A review of controlled release fertilizers biology essay

Business, Industries

In general, workss must be supplied with foods during the whole flora period. In gardening this is achieved by using rapidly soluble fertiliser one time to twice a hebdomad, for illustration.

This sort of fertiliser application is really labor-intensive and requires considerable specialist cognition, so as to choose the right rate of application, appropriate clip of application and right composing for the peculiar workss to guarantee optimal works production. With the usage of slow or controlled release fertilizers the full sum of foods necessary for the whole flora period can be applied at the clip of seting or at the earliest phases of works growing, in the signifier of a alimentary pool Besides, about half of the applied fertilisers, depending on the method of application and dirt status, is lost to the environment, which consequences in the taint of H2O [1] . This sort of environmental concerns of feeding harvests with traditional fertilisers has led to developing Slow Release Fertilizers (SRFs) or Controlled Release Fertilizers (CRFs) . SRFs or CRFs are easy and safe to utilize. They cut down hazard of wrong fertiliser application ; they are labour economy ; and minimise alimentary losingss by leaching or arrested development. The thought of bring forthing SRFs was developed from 1963 by encapsulation of fertilisers by waxes. After that, these merchandises have been commercialized.

There are tonss of SRF and CRF trade names ; market leader in controlled release fertilisers is Scotts Professional with cardinal trade names such as Osmocote Exact, Sierrablen and Osmoform. SunGro Company is besides bring forthing controlled release fertilisers with trade name name of

Multicoate. AGLUKON is besides another commercialized SRF merchandise [2-4] .

Like tonss of scientific Fieldss, agribusiness industry has been over shadowed by nanotechnology. Applications of nanotechnology in agribusiness includes agriculture harvest betterment, nanobiotechnology analysis of cistron look and ordinance dirt direction, works disease nosologies, efficient pesticides and fertilisers, H2O direction, bioprocessing, station crop engineering, supervising the individuality and quality of agricultural green goods and preciseness agribusiness [5] . Efficient pesticides and fertilisers in footings of “ Nano-composite based slow release fertilisers “ are developing in current decennaries. Using nanoparticles as reinforcing or cementing agent of polymer coatings has been the lone characteristic of nano atoms which is used in fixing slow release fertilisers [6, 7] .

Fertilizers

Fertilizers are applied to dirty to advance works growing. They contain some good foods including macronutrients and micronutrients. Macronutrients are nitrogen, P, and K which are added to dirty in measures from0.

2 % to 4. 0 % (on a dry affair weight footing) and are more indispensable than micronutrients. Micronutrients are elements which are applied to dirty in much smaller sums, runing from 5 to 200 ppm, or less than 0. 02 % dry weigh. These elements could be sulfur (S) , B (B) , Cu (Cu) , Fe (Fe) , manganese (Mn) , molybdenum (Mo) , zinc (Zn) [8, 9] .

2. 2.

Types of fertilisers

Fertilizers would be categorized from beginning of being and besides from release belongingss points of position. All fertilisers could be organic or man-made from beginning of being point of position. Organic fertilisers are of course occurred including seaweed, worm casting, manure, slurry, peat, humic acid, guano and brassin. They provide slow release of food as they need dirt ' s bacteriums to be broken down to needful elements.

Besides, they may better the biodiversity of dirt by providing organic affairs and micronutrients for beings. Organic fertilisers are cheaper and safer than man-made fertilisers [9, 10] . The chief man-made or mineral fertilisers are urea, ammonium sulfate, ammonium phosphate, phosphate stone, K chloride, ace phosphates, Ca ammonium nitrate, K sulfate and NPK, PK and PK compound fertilisers. The most of import drawbacks of man-made fertiliser is their long term sustainability.

Besides, they are more expensive in contrast to organic fertilisers [10] . Besides, fertilisers can be categorized into ordinary and controlled release fertilisers from release belongingss points of position.

Drawbacks of non- controlled release fertilisers

Ordinary fertilisers leach to dirty really rapidly and most of them are non used by the workss.

Harmonizing to figures " about 40-70 % of N, 80-90 % of phosphoric, and 50-70 % of the applied normal fertiliser is lost to environment and can non be

used by workss ” [11] . This rapid leaching will do combustion of workss and turning in jets. Besides, the lost elements will do some serious jobs for our environment. Eutrophication, Blue baby syndrome, dirt acidification, relentless organic pollutants, heavy metal accretion, atmospheric effects are environmental concerns of ordinary fertilisers. Another consequence of speedy leaching of fertiliser is reiterating the application of fertilisers which will increase the costs [8, 12, 13] .

