FERTILIZER TABLET MAKING MACHINE

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Abstract:

In India most of farmer use chemical fertilizers, insecticides, pesticides and irrigation to obtain higher productivity. Indian farmers having common practices to use fertilizers. Farmers use conventional method to supply fertilizers to crops, in this method of fertilizer supplying there is difficulty in proper distribution fertilizer to crops. Due to this method farmers not only applying fertilizers in excess quantity but also fertilizers loss due to over irrigation. The fertilizers use is imbalanced and uncontrolled due to which farms become salt affected, less fertile and losses of fertilizers takes place. Therefore it is necessary to maintain balance between uses of fertilizers to overcome losses of fertilizer and improve soil fertility. To overcome above problem, develop fertilizer tablet making machine.

The object of this project is to develop fertilizer tablet making machine. For developing fertilizer tablet making machine, a literature review has been done and basic parameters required for development has been studied. The design of machine parts such as hopper, pocket roller, gears, belts, shafts and bearings is done then these parts are fabricate. Then assembly of these parts and experimentation is done for obtaining fertilizer tablet. The designed machine having capacity to produce fertilizer tablet of 130 kg/hour.

Keywords: Fertilizers, tablets, agriculture, crops, hecture.

CHAPTER NO. 1

INTRODUCTION

In agricultural farm fertilizer is used as supplementary nutrient for healthy growth of crops. The fertilizers mostly used in farm are Nitrogen (N), Phosphorus (P) and Potassium (K).

Following are the different types of conventional method to provide fertilizers to crops,

1.1 FERTILIZER PROVIDING METHODS

1.1.1 Approximate quantity of fertilizers:

Conventional method of providing fertilizers to agricultural farms are farmer take approximate quantity of fertilizer, then give to crops, as shown in Fig.1.

Fig .1.1 Farmer provide fertilizer to crop [8]

1.1.2 Simply throw the fertilizer

Another method of providing fertilizer to crop is farmer simply throwing the fertilizer.

Fig. 1.2: Fertilizer providing method.[8]

1.2 PROBLEM IDENTIFICATION:

The conventional method used for fertilizer providing having some losses, in this method proper distribution of fertilizers is not take place. When farmer throw the fertilizer then some quantity of fertilizer drop outside the crop due to this losses of fertilizer takes place. The fertilizer dropped outside the crops give nutrients for unwanted grass, due to which unwanted grass grow up fast. Unwanted grass causes difficulty for growing of crops.

Every crop mostly urea is used. In urea nitrogen (N) is presents in 46%. A large proportion of nitrogen is wasted through runoff, atmospheric evaporation. Due to runoff/flood water nitrogen is dissolve in to it and loss takes place. The nitrogen flow with this water in slope area due to which in slope area concentration fertilizer increases this causes the harmful effect on crop some crops are die due overdose of fertilizers. In slope area this fertilizers provide nutrients for unwanted grass due to which unwanted grass grow up. For removing unwanted grass extra manpower is required .Due to this extra manpower economic loss is takes place.

CHAPTER NO. 2

AIM OF PROJECT

The aim of this project is as following

- The proper distribution of fertilizer to each single crop.
- The avoid losses of fertilizer.

2.1 OBJECTIVES OF PROJECT

The objective of this project is to develop a fertilizer tablet making machine that is capable of producing fertilizer tablet. The tablet of fertilizer, provide required quantity of fertilizer to single crop. Fertilizers tablets are made from fertilizer such as UREA and DAP .They are largely used for different crops. Fertilizer tablet contents depend on which fertilizer is used for making them. Fertilizer tablet is deep –placed at the base of crop, due to which nutrient is available throughout growth of crop.

2.2 METHODOLOGY ADOPTED FOR DEVELOPMENT OF FERTILIZER TABLET MAKING MACHINE:

The flow chart of methodology is shown in Fig.3.The first thing in this is information collection of fertilizers, fertilizer quantity require, fertilizer losses. The information is collected from books, journal, internet and agricultural experts. The literature can be done. Then problems are identified as explained in introduction such as losses of fertilizer and improper distribution of fertilizers. The solution of this problem is found out, for proper distribution of fertilizer make fertilizer tablet. For making fertilizer tablet develop machine for it. For developing new machine. Following methodology is used as shown in fig1.3.

