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A Review on Sustained Release Matrix Tablet

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Abstract:

The main methods used to produce sustained release matrix tablets are wet granulation, direct compression, and the dispersion of solid particles within solid particles inside a porous matrix made of various polymers, such as polymethyl methacrylate (PMMA), polyglycolic acid, and HPMC. The matrix governs the release rate of medication. Let Go Retardants such as HPMC are essential components of the formulation because they facilitate continuous release. To create a tablet where the medicine is embedded in a matrix core of the retardant, a combination of drug, retardant material, and additives is directly compressed; alternatively, granulation can be done before compression. It is possible for the matrices to be mineral, hydrophilic, hydrophobic, or biodegradable. The rate of medication release can be examined using in vitro dissolution experiments. Drugs like ambroxol HCl and nateglinide have been developed as sustained release matrix tablets. Thus, prolonged release matrix tablets can offer better patient compliance by reduction in total dose and dosage schedule, which can be of significant help to address for long term illness.

key words : Sustained release, Polymer, Matrix tablet.

CHAPTER-1: INTRODUCTION

To achieve specific goals including test masking or shielding opposed to environmental factors,
coating is the process of covering a preferred dosage form, such as a granule or pill, using an exterior dry film. Gums, resins, waxes, plasticizers, flavors, colorants, polyhydric alcohol, and gums are all potential ingredients for the coating material. In the modern era, the main application of polymers and polysaccharides, together with

additional excipients such as pigments and plasticizers, was as coating materials. Several measures must be taken while coating is being applied to ensure the coating durability and consistency. Organic solvents are prohibited by the International Council for Harmonization (ICH) due to worries about safety in the creation of pharmaceutical dosage forms. [1]

This can be resolved by changing the existing dosage form. Around 1500 BC, the concept of tablets as a solid dosage form was first mentioned. Papyri were the first source of ancient Egyptian pills. Tablets that are vulnerable to oxidation or moisture degradation should be coated with FC method. This method has the potential to increase the shelf life and mask of the product. It will mask the sour flavor and form a softer covering, making easy to swallow. Tablets were coated with chitosan and other muco adhesive polymers in order to them adhere the mucous membranes and achieve targeted, long-term drug release. [2]

Professor Brockedon of England invented the compressed tablet in 1844. These tablets were hard, and no evidence of their disintegration time or solubility was discovered. Mr. NewberypurchasedtheProfessorBrockedonshopin1871.Themostconvenientdosageformis orals olid dosage form (DF). Pharmacies carry it. Their production began many centuries ago. Severaladvantages exist for these DFs, including high patient compliance and relatively simple and convenient manufacturing. [3]

Members of this class have advanced in recent decades as a result of the introduction of techniques such as tablet coating, double compression and osmotic system stoachievea targeted and controlled release. Various methods can be used to complete coating. Sugar coating, filmcoating, microencapsulation, compression coating are the most common techniques. Sugar coatingisan ancient processfor FD coating.[4]