Slow or controlled release fertilisers

Slow release fertilisers or controlled release fertilisers are coated in a substance that enables a slow release clip and eliminates need for changeless fertilisation and higher efficiency rate than soluble fertilisers [14] .

The involvement in these stuffs is for one or more of the undermentioned grounds: Handiness of foods during the hole growing-season ; reduced alimentary loss via leaching and run-off ; reduced cost and labour outlay in harvest production ; reduced chemical and biological immobilisation reactions in dirt which cause works unavailable signifiers ; decrease of rapid nitrification and nitrogen loss through ammonia volatilization and denitrification ; reduced seed or harm from high local concentrations of salts ; reduced leaf burn from heavy rates of surface-applied fertilisers ; better seasonal distribution of growing and better acclimatisation in place or show environment ; improved storage and handling of fertiliser stuffs [15] .

Differences between slow and controlled release fertilisers

Although there is no a particular difference in general map of CRF and SRF, but it should be mentioned that they are manufactured by different stuffs and techniques with different belongingss. In slow release fertilisers elements are present in the fertilisers in a chemical signifier, which is non available to workss and they will be converted by physiochemical effects or microorganisms activities into alimentary signifiers in the dirt. But in controlled release fertilisers elements are packed in coated granules and are released through the coating over a certain period of clip. Besides, in SRFs foods available period is affected by a batch of factors such as H2O content of dirt, Ph, temperature, micro-organism ‘ s activity, aeration.

However, the length of service of CRF depends on surfacing thickness and temperature of dirt. Merely surfacing method is effectual in altering form of foods release and a fixed coating thickness control nutrients release. In CRFs declared release clip refers to dirty temperature of 20-21 oC.

Higher temperatures accelerate the component release and lower temperatures make it longer [4, 16] . SRFs are chemically prepared slow released. Some sorts of SRFs are Urea Aldehydes (UA) and Chelated Micronutrients (CM) . Common type of UAs is urea methanal which is high N fertiliser. Get downing release rate of UAs is high but it dies off easy for 3 old ages. This sort of fertiliser depends on micro-organisms to interrupt it down for works usage. CMs are substances that hold steadfastly together Fe, manganese, Zn, and Cu.

They slowly releases over a long period of clip [17] .

2. 4. 2.

Types of CRFs

2. 4. 2.

1. Sulfur Coated (SC)

Elemental S when is oxidized to its sulfate signifier would be one of the foods which is indispensable for some workss and is usually blended with other fertilisers. Using sulfur coating is besides another manner to supply S at the same time with doing slow release belongingss for a nucleus farinaceous fertiliser. As the S incorporating stuffs like polysulfides or lingosulfonate are brickle and besides give a low wetting of defects they are usually assorted with waxes or plasticisers. Many expressions are available for SCs. Their release clip is by and large 3-4 months. SDs are released by microorganisms [18-22]

2. 4.

2. 2. Wax coated (WC)

One of the methods of cut downing fertilizer release rate is scattering farinaceous fertilisers with liquefied wax and so chilling the mixture below the runing point of the wax [23] . Paraffin is one of the most used wax as a coating for fertilisers. ParaffinA waxA is a white, tasteless, odourless, waxen solid, with a typical thaw point between about 47 A°C and 64 A° [24] .

Other types of waxes are man-made oil based, crude oil or mineral waxes. Waxs are usually used by an linear or a tackifiere agent to do a good waterproofing belongingss [25, 26]

2. 4. 2. 3.

Polymer Coated (Personal computer)

Polymer-coated fertilisers (PCF) represent the most technically advanced controlled released fertilisers. They include a water-soluble fertiliser nucleus and one or more than one beds of polymer. There are big assortments of polymers to surface the nucleus fertiliser besides the coatings bed could be the same one or different. In Personal computer fertilisers release of foods will go on by diffusion through a semi permeable polymer membrane. Water penetrates the coating and dissolves the nucleus. Let go of rate can be controlled by changing the composing and thickness of the coating. In add-on, force per unit area builds up can do clefts to organize, from which fertiliser passes into the dirt [27, 28] .

