the components, since differences in size, shape or density of the different particles can lead to segregation.

When materials are cohesive, which is the case with e.g. fine particles and also with wet material, convective mixing is no longer sufficient to obtain a randomly ordered mixture. The relative strong inter-particle forces form lumps, which are not broken up by the mild transportation forces in the convective mixer.

To decrease the lump size additional forces are necessary; i.e. more energy intensive mixing is required. These additional forces can either be impact forces or shear forces.

Liquid–solid mixing

Liquid–solid mixing is typically done to suspend coarse free-flowing solids, or to break up lumps of fine agglomerated solids. An example of the former is the mixing granulated sugar into water; an example of the latter is the mixing of flour or powdered milk into water. In the first case, the particles can be lifted into suspension (and separated from one another) by bulk motion of the fluid, in the second, the mixer itself (or the high shear field near it) must destabilize the lumps and cause them to disintegrate.

One example of a solid–liquid mixing process in industry is concrete mixing, where cement, sand, small stones or gravel and water are commingled to a homogeneous self-hardening mass, used in the construction industry.

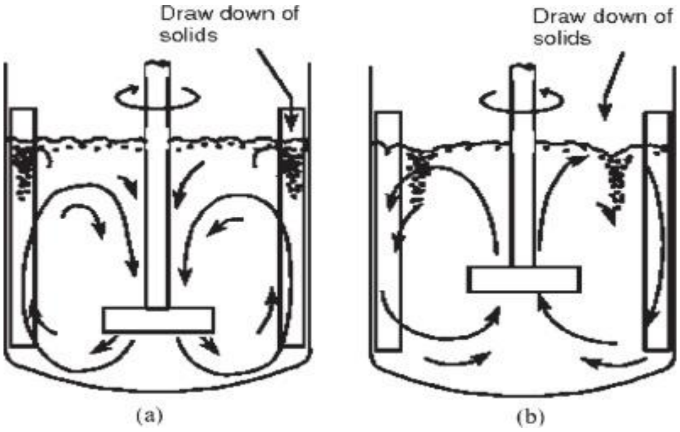

Fig:22 Liquid-Solid Mixing

Solid suspension

Suspension of solids into a liquid is done to improve the rate of mass transfer between the solid and the liquid. Examples include dissolving a solid reactant into a solvent, or suspending catalyst particles in liquid to improve the flow of reactants and products to and from the particles.

The associated eddy diffusion increases the rate of mass transfer within the bulk of the fluid, and the convection of material away from the particles decreases the size of the boundary layer, where most of the resistance to mass transfer occurs. Axial-flow impellers are preferred for solid suspension, although radial-flow impellers can be used in a tank with baffles, which converts some of the rotational motion into vertical motion.

When the solid is denser than the liquid (and therefore collects at the bottom of the tank), the impeller is rotated so that the fluid is pushed downwards; when the solid is less dense than the liquid (and therefore floats on top), the impeller is rotated so that the fluid is pushed upwards (though this is relatively rare).

The equipment preferred for solid suspension produces large volumetric flows but not necessarily high shear; high flow-number turbine impellers, such as hydrofoils, are typically used. Multiple turbines mounted on the same shaft can reduce power draw.

The degree of homogeneity of a solid-liquid suspension can be described by the RSD (Relative Standard Deviation of the solid volume fraction field in the mixing tank).

A perfect suspension would have a RSD of 0 % but in practice, a RSD inferior or equal to 20 % can be sufficient for the suspension to be considered homogeneous,[6] although this is case-dependent.

The RSD can be obtained by experimental measurements or by calculations. Measurements can be performed at full scale but this is generally unpractical, so it is common to perform measurements at small scale and use a scale-up criterion to extrapolate the RSD from small to full scale.

Calculations can be performed using a computational fluid dynamics software or by using correlations built on theoretical developments, experimental measurements and/or computational fluid dynamics data.