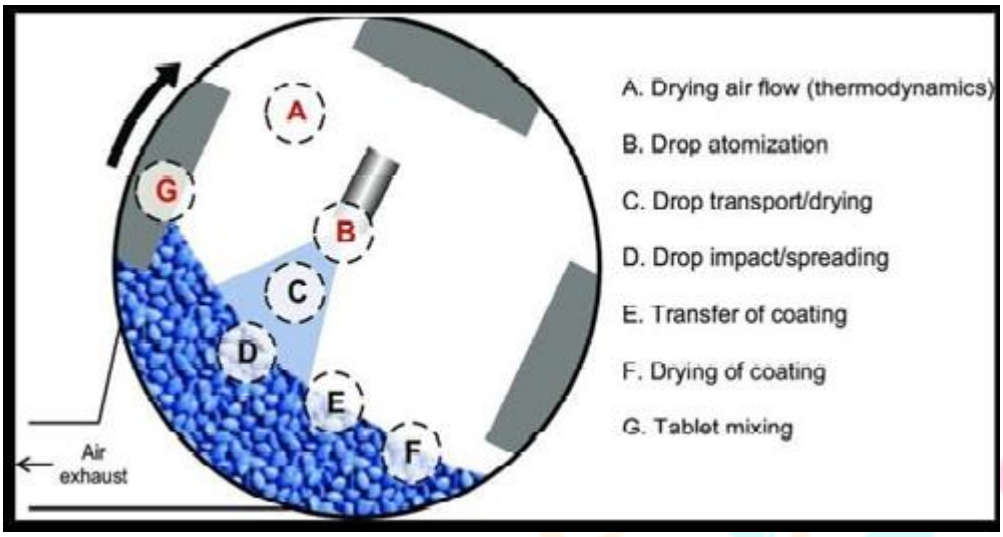


Fig.No-1:Diagrammaticviewoftabletcoating

CHAPTER – 2: TYPESOFTABLETCOATINGS:-

SugarCoating:-

Tomaskthebittertasteofthetablets,asugarcoatingwas applied.BitterTabletsaresugar-coatedtomaskthetaste. Italsoimprovestheappearanceofyour tablet.[5]

Sealing:-

Itprotectsthetabletfrommoisturetomakeitharder.[6]

SubCoating:-

Thisactionisusedtosoftenthecornersandaddweightofthetablet.[7]

Grossing/Smoothing:-

Thisfixesthesubcoatingflawandenlarges thetablettoapredetermineddimension.[8]

1.1 Coloring:-

This providesthetabletwithitsfinalcolour.[9]

1.2 Polishing:-

Thegoalofthisistogetthedesiredlustre.[10]

1.3 FilmCoating:-

Film coating technology has replaced the time-consuming sugar-coating process. During thisprocess,apolymersolutionis sprayed.Auniformfilmispresentonthetablet'ssurfaceaswellaspigments and plasticizers in the rotating tablet bed. The preferred drug release site(gastrointestinal) or the preferred release rate are the main determinants of the polymer selected.[11]

1.4 Aqueousfilmcoating:-

Duetoalloftheaforementionedissueswithorganicsolvents,waterisnowthepreferredcoatingsolvent.Asopposedto organic-basedcoatings,aqueouscoatings areincreasinglyused.[12]

Thecoatingprocessbecomesmorecost-effectivewhenswitchingfromcoatingbasedonorganicsolvents to coating based on water, but initially improving the coating line need a smallinvestment. The requirement for more drying capacity necessitates this upgrade. In comparisontoorganicsolvents,this meansthat fourtimes asmuchenergyisneeded.[13]

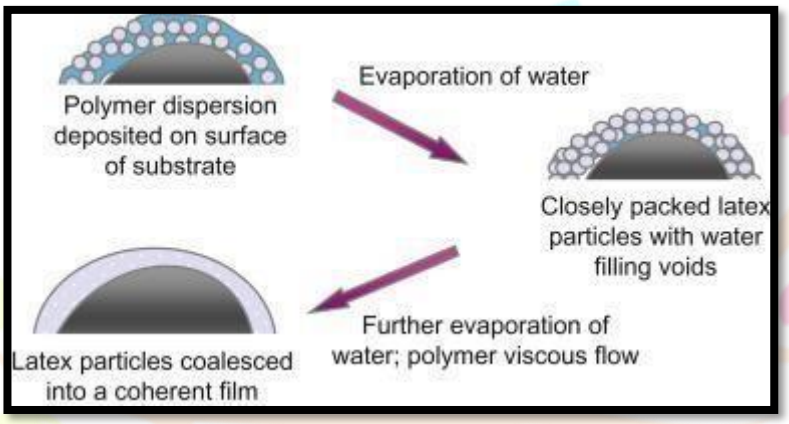
Mechanismsoffilmformationaqueous filmcoating-

Applications might be either solutions or suspensions, According to the film-forming polymerliquid solubility. Polymer solutions go through several steps before forming films. After thepolymersolutionhasappliedtothetabletsurfacecohesiveforcesresultingthepolymermoleculesofcoating to

link together. [14]

Inorderhighcohesionisneededforthecontinuoussurfaceoffilmmaterialdeveloptogetherandthe cohesion of the polymer molecules must be relatively high. The process of adjacent polymermolecular layers or surfaces coalescing brought about using diffusion. The solution thickens(gelates) when the majority of the water evaporates, holding the polymer chains together andcausingthemto depositon top of thepreviouslayerofpolymer. [15]