2. 5. Review of readying methods of different polymer coated CRFs

2. 5.

1. Exclusive Polymer coated

One type of polymer coated CRFs is the one which the fertiliser nucleus which could be N, P, K OR NPK compound, is merely coated with one or more than one bed of polymer coating. In this instance the polymer could be solvent based or water-based. The application procedure starts with fade outing the polymer in a organic dissolver or H2O. After fade outing the

coating will be sprayed onto the fertiliser in a coating membranophone or fluid bed [29] . Benefits of polymer coated CRFs are as follow ; uniform and defect free coating will environ fertiliser ; the coating will be really tough and lasting which is immune against mechanical dislocation ; they are biologically inactive so they will non breakdown by dirt bugs.

In most instances except for degradable polymers release of fertilisers will be happen by diffusion through polymer coat instead than through defects. In some other coated fertilisers like sulfur coatings there should be a defect in surfacing to do release of fertiliser. There are tonss of illustrations for polymers which have been used in literatures as surfacing for fertilisers, some of them are as follow ; dicyclopentadien [30] , Urea and urethane based [31-36] , epoxy based [37-39] , polyvinylidene chloride-based latex [29] carboxyl-carrying ethene polymers [40] , biodegradable amylum based [41] , urea methanal [42] . However, polymer coated fertilisers have some hebdomad points. About solvent-based coatings utilizing big sum of organic dissolvers like methylbenzene or xylol will take to environmental concerns.

These dissolvers are volatile and let go ofing them to environment makes some jeopardies for human wellness. Besides, polymer coatings are more expensive than sulfur coatings ; the procedure and equipments are besides more complex than equipments used for other coatings.

2. 5. 2. Sulfur-polymer coated

One of most common coated fertilisers are the 1s in which nucleus fertiliser is covered by a bed of S coating and a bed of polymer. The polymer bed can

be primer or outer bed ; means that S bed in some researches has been the first bed and in some others the outer bed. SulfurUsing coating is a suggested method to take drawbacks of S coated CRFs.

One of these drawbacks is really fast release of fertiliser in first few yearss after application. The other one is crispness of S coatings which may take to some breaks during managing or storage and losing the fertiliser into dirt. Another job is that sulfur coatings have a high surface tenseness with H2O and can non supply plenty wetting for a good diffusion [19, 29, 38, 21] . The most common method for using the S coating is spray. Molten sulfur compound will be sprayed over a pre-polymer coated fertiliser granule [38, 43] .

2. 5. 3.

Wax-polymer coated

There are tonss of researches concentrating on doing controlled release fertilisers utilizing Wax-polymer coatings. Wax bed has three major benefits ; one is that they are applied over the polymer bed for diminishing the break chance of coating and the other one is for diminishing the sum of polymer and avoiding devouring more polymers to do the procedure cost effectual. Besides, they can extinguish imperfectness of granules surface to do a good surface coating. Most common waxes which have been used in province of the art is C30 alpha-olefin and paraffin.

Other crude oil merchandises like lubricators and bitumen or natural merchandises like canola oil, soya bean oil, coconut oil and thenar oil,

besides have been used. After runing the wax it will be applied by blending with polymer coated fertiliser. Normally the polymer is thermoset to avoid any amendss of polymer by the wax in its thaw point. The wax usually should hold bead runing point from 50 to 120°C.

Wax is usually approximately 0. 2 % to 10 % by weight of fertiliser [25, 38, 44, 45] .

2. 5. 4. Filler- polymer coated

As mentioned before, despite tonss of advantages of polymer coating to do slow release belongingss when such polymers are used as a exclusive coating stuff the ultimate merchandise would be expensive as you have to devour big sum of polymer. Using mineral or organic fillers is one manner to avoid utilizing big sum of polymer.

Besides, in some researches fillers play the function of detackifier, to forestall attachment of coated granules to each other, and beef uping agent [46] . Fillers may be used either as a mixture with polymer to do a nano-composite polymer [47] or as a separate bed. The most common method is 2nd one in which the filler will be added and assorted with polymer coated granules before drying the granules.