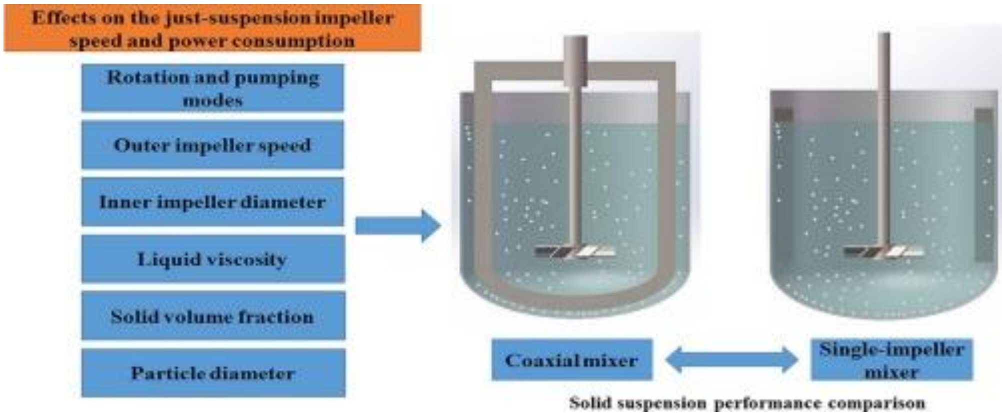

Fig:23 Solid Suspension

Solid Deagglomeration

Very fine powders, such as titanium dioxide pigments, and materials that have been spray dried may agglomerate or form lumps during transportation and storage. Starchy materials or those that form gels when exposed to solvent can form lumps that are wetted on the outside but dry on the inside.

These types of materials are not easily mixed into liquid with the types of mixers preferred for solid suspension because the agglomerate particles must be subjected to intense shear to be broken up.

In some ways, deagglomeration of solids is similar to the blending of immiscible liquids, except for the fact that coalescence is usually not a problem. An everyday example of this type of mixing is the production of milkshakes from liquid milk and solid ice cream.

Liquid Gas Mixing

Liquids and gases are typically mixed to allow mass transfer to occur. For instance, in the case of air stripping, gas is used to remove volatiles from a liquid. Typically, a packed column is used for this purpose, with the packing acting as a motionless mixer and the air pump providing the driving force.

When a tank and impeller are used, the objective is typically to ensure that the gas bubbles remain in contact with the liquid for as long as possible.This is especially important if the gas is expensive, such as pure oxygen, or diffuses slowly into the liquid.

Mixing in a tank is also useful when a (relatively) slow chemical reaction is occurring in the liquid phase, and so the concentration difference in the thin layer near the bubble is close to that of the bulk. This reduces the driving force for mass transfer. If there is a (relatively) fast chemical reaction in the liquid phase, it is sometimes advantageous to disperse but not recirculate the gas bubbles, ensuring that they are in plug flow and can transfer mass more efficiently.

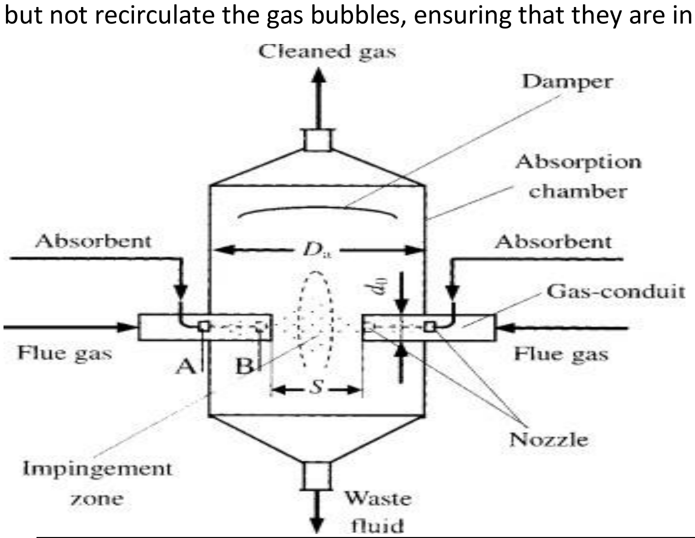

Fig:24 Liquid-Gas Mixing

Gas–solid mixing

Gas–solid mixing may be conducted to transport powders or small particulate solids from one place to another, or to mix gaseous reactants with solid catalyst particles. In either case, the turbulent eddies of the gas must provide enough force to suspend the solid particles, which otherwise sink under the force of gravity.