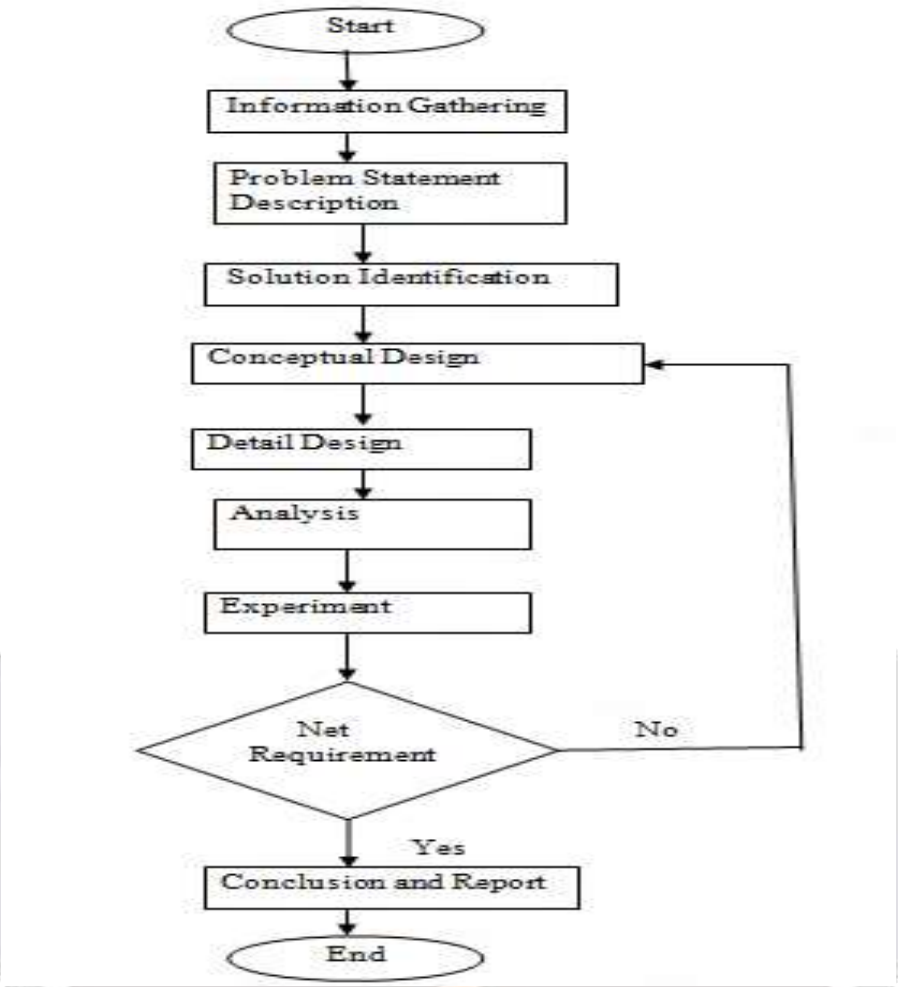

Fig.2.1. Overview on flow of methodology. [2]

CHAPTER NO. 3

LITERATURE REVIEW:

Literature survey was conducted for the development of fertilizer tablet making machine, mainly in the area of fertilizers uses, fertilizers types ,fertilizers losses, crops type and fertilizer require for it, rolling compaction process and machine design.

Dr. M. S. Lupin Mr. J. R. Lazo Mr. N. D. Le Mr. A. F. Little [2] In this paper alternative process of urea super granules is explained that is briquetting .The physical and chemical characteristics of urea make the material well suited for production of urea supergranules by briquetting. Briquetting of urea fertilizer up to 0.8 to 2.0 grams produced by International Fertilizer Development Center (IFDC).

Rajiv Shah [3] describes the deep placement of urea briquettes .This method is simple and effective. Instead of applying urea, a nitrogen fertilizer, to the soil, where as much as 70 percent is lost to runoff or the atmosphere .It is compacted in to briquettes and buried near plant roots, where it releases nitrogen slowly.

Krushiswadini, 2012 [1] in this book different types crops, their fertilizer require quantity and there area is given for Vidarbha region. From data of fertilizer quantity, duration and number of crop in each hectare, calculate fertilizer require for single crop, as shown in following table. From this quantity fertilizer tablet size find out.