Most common used fillers are some really all right (less than 20 micrometers) inert inorganic stuffs like clay, diatomaceous Earth, bentonite, china clay, gypsum powdered limestone, talc, Ba sulphate. Some other fillers like waste cellulosic stuffs besides have used as filler in combination with polymer. [47-51]

2. 6.

Techniques surfacing application

Harmonizing to surveies have been done ; encapsulation methods of fertilisers can be divided into three methods including unmoved, spray and commixture.

2. 6. 1. In situ

This method includes formation of unstable scattering of the soluble fertiliser in a dissolver and blending the prepared solution with monomers of a polymer.

Polymerization will go on and depend on the method ; granules or atoms of fertilisers will organize. Ni et al [52] have developed a double-coated urea fertiliser. For readying of poly (N-vinyl-pyrrolidone) hydrogels incorporating urea (PCU) , the monomer and a solution of urea in N-vinyl-pyrrolidone were assorted together. The polymerisation was carried out at 65a-¦C for 3 h. The ensuing samples were vacuum-dried, milled, screened and stored.

After that first coating was dried sample and some sums of carbamide were assorted with sodium alginate (SA) solution. Assorted solution was so added bead wise into 5 % (w/w) CaCl2 aqueous solution and stirred invariably. The beads instantly turned into granules (about 4mm in diameter) because the SA in the bead was crosslinked by Ca2+ at one time. The granules were filtered and dried in oven at 70a-¦ C. Then the granules were added to ethylcellulose – ethanol solution.

Multiple EC coatings were prepared by submergence of the antecedently coated granules into the Ethylcellulose (EC) solution repeatedly. Therefore, EC-coated urea granules with different surfacing thickness were obtained. Hanafi et al [53] , have coated a compound fertiliser by polyvinyl chloride (PVC) , polyacrylamide (PA) , natural gum elastic (NR) , and polylactic acid (PLA) utilizing in situ method. For encapsulation of compound fertiliser with polyacrylamide the granules were added to the solution mixture of monomers.

Then the polymerisation reaction will get down in being of fertilisers. The thickness of the surfacing bed on the compound fertiliser granules, determined by SEM, gave PVC compound coated fertilizer the highest value of 3. 04 lumen, and the lowest was obtained by PA (2. 04 Aμm) . Variation in the features of the polymers would be utilized in bring forthing CR compound fertiliser that fit the demands of turning workss. Hudson et al [38] used epoxy to surface the fertiliser.

In this research the urea granules were charged to a pan and warmed to 95°C. Then the hydrogenated tallaw aminoalkane, 2-amino ethyl peperazine and bisphenol A diglycidyl quintessence were assorted and were added to the granules ; meanwhile polymerisation happened and prepared mixture was agitated till the fertiliser granules dried.

2. 6. 2. Spray method

This method is most common method for surfacing the fertiliser granules in province of the art [.

Normally, the solution of polymer in a suited dissolver is sprayed on the granule of fertiliser and so the granules are dried to take the dissolver through vaporization. The intervention is repeated every bit frequently as necessary until the coveted coating per centum is reached. Lan et al [54] have used Chitosan and poly (acrylic acid-co-acrylamide) as biodegradable polymers to surface the NPK fertiliser. The NPK was compound fertiliser granules with about 2 millimeters in diameter.

It was placed in a rotary membranophone and so the Chitson pulverization which was dissolved in epoxy-aceton solution was sprayed over the fertiliser. After drying the coating, Chitson coated granules were added to a flask equipped with a mechanical sociable. Carbon tetracholoride, polythene glycoloctyl phenyl quintessence, sorbite anhydride monostearic acid ester, solution of acrylic acid acrylamide, N, N- methylenebisacrylamide and ammonium persulfate was easy added to the flask. After blending the coated granules were dried in oven. This merchandise with good controlled-release and water-retention capacity, being degradable in dirt and environment-friendly, could be particularly utile in agricultural and horticultural applications. Tomaszewska et al [55] have used spray technique for encapsulation of fertilisers. In order to better the belongingss of coatings, the granules of antecedently coated fertiliser (wet method) were sprayed with a polymer solution or pure dissolver (N, N dimethylformamide) .