The size and shape of the particles is an important consideration, since different particles have different drag coefficients, and particles made of different materials have different densities. A common unit operation the process industry uses to separate gases and solids is the cyclone, which slows the gas and causes the particles to settle out.

Multi phase mixing

Multi phase mixing occurs when solids, liquids and gases are combined in one step. This may occur as part of a catalytic chemical process, in which liquid and gaseous reagents must be combined with a solid catalyst (such as hydrogenation); or in fermentation, where solid microbes and the gases they require must be well-distributed in a liquid medium.

The type of mixer used depends upon the properties of the phases. In some cases, the mixing power is provided by the gas itself as it moves up through the liquid, entraining liquid with the bubble plume. This draws liquid upwards inside the plume, and causes liquid to fall outside the plume. If the viscosity of the liquid is too high to allow for this (or if the solid particles are too heavy), an impeller may be needed to keep the solid particles suspended.

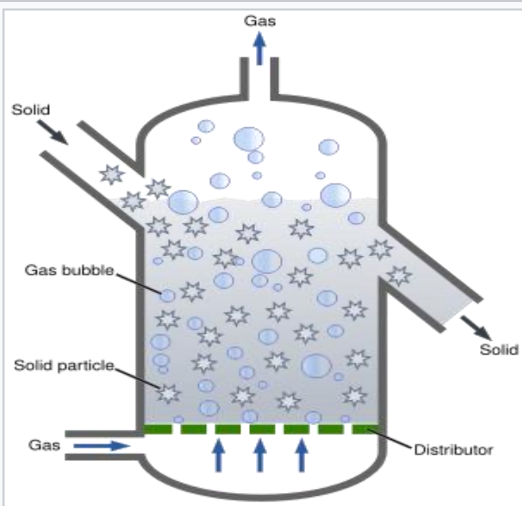

Fig:25 Multi phase mixing

Basic Nomenclature

For liquid mixing, the nomenclature is rather standardized:

- Impeller Diameter, "D" is measured for industrial mixers as the maximum diameter swept around the axis of rotation.
- Rotational Speed, "N" is usually measured in revolutions per minute (RPM) or revolutions per second (RPS). This variable refers to the rotational speed of the impeller as this number can differ along points of the drive train.
- Tank Diameter, "T" The inside diameter of a cylindrical vessel. Most mixing vessels receiving industrial mixers will be cylindrical.
- Power, "P" Is the energy input into a system usually by an electric motor or a pneumatic motor
- Impeller Pumping Capacity, "Q" The resulting fluid motion from impeller rotation.

Constitutive Equation

Many of the equations used for determining the output of mixers are empirically derived, or contain empirically-derived constants. Since mixers operate in the turbulent regime, many of the equations are approximations that are considered acceptable for most engineering purposes.

When a mixing impeller rotates in the fluid, it generates a combination of flow and shear. The impeller generated flow can be calculated with the following equation:

Flow numbers for impellers have been published in the North American Mixing Forum sponsored Handbook of Industrial Mixing.

The power required to rotate an impeller can be calculated using the following equations:

Is the (dimensionless) power number, which is a function of impeller geometry; is the density of the fluid; is the rotational speed, typically rotations per second; is the diameter of the impeller; is the laminar power constant; and is the viscosity of the fluid.

Note that the mixer power is strongly dependent upon the rotational speed and impeller diameter, and linearly dependent upon either the density or viscosity of the fluid, depending on which flow regime is present. In the transitional regime, flow near the impeller is turbulent and so the turbulent power equation is used.