With sufficient cohesive forces between molecules, diffusion, and coalescence, the individualpolymerchains alignintoacoherentfilmastheremainingwaterentirelyevaporates.However,utilising aqueous polymer dispersions as opposed to organic polymer solutions significantlyaltersthemechanismof filmgeneration.[16]



Figno2-Diagrammaticviewofmechanisms ofFilmFormation

2.1 CompressionCoating:-

Using specially designed tableting equipment, granular material is compressed around a pre-formed tablet core. Dry compression coating is used. It is advantageous when the tablet coreneeds tobecoatedtocoverthetasteorgivetheproductadelayedorentericcoatingbecauseitcannotsurviveorganicsolventso r water. [17]

2.2 Dipcoating:-

Thepillsarecoatedbydippingtheminacoatingsolution,andafterdryinginatypicalcoatingpan, the coated tablets are removed. You can go through the soaking and drying processnumeroustimes. Itispossibleto coattheway youwant[20].

2.3 Entericcoating:-

Enteric coatings are barriers that control the location of an oral drug within the digestive systemforabsorption. Theword"gut"thetinyintestineisreferredto.In orderto stop drugreleasebeforeitentersthesmall intestine,anentericcoatingisused.AtlowpH,enteric-coatedpolymersare still bonded and so insoluble. However, the acidic functional groups ionize as the GIT pHrises, causingthepolymertoswellor turnsolubleingastrointestinalfluids[21].

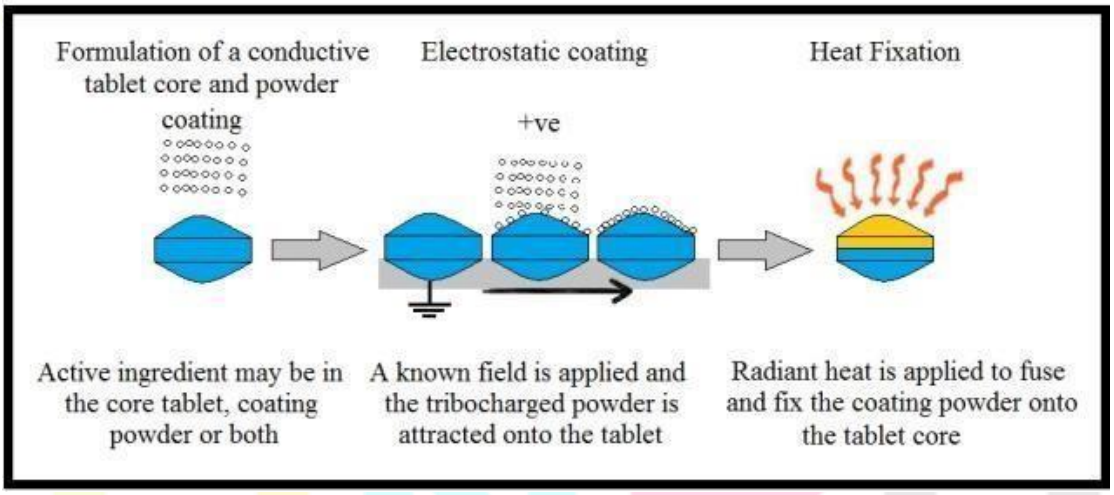
Tableno1-Variouspolymerusedinentericcoatingformulations

olymers	**issolutionpH**	**eference**
hellac	7	22]
ellulose acetate phthalate (CAP)	6.1	23]
oly (methacrylic acid) (PMA)	5.5-7	24]
ellulose acetate taramellite (CAT)	5	25]
oly (vinyl acetate phthalate) (PVAP)	5	26]
ydroxypropyl methylcellulose phthalate (HPMCP)	4.4-5.4	27]

CHAPTER -3: RECENT TECHNIQUEINTABLETCOATIN

A] ElectrostaticCoating –

Theapplicationoflayerstoconductive materialsbyelectrostaticcoatingisefficient.Ahighstatic charge ispresent on the board. A coating substance made of conductive ionic species with opposing charges sprayedontothechargedsubstrate.Completeuniformcoatingisappliedtothesubstratecorners.[28].