Concentration of the polymer in solutions used for spraying was in the scope of 13-17 wt % . Measurements of thickness, porousness of prepared coatings and microphotographic observation of the coatings were taken. Ma et al

[56] have developed a method for encapsulation of fertiliser with a ego assembled coating. The fertiliser granules were heated in a rotary membranophone to 75°C for 10 proceedingss. Then the ego piecing amphiphilic molecules (N, N-bisaminoethyl eleostearate) were sprayed over the fertiliser. After 20 proceedingss aliphatic isocyanates were sprayed over fertiliser.

This procedure was repeated one time once more. The fertiliser kept for drying in the 75°C for 20 proceedingss. Dai et al [57] , have developed a controlled release fertiliser utilizing a H2O soluble rosin as a coating. The farinaceous compound fertiliser was coated in fluidized bed.

Lan et al [58] , prepared a double-coated slow-release NPK compound fertiliser with superabsorbent and water-retention belongingss (DSFSW) , whose inner coating was chitosan (CTS) , and the outer coating was crosslinked poly (acrylic acid) /diatomite-containing urea (PAADU) . This prepared merchandise non merely has slow-release belongings but besides could absorb a big sum of H2O and continue the dirt wet at the same clip. In add-on, the outer coating (PAADU) could protect the inner coating (CTS) from mechanical harm. These were important advantages over the normal slow release or controlled-release fertilisers, which by and large have merely a slow-release belongings. The consequences indicated that the DSFSW could be found an application in agribusiness and gardening, particularly in drought-prone parts where the handiness of H2O is deficient. At first the outer surfacing incorporating urea diatomaceous earth (PAADU) was prepared.

The NPK compound fertiliser granule was placed into a rotary membranophone, and the Chitosan pulverization was stuck on the granules by agencies of epoxy dissolved in propanone. The adhesive was applied by spraying at regular clip intervals. The procedure was finished until compact and homogenous coating formed on fertiliser granule. The coated granules were dried to a changeless mass at room temperature for 6 h. Then the CTS-coated NPK compound fertiliser granules were obtained.

CTS-coated NPK compound fertiliser granules were dipped in H2O and so were instantly placed on PAADU pulverization and shaken. In this mode, PAADU could adhere to the surface of CTS-coated NPK compound fertiliser and organize the outer coating. The surface of the merchandise was crosslinked by spraying methanol solution of epoxy chloropropane and so dried in a 70 °C oven to obtain the concluding merchandise, i. e.

, the double-coated slow-release NPK compound fertiliser with superabsorbent and water-retention. Hansen et al [36] , encapsulate the farinaceous fertiliser with the epoxy rosin utilizing spray method. In this research non coated fertiliser was placed in a rotating membranophone and pre heated to 250° F. A rapid drying solution of copolymers dicyclopentadiene and a modified vegetable oil were applied over fertiliser utilizing spray in a thin watercourse of rosin.

Simultaneously hot air was passed through membranophone. Following monomers of 2nd rosin including a mixture of epoxidized soya bean oil and polyester bring arounding agent were applied over prepared granules. The

dissolver was a mixture of xylene and Cellosolve ethanoate. Hansen et al [39] besides have used the above mentioned method for encapsulation of fertiliser with polyurethane.

First of all the preheated fertiliser was coated by a man-made drying oil. After drying the coating for a few proceedingss fertilizer were dusted by clay. Then Urethane solution in xylene and Cellosolve acetate were applied utilizing spray.

2. 6. 3. Simple commixture

In this method granules are merely assorted with the coating at its runing point or with a solution of polymer in a suited dissolver. Tomaszewska et al [59] used this method for surfacing the farinaceous NPK fertiliser with polysulfone (PSF) , cellulose ethanoate (CA) and polyacrylonitrile (PAN) .

The coating solutions were prepared by the disintegration of the solid polymer in equal dissolver. The NPK fertiliser was in turn added to adequate polymer solution, and was covered by a thin bed of the solution. Subsequently, granules were dropped into H2O, where the gelation procedure takes topographic point. The coated granules were removed from the precipitation bath and so dried to a changeless mass. The multiple coatings were prepared by submergence of the individual coated fertiliser into equal polymer solution, so into H2O and drying. Hon [47] has prepared the coated granules by blending method.

After runing the thermoplastic polymer by heating, the cellulosic additive has been added to run rosin. Then after leting the temperature to drop, for

avoiding the fertiliser harm, the granules or pulverization fertiliser has been mixed with the prepared mixture utilizing a Brabender Mixer. Markusch et al [60] merely has mixed the fertilizer pellets with at first, a diluted polyol and so with a diluted isocyantae to do a polyurethane coating. Then the feretilizer were placed in oven for drying.