Laboratory Mixing

At a laboratory scale, mixing is achieved by magnetic stirrers or by simple hand-shaking. Sometimes mixing in laboratory vessels is more thorough and occurs faster than is possible industrially. Magnetic stir bars are radial-flow mixers that induce solid body rotation in the fluid being mixed. This is acceptable on a small scale, since the vessels are small and mixing therefore occurs rapidly (short blend time).

Fig:26 Laboratory Mixing

A variety of stir bar configurations exist, but because of the small size and (typically) low viscosity of the fluid, it is possible to use one configuration for nearly all mixing tasks. The cylindrical stir bar can be used for suspension of solids, as seen in iodometry, deagglomeration (useful for preparation of microbiology growth medium from powders), and liquid–liquid blending.

Another peculiarity of laboratory mixing is that the mixer rests on the bottom of the vessel instead of being suspended near the center. Furthermore, the vessels used for laboratory mixing are typically more widely varied than those used for industrial mixing; for instance, Erlenmeyer flasks, or Florence flasks may be used in addition to the more cylindrical beaker.

Mixing in When scaled down to the micro scale, fluid mixing behaves radically different.[14][15] This is typically at sizes from a couple (2 or 3) millimeters down to the nanometer range. At this size range normal advection does not happen unless it is forced by a hydraulic pressure gradient.

Diffusion is the dominate mechanism whereby two different fluids come together. Diffusion is a relatively slow process. Hence a number of researchers had to devise ways to get the two fluids to mix. This involved Y junctions, T junctions, three-way intersections and designs where the interfacial area between the two fluids is maximized.

Beyond just interfacing the two liquids people also made twisting channels to force the two fluids to mix. These included multilayered devices where the fluids would corkscrew, looped devices where the fluids would flow around obstructions and wavy devices where the channel would constrict and flare out. Additionally channels with features on the walls like notches or groves were tried.

One way to know if mixing is happening due to advection or diffusion is by finding the Peclet number. It is the ratio of advection to diffusion. At high Peclet numbers (> 1), advection dominates. At low Peclet numbers (< 1), diffusion dominates.

Peclet number = (flow velocity × mixing path) / diffusion coefficient

Industrial Mixing Equipment

At an industrial scale, efficient mixing can be difficult to achieve. A great deal of engineering effort goes into designing and improving mixing processes. Mixing at industrial scale is done in batches (dynamic mixing), inline or with help of static mixers. Moving mixers are powered with electric motors that operate at standard speeds of 1800 or 1500 RPM, which is typically much faster than necessary. Gearboxes are used to reduce speed and increase torque. Some applications require the use of multi-shaft mixers, in which a combination of mixer types are used to completely blend the product.[16]

In addition to performing typical batch mixing operations, some mixing can be done continuously. Using a machine like the Continuous Processor, one or more dry ingredients and one or more liquid ingredients can be accurately and consistently metered into the machine and see a continuous, homogeneous mixture come out the discharge of the machine.[17]

Many industries have converted to continuous mixing for many reasons. Some of those are ease of cleaning, lower energy consumption, smaller footprint, versatility, control, and many others. Continuous mixers, such as the twin-screw Continuous Processor, also have the ability to handle very high viscosities.

Fig: 27 Industrial Mixing Equipment

Turbines

A selection of turbine geometries and power numbers are shown below.

Different types of impellers are used for different tasks; for instance, Rushton turbines are useful for dispersing gases into liquids, but are not very helpful for dispersing settled solids into liquid. Newer turbines have largely supplanted the Rushton turbine for gas–liquid mixing, such as the Smith turbine and Bakker turbine.[18] The power number is an empirical measure of the amount of torque needed to drive different impellers in the same fluid at constant power per unit volume; impellers with higher power numbers require more torque but operate at lower speed than impellers with lower power numbers, which operate at lower torque but higher speeds.