Figno03-Schematicdiagramelectrostaticcoating

B] Coronacharging-

This results from the application of a high voltage applied to a charging pin electrode with a pointed, needle-like tip at the gun exit, which leads to electrical failure and subsequent air is ionized. Negative ions areabsorbedbypowderparticles astheytravelfromthecannontothesubstrate.A combinationofelectricalandmechanical factors essentially controls particle mobility between the charge gun and substrate. The powderfromthespraygun ispushedontothesubstratebyamechanicalforce producedbytheair [29].

Incaseofcoronacharging,theelectricalforceiscreatedbytherepellingforcesbetweenthechargedparticlesand the electric field between the spray gun tip and the soil. The size, shape between the spray gun andgroundedpe,andpowder densityofthecontrolpattern canallbechanged byadjusting theelectricfield.[30]

C] TriboCharging-

Unlike corona charging firearms, tribo charging uses an understanding of tribo charging since there are nounboundionsorelectricfieldsbetweenthespraygunandgroundedmaterialduetodielectriccharacteristicsofsolid materials. The electric force is only considered for tribe electric weapons as the repulsive force betweenchargedparticles.Whenchargedparticles migrateintothevicinityofthesubstrateafterspraying,theparticles aredepositedonthesubstrateasaresultoftheattractionbetweenthechargedparticlesandthegroundedsubstrate.[31] Thedirtsubstrateisuniformlysprayedwithchargedparticlesthankstoelectrostaticandmechanicalattraction.Befor e the electrostatic attraction is overcome by the repelling force exerted by the deposition of particlesagainst incoming particles, particles build up on the substrate. The coating thickness eventually stopsincreasing and the particles are unable to stick to the substrate when the attractive and repulsive forces areequal[32].

D] Magneticallyassistedimpactioncoating(MAIC)-

Numerousdrycoatingmethods,suchaselectrostatic drycoating,plasticizerdrycoating,heatingdrycoatingand pressure coating have been developed. In order to achieve coating, these techniques typically permit theemployment of high auditory loads, high impact forces, as well as exposure to high temperatures. The guestparticles may layer and even become lodged due to the host particle surface being exposed to intensemechanicalforcesand heatthataccompanythem.[33]

Many substances used in food and medicine are organic, somewhat delicate, and highly sensitive to heat. Theycan also be easily distorted by powerful mechanical pressures. Such applications would benefit from a softcoatingmethodthat causeslessdegradationinthehostandguestparticles(thecoatingmaterialandthe itemtobe coated). Without significantly altering the material form or size, magnetically assisted impaction coating(MAIC)devicecould coatbothsoftorganichostparticlesandforeign particles. [34]

F] Vacuumfilmcoating:-

This new coating technology makes use of a baffle plate that has been specially designed. The pan can besealedtocreateavacuumsystemeventhoughitis hotandhas awaterjacket.Putthepillsinthepot,thenusenitrogen to expel air until the necessary vacuum level is reached. An airless spray system is used to apply thecoating fluid. A vacuum system removes vapours from the evaporated solvent. Organic solvents can be usedsuccessfully.Thesecoatingtechnologiesarealsoinplace,as is highenvironmentalsafety.[35]

G] Compression coating:-

Compression coating is rarely used, it is frequently used when the core of a tablet cannot a coating isnecessarytohidetheflavouroforganicsolvents orwaterimpartaslow-actingorentericcoatingtotheproduct. Furthermore, the method can easily separate incompatible components. This type of coatingnecessitatestheuseof aspecialisedtabletpress. [36]