2.

7. Particular equipment for application of polymer coating

Typical physical method for encapsulating fertilisers are spray coating, spray drying, pan coating, rotary disc atomisation. Particular equipments for these methods are rotary membranophone, pan or thread or paddle sociable, fluidized. Fluidized bed and rotary membranophones are the most of import equipments [87, 88]

Polymers used as surfacing for CRFs

A wide scope of polymers has been used in fertiliser coating. These polymers could be thermoset, thermoplastic or biodegradable. Some of common thermoset polymers are urethane rosin, epoxy rosin, alkyd rosin, unsaturated polyester rosin, phenol rosin, urea rosin, cyanuramide rosin, phenol rosin, Si rosin. Among them, urethane rosin urethane is really common used.

[36, 61]Thermoplastic rosins are non really common used in art because of some jobs. As mentioned before a really preferred method of using polymers is spraying the dissolved polymer over granules. Either some of thermoplastic rosins are non soluble in a dissolver or do a really viscose

solution which is non suited for spraying. Polyolefine is used in art for surfacing the fertiliser granules [47, 62] .

Biopolymers, dispose in bioactive environments, degrade by the enzymatic action of micro-organisms such as bacteriums, Fungis, and algae and their polymer ironss may besides be broken down by non enzymatic procedures such as chemical hydrolysis. Non-biodegradable polymers are non environmental friendly. Due to environmental concerns there are some tendencies of replacing non-bio with bio degradable polymers as surfacing stuff from 1970s. But it should be mentioned that they are expensive yet and non really cost effectual. Besides, in production procedure lastingness of polymer should be adjusted with release clip of fertiliser.

Among natural and man-made biopolymers starch and cellulose based polymers, chitosan (a linearA polyose) , poly lactic acid and poly (Iµ-caprolactone) due to low cost and copiousness are some of used biopolymers in fertiliser industry [41, 52, 58, 63-69]

2. 5. Coating thickness

By and large, polymer coatings are applied in a thickness which is suited to do a desired controlled release belongings. Thickness could be related to characteristic of polymer and besides it depends on existed porousness of polymer surface. If H2O vapor transmittal rate of surfacing stuff is 0. 01 to 20, surfacing thickness would be 1 to 100 micrometers. Preferred surfacing thickness is 1 to 50 micrometers. Coating procedure could be repeated more than one bed to acquire coveted alimentary release [49] .

2. 6. Probe of release behaviour of CRFs

Release mechanism for different coatings is different. Thick encapsulated granules like S coating will let the food to let go of when a defect or rupture appears on the coating surface. In this instance, rupture will go on because of pervasion of H2O into surfacing and indoors osmotic force per unit area. Besides, biodegradable polymers will let go of foods while destructing by dirt bug ‘ s activity.

Polymer coatings or combination of different coatings will go on by diffusion of H2O through wall ‘ s porousnesss. In this instance release rate of can be controlled by the atom size of coated granules, thickness of coating and permeableness of surfacing surface. Besides, changing the chemical composing of fertiliser nucleus and the coating will alter permeableness of coating ; means that even basic or acidic environment will alter the permeableness. In some researches when the coating has been starch-vinyl, increasing size of encapsulated granules has led to decelerating down the alimentary release [70, 71] . There are some standard trial methods for measuring of controlled release belongingss.

Harmonizing To European criterion the standard release clip of N during 24 Hs should be 15 %of entire nucleus food. Besides, release rate for 15 twenty-four hours should be 75 % of entire foods. Besides American and Nipponese criterions say that the initial release should n’t be more than 40 % of entire food. Harmonizing to European criterions for mensurating the release rate encapsulated fertiliser should be immersed in pure H2O at 25 °C (room temperature) in incubated province [72, 73] . For illustration Detrick et all [

43] have investigated the release behaviour of their merchandise by submergence of 20 g of encapsulated granules for 8 H in H2O. After filtration of solid they dried the solid. Vaporization of H2O was done at 100 °C for 8 hours.