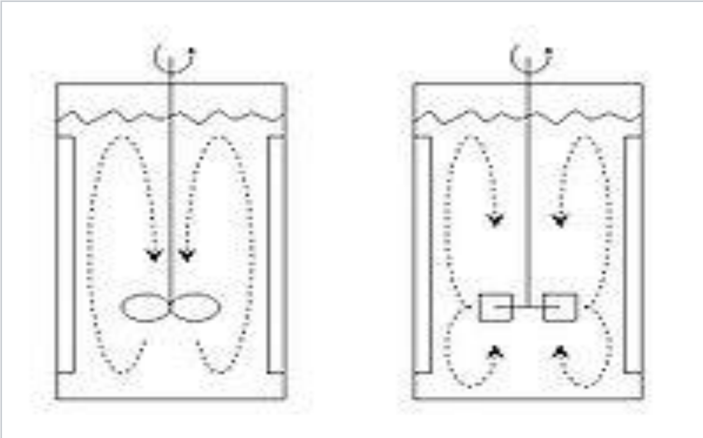

Fig: 28 Turbines

Close-clearance mixers

There are two main types of close-clearance mixers: anchors and helical ribbons. Anchor mixers induce solid-body rotation and do not promote vertical mixing, but helical ribbons do. Close clearance mixers are used in the laminar regime, because the viscosity of the fluid overwhelms the inertial forces of the flow and prevents the fluid leaving the impeller from entraining the fluid next to it. Helical ribbon mixers are typically rotated to push material at the wall downwards, which helps circulate the fluid and refresh the surface at the wall.[19]

High shear dispersers

High shear dispersers create intense shear near the impeller but relatively little flow in the bulk of the vessel. Such devices typically resemble circular saw blades and are rotated at high speed. Because of their shape, they have a relatively low drag coefficient and therefore require comparatively little torque to spin at high speed. High shear dispersers are used for forming emulsions (or suspensions) of immiscible liquids and solid deagglomeration.[20]

Static mixers

Static mixers are used when a mixing tank would be too large, too slow, or too expensive to use in a given process.

Liquid whistles

Liquid whistles are a kind of static mixer which pass fluid at high pressure through an orifice and subsequently over a blade.[21] This subjects the fluid to high turbulent stresses and may result in mixing, emulsification,[22][23] deagglomeration and disinfection.

Pharmaceutical Applications

Pharmaceutical Application means any product that (i) requires and is indicated for the treatment of a specific medical condition by a regulatory agency and (ii) is administered under the supervision of a clinician.

Examples of Pharmaceutical Powders

- **Antibiotics, vaccines, human blood-plasma fractions, and steroid hormones** are other important pharmaceuticals manufactured from natural substances. Vitamins, which were formerly obtained from natural sources, are now often made in the laboratory.
- Pharmaceuticals are generally classified by chemical group, by the way they work in the body (pharmacological effect), and by therapeutic use. Alkaloids were the first pure pharmaceuticals derived from natural substances (plants); they include quinine, nicotine, cocaine, atropine, and morphine. Drugs of animal origin include glandular extracts containing hormones, such as insulin for use in treating diabetes.
- Antibiotics, vaccines, human blood-plasma fractions, and steroid hormones are other important pharmaceuticals manufactured from natural substances. Vitamins, which were formerly obtained from natural sources, are now often made in the laboratory.

- In the preparation of dosages, many pharmaceuticals are ground to varying degrees of fineness. Many medicinal substances are added to water, alcohol, or another solvent so that they can be used in solution form. These may include spirits, elixirs, and tinctures. Ointments are one of many semisolid preparations, which also include creams, pastes, and jellies.

- Solid pharmaceuticals include pills, tablets, lozenges, and suppositories. In this form the compounds are more stable, with less risk of chemical reaction, and the dosage is easier to determine. Storage and packaging also is made simpler, and solid forms are more efficient to produce.

What is the of uses of Powder

Pressed Powder: Primarily used to set liquid foundation/concealer so that the makeup lasts longer and does not move around, or rub off of your skin. Pressed powders can also be formed into foundations and used as a base for your entire makeup routine, or added to liquid foundation to build up coverage.