CHAPTER- 4:POLYMERSUSEDINCOATING

A] Rosin:-

Biopolymer rosin which creates films and its byproducts have undergone extensive pharmacological researchsuch as film-coating and microencapsulation materials for long-term drug release. It can also be found incosmetics, chewing gum, and toothpaste. Rosin was used in a process based on phase separation by solventevaporation to create spherical microcapsules. A 30% w/w blend of rosin, polyvinylpyrrolidone, and dibutylphthalate yieldssmoothfilmswithimprovedelongationandtearstrength.Chitosan-D-glucoseandChitinaseis an enzyme that degrades chitin. Chitosan is a polysaccharide that is made up of randomly distributed linkedD-glucosamines (deacetylation units) and N-acetyl-glucosamines (acetylation units). Chitosan positive chargeunderacidicconditions isitsmostimportantpropertyindrugdelivery.Theprotonationofitsfreeaminogroupresults in thispositivecharge.[37]

B] Zein:-

Abyproductofcornprocessingiszein,analcohol-solubleproteinfoundinzeamis endospermtissue.Fordecades, Zein has been applied as a food and drug coating material a cost-effective, high-performingreplacementfor syntheticfilmcoatings.[38]

C] Collagen:-

The most prevalent protein in mammals is collagen and an important source of tissue strength. It has beenresearchedforuseinavarietyofsurgeries,cosmeticprocedures,anddrugdelivery,aswellasbioimplantsandmultipleorgan tissueengineeringincrease.[39]

D] Starch:-

It is the most common type of carbohydrate stored in green plants, particularly in underground organs as wellas seeds. Starch is found in the form of granules (starch granules), whose size, shape, and composition varydepending on the species components amylose and amylopectin content. Many starches have been identifiedas medicinalproducts.

These include Maize (zea mays), Rice (Oryza sativa), Wheat (Triticum aestivum), Potato (Solanumtuberosum).Microcapsulescontainingproteinsandproteinase inhibitorsareusedfortheoraladministrationofprotein and peptidic drugs have been developed. Mixed-wall starch/bovine serum albumin microcapsules wereproduced by interfacial cross-linking with terephthaloyl chloride. During the cross-linking process, proteaseinhibitorswereaddedtotheaqueous phasetocreatemicrocapsulesthatwerelaterfilledwithnativeoramino protectedaprotinin.Microcapsulescontainingaprotininhavebeenshowntobeprotectiveinvitroagainstbovineserumalbumin.[40]

E] Polycaprolactone:-

A polyester that is biodegradable and has a low melting point of roughly 60°C and a temperature at whichglass transitions is occur that time temperature is roughly -60°C is called polycaprolactone (PCL). PCL isproduced by ring-opening polymerizing caprolactone using a catalyst like stannous octoate. Production ofspecialtypolyurethanesiswherepolycaprolactoneismostfrequentlyusedexcellentresistancetowater,oil,solvents and chlorineisaddedbypolycaprolactoneto syntheticpolyurethanes.[41]

F] Polyorthoesters:-

Materials that can undergo room-temperature polymerization without generating condensation byproductshave been developed through several generations of refinement in synthetic chemistry. These substances arehydrophobicduetotheirhydrolyticbonds,whichareacidsensitivebutbasestable.Theyerodeattheirsurfaceandbyaddingbasicoracidicadjuvants,therateofdegradationcanbesloweddownor accelerated.[42]

Tableno2:Listofcoatingconditionsanditsparameters

actor	onditions	eference
quipment	rwekaCoatingPan	43]
ubstrate	0mgErythromycinstearate ıblets	44]
anCharge	.5 Kg	45]
ispersionsolidcontent	5.0%(w/w)	46]
anspeed	4 rpm	47]
letTemperature	2-58ºC	48]
xhaustairtemperature	0-42ºC	49]
edTemperature	5-40ºC	50]
prayrate	0g/min.	51]
istancebetweenspraygunandtabletbed	5cm	52]
oatingtime	60min.	53]

CHAPTER6:-

THE CURRENT TREND AND SCOPE OF COATING IN PHARMACEUTICAL ORAL SOLIDDOSAGE FORMS:-

Themostpopularcoatingmethodfororalsoliddosageforms isstillaqueous coating.This is trueregardlessofthepurposeofthefilmcoating application.Environmentalregulationsregardingtheuseoftheorganicsolvent, recent developments in the formulation of water-based film coating materials, and significantadvancements made to coating machines and their accessories are the main drivers of its popularity. Inconventional (immediate release), enteric coating (delayed release), and controlled release (delayed release)barrier membrane film coating systems, aqueous coating systems are frequently employed. Opadryformulations provide fewer ingredients for Quicker dispersion preparation times, regular color-matchingformulations, and quality control testing, better processability, and improved tablet appearance compared tousing individual ingredients. They provided numerous benefits, including superior mechanical film properties.[54]