Besides, Ma et all [31] placed 14 g of granules in wire mesh holder into a jar with 300 ml H2O at 23 °C and agitated Ir by an orbital shaker. Then, the equal H2O was taken for elemental analysis.. Locquenghien et Al [40] for probe the slow release consequence of fertiliser some sums of fertiliser were continuously extracted with H2O. For this intent the granules were arranged in bed in a cylindrical vas field with H2O. Water was passed through this bed and its Nitrogen content was analyzed.

2. 8.

Commercial CRFs in universe and Malaya

Urea-formaldehydes are oldest slow release merchandises which were produced in 1936 and so were commercialized in 1970s. These merchandises were known as Ureaform, Bluchip, Nitroform Methex and Nutralene. After that Tennessee Valley introduced sulfur coated urea engineering in1960s. Polymer coated fertilisers were produced every bit early as 1970 in Japan. Most of import commercialized polymer coated CRFs are Osmocote, Nutricote [74]Osmocote CRFs are NPK granules coated by a thermoset copolymer of dicyclopentadiene and a glycerin ester (linseed oil) dissolved in an aliphatic hydrocarbon dissolver. The Osmocote CRFs are usually used for cosmetic gardening production like nurseries, baby’s rooms, citrous fruit, and strawberry production [75] .

Nutricote prills are encapsulated by thermoplastic rosins likeas polyolefins, polyvinylidene chloride. The procedure of Nuricote involves fade outing polymer in fast-dryingchlorinated hydrocarbon dissolvers and so using the solution to a assortment of alimentary substrates including urea, potassium sulphate, diammonium phosphate, ammonium nitrate and K chloride. Blendin the polymer with talc and ethylene-vinyl ethanoate has been done to obtain coveted release rate [76] Sierra, Lesco and polyon are some other commercialaized CRFs in the universe.

In Malaysia two trade names named Greenfeed [77] and KAMILA [78] has developed slow release fertiliser. Greenfeed contains Zeolite which helps to let go of foods when it is in contact with dirt. KAMILA is specially formulated for oil plantation industry.

2. 9. Tracing nano-technology characteristics in fertiliser industry

Reviewing literature shows that researches which have used nano-technology characteristics in fertiliser industry are really rare.

The chief benefits of nanoparticles in these researches are utilizing them as reservoir of fertiliser or as filler [79, 80] . Solid nano-particles, have big surface countries and their responsiveness is much more greater than that of micron size stuffs. Besides, their surfaces and interfaces provide an active substrate for physical, chemical, and biological reactions [80] . Two published researches have done utilizing nano-particles. One has used nano-clay as bearer of metal-urea composite ; urea intercalated clay without any coating has been developed as slow release fertiliser [79] . In other one, a

nanocomposite of nano atom, fertiliser and polymer has been granulated and developed as slow release fertiliser. The production method involves blending monomers, adding nano atom, which could be nano clay, nano bentonite, nano china clay, polymerisation and so graining the mixture. In this research nano atom merely work every bit good and effectual filler [81] .

Making polymer-nano-particle complexs is something common in industries. Tonss of researches have been done in this country, but researches around utilizing nano-particle as reservoir for fertiliser have been done seldom. For more survey here, we will reexamine the researches have been done.

2. 9. 1. Embolism of fertilisers into clay

The superimposed clays like Montmorillonite, Kaoline are made of high facet ratio beds.

Thickness of the beds is one nanometere and their long and broad is 100 nanometres. Blending clay and liquid or semi-liquid stuffs will do three sort of nanocomposites depending on new construction of clay. If material intercalate into interlayer infinite intercalated nano-composite is formed.

Blending may bring forth exfoliated nano-composite if nano beds exfoliate or delaminate in the matrix. If no embolism or exfoliation happen, merchandise will be traditional composite [82]Embolism of clays has been done by some methods including in situ, solution commixture, direct commixture and thaw commixture. In the first method which is common in fixing polymer-clay nanocomposite monomers will be pushed in to clay beds while

polymerisation go oning. Second method refers to fade outing intercalating stuff in a suited dissolver and intercalating solution into d-spacing of clay utilizing mechanical sociables.