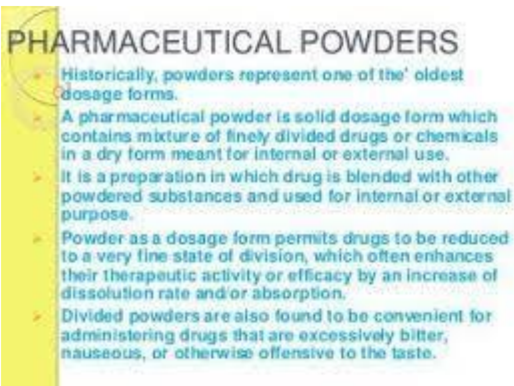

Fig:29 uses of Powder

Powders represent one of the oldest and most conventional dosage forms. The term “powder” has more than one connotation in pharmacy. It may be used to describe the physical form of a material, that is, a dry substance composed of finely divided particles that may be used as the basis of many other solid dosage forms such as tablets, capsules, etc.

Powders may also be used to describe a type of pharmaceutical preparation, that is, a medicated powder intended for internal or external use.

Powders were originally found to be a convenient mode of administering drugs derived from hard vegetables such as roots (e.g., rhubarb), barks (e.g., cinchona), and woods (e.g., charcoal). As synthetic drugs were introduced, powders were used to administer insoluble drugs such as calomel, bismuth salts, mercury, and chalk.

The rapid development of formulations containing high potent compounds has reduced the use of powders as a dosage form. Most of the powders are replaced by tablets and capsules. However, under certain circumstances, powders still have some advantages over solid dosage forms on the market.

What are the pharmaceutical uses of powders?

As synthetic drugs were introduced, powders were used to administer insoluble drugs such as calomel, bismuth salts, mercury, and chalk. The rapid development of formulations containing high potent compounds has reduced the use of powders as a dosage form. Most of the powders are replaced by tablets and capsules.

A pharmaceutical powder is defined as a dry, solid substance, composed of finely divided drugs with or without excipients and intended for internal or external use. It is a solid substance in finely divided state typically obtained by crushing, grinding, or communicating.

Properly prepared, powders have a uniform, small particle size (varying 10nm-1000µm) that has an elegant appearance. In general, powders are more stable than liquid dosage forms and are rapidly soluble, enabling the drug to be absorbed quickly.

Fig:30pharmaceutical uses of powders

Which powder is used for the external use ?

Powders are intimate mixtures of dry,finely divided drugs and or chemical that may be intended for internal or external use (e.g. external applications to the skin). 1. DUSTING POWDERS: They are meant for external applicatin to the skin generally applied in a very fine state of subdivison **to avoid local irritation**.

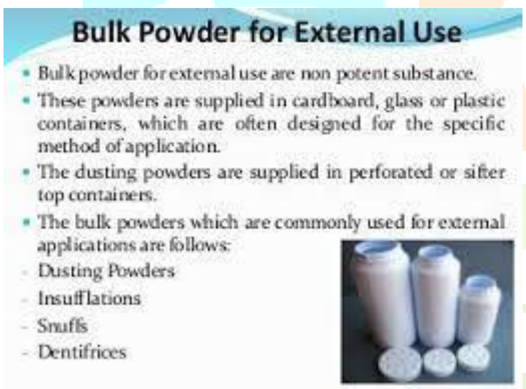

Fig:31 External Use Powder

Which powder is used for the internal use ?

Pharmaceutical powders for internal use are preparations consisting of solid, loose, dry particles of varying degrees of fine particle size that contain one or more active substances, with or without excipients. Powders for internal use can be taken orally (e.g., Oral powders), administered through the nose as snuffs, or blown into a body cavity as an insufflation.