Opadryformulationscontinuetobeusedinnumerouscommercialproductsdespitetheirwidespreaduseandsuccess in the world. The Opadry formulation has the disadvantage that the dispersed solids must be keptbetween10–15%ofthewaterweighttoachieve ausefuldispersedviscosityof300–600centipoise.Withthe introduction of his Opadry II product family, which includes HPMC and polysaccharides, in the 1980s,productivity was improved by shortening coating times or increasing spray rates. With opadry II processabledispersions, 20% solids instead of 10–15% solids can be obtained, enabling both increased productivity andimproved adhesion.The most important recent advancement in the creation of fully formulated aqueous filmcoatings is the introduction of new coatings based on sodium carboxymethyl cellulose (NaCMC) andpolyvinylalcohol(PVA).[55]

These polymers are used in film coating provide formulators with comparable or better manufacturingfacilitiesthanwhenusingOpadryformulations containinghydroxypropoxymethylcellulose(HPMC),aswellas previously unrealized capabilities increase. PVA-based films are known to have only moderately highoxygen and water vapour permeability. In contrast, NaCMC-based films have a high water vapourpermeability but a low oxygen permeability. NaCMC-based films also have the significant advantage ofbeing extremely glossy when properly formulated and applied. Because of this, NaCMC-based film coatingshavethepotentialto enhancebothfunctionalityandappearance. [56]

Two exclusive PVA-based product families that were introduced in the middle to end of the 1990s areAqueous Moisture Barrier (AMB) and the Opadry II. The Opadry AMB formulations offer all the advantagesofafullyformulatedfilmcoatingsystemwhilehavingthelowestpossibleMoistureVaporTransmission Rate(MVTR).Itisavailableasa color-matchingsystem,is 20%solids,andis readilysolubleinwater.[57]

The maximum spray rate that can be achieved with Opadry AMB is lower than it is with his HPMC-

basedOpadryIIfilmcoatingbecauseoftheinherentstickinessofthePVA polymer.Toaddress this problem,theOpadry II series of products was created. The Opadry II series products have a similar low MVTR to theOpadryAMB butcan besprayed on atmuch faster rates.

Formulators have new functional advantages to film coatings based on PVA and NaCMC. Cores that aresensitive to moisture can now be protected by coating with PVA-based coatings using an aqueous coatingprocess.NaCMC-basedcoatingshaveexcellentaestheticqualitiesandaprovenabilitytoactasanoxygenbarrier.[58]

Tableno3-Recentlyusedpolymersformodifyingdrugdeliverysystems

olymer	**oatingtechnique**	**eference**
thylCellulose	ustained release	59]
udragitRS30Daloneand incombination ithammoniamethacrylate	ustainedrelease	60]
udragitNM30DandEudragitNE30D combination with ethyl acrylatemethyl ethacrylatein1:2	ustaineddrelease	61]
ollicoatSR30D	ustained release	62]
PMCacetatesuccinate	ntericcoating	63]
elluloseacetatephthalate(CAP)	nteric coating	64]
udragitL30D55	ntericcoating	65]

CHAPTER- 7: -SUSTAINEDRELEASCOATING:

Product batches were sufficiently big in big businesses to warrant the usage of pan coating. Today, a verysmall numberof people might inexpensively coat thousands of pills or tablets. Pharmaceutical coatings arebecoming commonplace. Tablet coating developed into the procedure that we are familiar with over the firstfifty years of this century. In the pastcentury, little has changed about glaze bread. Stainless steel was usedinsteadof theleftovercopper potsfromtheconfectioneryindustry. [66].

Charcoal,thensteam,andfinallythehotairsystemsweusetodaywerethefirstdryairsources.Forimprovedcontrol over the coating solution application, the coater outlet was lastly changed to a spray nozzle. By thebeginning of 1950, the sugar-coating method had come very close to being flawless, but its drawbacksovershadowed a more effective and adaptable method. Tablet prescription patterns significantly changed oncethepharmaceuticalindustry used filmcoating(AbbottLaboratories, 1953). [67].