In mechanical commixture method the intercalating stuff will be pushed into beds utilizing ultrasound or other mechanical sociables like ball-mill or three axial rotation factory. In last method stuff would be in melt province and embolism will be done utilizing mechanical forces under shear emphasis. Mechanisms which are involved in interaction between clay and organic stuffs depends on some factors like clay type, functional groups of organic stuff and physical or chemical belongingss of organic stuff. For illustration basic molecules bond strongly to montmorillonite but anionic molecules show much weaker interaction sets. Besides, for case benzoic acid or anionic species are adsorbed on the border face of clay or cationic (crystal violet) are adsorbed on the basal plane. Harmonizing to tabular array 1 which shows different interaction of organic compound with clay interaction between clay and carbamide could be through cation exchange, cation bridging and H [83] .[83]Reviewing the literatures shows that embolism of fertilisers into clay minerals have been done scarcely.

The methods include blending urea in solid signifier with clay under temperature, utilizing extremist sonication for handling clay with urea solution. Mechanochemical intervention of clay with solid carbamide and so thermic intervention is another manner. Merely concentrating on urea, we can happen a few published plants. Embolism of metal- urea composites is done supplying controlled release N incorporating fertiliser.

The chief grounds for utilizing Mg (Urea) x alternatively of Pure Urea are two barriers, One is break uping urea at its thaw temperature (132. 7) and another is impersonal construction of urea which is non accommodated easy by anionic Na+- Montmorillonite. The embolism procedure was done through blending Urea- MgCl2. 6H2O with montmorillonite clay with ratio of 1: 1. The commixture was done under heating to 105°C. The merchandise contains 34. 8 wt.

% urea. The XRD patterns showed increasing d-spacing of clay.[79]Release of urea from clay was investigated analyzing IR and XRD forms. Let go ofing of carbamide will be done by ligand exchange reaction with H2O. Two times rinsing of merchandise was done to look into the urea release. As the fig shows shrinking of clay d-spacing happened because of urea release [79] .

Adsorption of urea by clays was investigated in another research. This research was done merely for probe of clay capableness to adsorb blood urea. Different sort of clay at first were dispersed in H2O utilizing supersonic investigation so the clays were individually dispersed in proportion of 1 gm in 10 milliliter of urea solution. The mixtures were placed in tubing incorporating glass balls sealed tubings were maintain in a changeless temperature bath (l8°C or 37°C) for 24 h.

After centrifugating the mixture with 400 revolutions per minute for 30 min, aliquots of the clear supernatant were used for urea appraisal. This experiment besides was done while sonicating mixture of kaolinite and urea solution utilizing ultrasound investigation. The consequences shows

increased urea surface assimilation after utilizing ultrasound and besides after increasing urea concentration (fig) [84] . In another research [85] , embolism of urea into clay beds was done utilizing different sorts of montmorillonite.

The methods of embolism was mechano-chemical commixture. Different sorts of Montmorillonite like Ca2+ , Na+ , K+ , Mg2+ and Li+ 1s were dry-grounded with different ratio of urea utilizing an agate howitzer and stamp. After anchoring the mixture was heated for 3 H in different temperature runing from 150 °C to 375 °C.

XRD patterns show that swelling of the clay is depended to clay ‘ s exchangeable cations. Claies with high polarising ability like Al+ and Fe+ led to extensive puffiness. Besides, the consequences show that high temperetures have led to clay collaps and urea vaporization.

3. Decision

Among readying methods used by scientist for developing polymer coated CRFs, spray method and mechanical commixture methods seem more convenient particularly because of instruments which could be accessible. Besides, the reappraisal of researches about the polymers, H2O absorptive coatings seems good picks for drought-prone countries because of H2O keeping ; non really suited for showery countries like Malaysia.

On the other manus, biodegradable coatings like ethylcellulose or amylum containing polymers are suited picks because of environmental concerns and automatic degrading. From current literature reappraisal, we can happen out

that published articles and patents utilizing nano-technology characteristics in fixing controlled release fertilisers are really rare. Although there are tonss of thoughts and possible suggestion about utilizing nano-particles features in CRF industry and you can happen merely a few published articles in this field. But utilizing nanoparticles in other Fieldss like drug bringing [86-88] , smart inhibitor release [89] would be a good thought to develop in CRF industry.

High surface country of nanoparticles is one of the utile belongingss of nanoparticles which can be used for transporting and reserving the fertilisers. Using Urea as an intercalating agent for Clay atoms is one of the more interesting countries have been carried out by research workers, although, there are rare published any application of these modified nano-clays in CRFs.