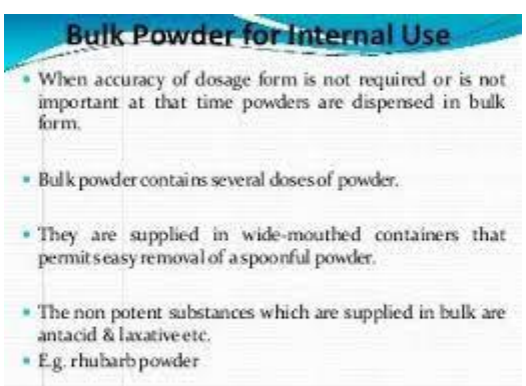

Fig:32 Internal use of Powder

What are the special powders?

Special powders

Main uses: Latent fingerprints on non-porous and semi-porous surfaces.

The special powders mixtures are developed to improve the characteristics of concentrated or regular powders:
- greasy features are reduced
- lumps are avoided
- prints show better contrast
- far fewer problems are encountered with excessive use of powder (e.g. smearing of prints)

Consequently, the development of latent prints can be done much faster, with less risk and better results.

A pharmaceutical powder is defined as a dry, solid substance, composed of finely divided drugs with or without excipients and intended for internal or external use. It is a solid substance in finely divided state typically obtained by crushing, grinding, or comminuting.

Powders do not mix spontaneously; therefore, effective mixing requires a thorough understanding of the materials to be mixed, as well as the science of mixing. Effective mixing of powders poses the greatest challenge when the amount of one of the components of the mix is relatively small compared to the other components.

Conclusion

*** The origins, structure, and properties of particles within a powder dictate their dynamic performance. Gathering information on the physicochemical proper-ties of the powders is a prerequisite for interpreting and manipulating their flow and mixing properties. ***

This conclusion discusses the transformatory potential of public participation, and its capacity to contribute to a process of political renewal. It argues that the aspirations highlighted may need to be tempered by an awareness of the institutional practices that constrain agency or produce a loss of trust. It emphasises the power of official discourses to define and delimit notions of 'the public' and of 'legitimate participants', and suggest ways in which such meanings are contested and negotiated.

It examines how relationships and identities are shaped in the context of power inequalities, as well as the tensions present when those engaged in autonomous collective action are engaged in dialogue with public bodies. It also shows new insights into the dilemmas experienced by public service workers exposed to new encounters with the public.

The case studies in this book highlight a set of issues and raises a series of questions that might productively be addressed in future policy and practice. It argues that public participation can help to equip people to become better at dialogue with others, enabling a greater understanding of different perspectives and a respect for others' positions.

The variability of powder systems is not in doubt and, to date, very few definitive relationships which link one or more of a powder's measurable characteristics to specific process design parameters have been identified[10]. Although it is nice to believe that one can say Powder A is better than Powder B, the reality is that a single index or characteristic will not enable a complete understanding of any given powder's performance in all situations.

This article has shown that a range of characterisation methods are required to ensure a complete understanding of how multiple powder properties can influence the performance in a typical range of pharmaceutical processes.

Comprehensive characterisation quickly leads to an understanding of why certain powders behave in a specific way within a particular process. Limiting the characterisation of a powder to a single measurement – whatever method is used – is unlikely to provide sufficient information to design/troubleshoot any given process.

Equally,knowledge of the stress regimes and shear rates experienced by powders in a specific process bottleneck or failure mode will assist with identifying the range of tests required to replicate the same powder response during a measurement. Building on this concept will allow the development of a 'database' of powder/process relationships which captures current and historical data. With such a foundation, it will be possible for equipment manufacturers and processing companies to improve their efficiencies and productivity.

The volume and types of powder production is increasing day-by-day as this is the most stable form of the food that is also easy to use, pack, distribute and handle. Many new product formulations are now developed by mixing a number of powders and the final product is made later by rehydration with water and further processing.

Due to the increased use of the powder in the food industries it has been more important to understand the properties of various powders in order to control the quality and processing conditions. In the meantime, the process of making powders has also been an important field of research as a number of food products cannot simply be converted to powder form due to their inherent composition and stickiness behaviour. Engineered food powders to achieve a desired functionality are another area that has been a focus in recent times. This involves control of surface and internal structure of the powder particles.

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