Now polymer coating allows tablets to take on a variety of shapes, so we are no longer restricted to usingdifferent shaped tablets, roughly spherical tablets. Embossed tablets can also be coated efficiently andaesthetically. Despite the fact that these new coatings are adaptable, they are not ideal for use withconventionalcoatingmachinery.HisTwonewcoatingtechnologiesweresereleasedalmostsimultaneouslywitht he development of his new polymer coating. Both are now crucial components of the

contemporarypharmaceuticalbusiness. [68].

Adding many small holes and including them in a sealed cabinet was a modification of the traditionalplating, resultingin a "perforated" pan. Perforated pan (such as Thomas Engineering Accela Coater) allowlargevolumes ofairtoflow throughthetabletbedandcontrolthetemperaturerequiredtomeetthepolymerfilm coating requirements. The air suspension coater, the second of these developments, represented analtogether new method of coating. Unlike the coating pan, the suspension coater is a mechanism thatcontinuouslymovesthetablets upanddowninanairstreamwhilespraying thecoating liquidfrombelow.

The "fluid bed" coater has undergone constant development since its beginnings and has become a veryadaptable equipment capable of quickly coating tablets, pellets, and even extremely minute granules. Thecapacity of this device towork in a "closed-loop" mode, which enables the recovery of organic solvents andraises thedegreeofoccupationalandenvironmentalsafety,is likelyits biggestbenefit. [69].

CHAPTER- 8 :FEATURESOFTHECOATING

In ancient times, the idea of coating was created. Rhazes first covered the taste of the pills with psyllium.Later, it was claimed that Avicenna covered the tablets in a layer of gold and silver. At that time, coatingswere made from a variety of materials. Talc, known as Pearl Coating, was introduced by white used of coattablets.Garotdevelopedatechniqueforgelatin tabletcoatingin1838. [71]

Wax was applied to the poisoned tablets to guard against accidental poisoning. Previously, only dragees weremadeforinstantprescriptionsbypharmacyworkers.Large-scaleproductionthenstartedasthepracticegainedpopularity in the pharmaceutical sector. The first sugar coated (SC) tablets were brought into the United States(USA) from France in 1842. A Philadelphia pharmacist developed a native-coated pill in 1856. Until 1950, SCwasconsidered acoating-purposetechnology with alotof work todo.[72]

Tableno5-Someofthemarketed productsweresummarized.

TypeofTablet	**Example**	**Brand Name**	**Manufacturer**	**Reference**
Enteric-coated tablet	Naproxen	Naprosyn	RPGlifesciencelimited	[73]
SugarCoated tablet	Conjugated estrogen	Premarin	WyethLtd.	[74]
FilmCoated tablet	Diclofenac	Voveran-D	Novartis	[75]
Sugarcoated tablet	mebeverine hydrochloride	Colofac	Abbott	[76]
Enteric-coated	Misoprostol	Cytotec	Pfizer	[77]

ablet				
Enteric-coated ablet	Rabeprazole	Rabekind	Mankind	78]

Tableno4-Representingdisadvantages ofFC

efect	efinition	reatment	
listering	isaprocessofa batingseparating froman bject'ssurface(suchasatablet) ndforming listers.	y creating entledryingconditions, atflaw couldbefixed.	79]
hipping	heterm"chipping"describes phenomenon inwhich the argins of the lmgetdamagedandchipped.	o prevent over-dryingthe illsduring the pre-heating hase, theoperator must secaution. therwise,thetablets'brittleness ncouragesthefault.	30]
icking	ischaracterisedasthe adherent yerthatcouldcomeoffthe blet's surfaceand ausetabletsto ick.	reatment ptionsincludelowering eamountofadministeredliqui or increasing thetemperature f the dryair.	31]
itting	n the surface ofthe dosage rm,specific pits haveappeared this typeof fault, but the Chasnotvisually anished.	uchflawsareeliminatedby djustingthe temperature uringthe tablet premanufacturingprocess.	32]

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