CHAPTER 4

STUDY ON FERTILIZER REQUIREMENT FOR DIFFERENT CROPS:

Fertilizer name	Elements percentage (%) in fertilizer				
	Nitrogen N	Phosphorous P	Potassium K	Sulphur	Calcium
A) Nitrogen					
Urea	46				
Ammonium sulphate	20.6			24	
Ammonium sulphate nitrate	26			15	
B) Phosphorous					
Single super phosphate		16		12	21
Dicalcium phosphate		34			
Triple super phosphate		45		2	13
C)Potassium					
Muret of potash			60		
Potassium sulphate			50	18	
D) Combined					
Mono-ammonium phosphate	11	48			
Di-ammonium phosphate	18	46			
Ammonium phosphate sulphate	16	20		15	
Urea ammonium phosphate	28	28			
Ammonium nitrate phosphate	18	8	9		

Table no. 1: (4.1) Fertilizer types and elements present in it. [9]

4.1 FERTILIZER PROVIDING DOSE

Fertilizer providing dose is depend upon soil. The elements present in soil are varying from farm to farm so due to this fertilizer providing according to elements present in the soil. The following table shows fertilizer providing quantity according to elements present in the soil.

Sr. no.	Available N (Kg/Hectare)	Available P (Kg/Hectare)	Available K (Kg/Hectare)	Class	Providing quantity
1	Less than 140	Less than 15	Less than 120	Very low	More than 50%
2	141 to 280	16 to 30	121 to 181	Low	More than 25%
3	281 to 420	31 to 50	181 to 240	Medium	Suggested quantity
4	412 to 560	51 to 65	241 to 300	Good	Less than 10%
5	561 to 700	66 to 80	301 to 360	Better	Less than 25 %
6	More than 700	More than 80	More than 360	Best	Less than 50%

Table no. 2: (4.2) Fertilizers providing dose on the basis of available quantity of nutrients in soil. [10]

4.2 CROPS:

Crops type and fertilizer require for it and there area is given for Vidarbha Region. Fertilizers require for different crops and their quantity is given which is used to find size of fertilizer tablet.

4.2.1 Crops type and fertilizer require for it and there area in hectare.

4.2.1.1 Cotton crop.

Different types of cotton crops and their quantity in one hectare is given in following table.

Sr.no	Type of cotton	Number of crops in one hectare
A	Horticultural cotton	
1	Hybrid	9,300
B	Dryland cotton	
2	Indian developed AKA5.AKA7,AKA8	1,11,100
3	Indian developed AKA 8401	55,600
4	American developed DAHYA 286	55,600
5	American developed PKV RJAT	55,600
6	American developed AKAH 8828	55,600
7	American developed AKAH 081	1,11,100
8	Indian hybrid PKAV DAH 1	37,000
9	Indian hybrid PKAV SUWARNA	37,000
10	American hybrid PKAV HI -2	18,500
11	American hybrid PKAV HI -4	18,500
12	American hybrid PKAV HI -5	27,800

Table no. 3: (4.3) Types of cotton crop and their quantity in one hectare. [11]

The fertilizer required for different types of cotton crops and their duration is shown in following table.

Type	Hectare quantity in Kg		
	At time of sowing	After growth	
	N:P:K	After one month	After two month
Horticultural cotton	40:60:60 34:50:50	45	40
Indian developed	20:20:00	20	
American developed	30:30:00	30	
Indian hybrid	30:30:30	30	
American hybrid	30:30:30	30	

Table no. 4: (4.4) Fertilizer requirement for different types of cotton crop and their providing duration. [12]

The proportion of different fertilizer for above types of cotton crop is shown in following table

Fertilizer quantity (kg) N +P+K	Fertilizers name and their quantity in hectare
40+60+60	1) DAP 130Kg + UREA 40 Kg +Muret of potash 100 Kg OR 2) 15:15:15 - 200 kg +super phosphate 120 kg + muret of Potash 30 kg OR 3) 20:20:0 -200 kg +Super phosphate 120 kg + muret of potash 100 kg OR 4) Urea 90 kg +Superphosphate 375 kg + muret of potash
30+30+30	1) DAP 65 Kg + UREA 40 Kg +Muret of potash 50 Kg OR 2) 15:15:15 - 200 kg OR 3) 20:20:0 - 150 kg + muret of potash 50 kg OR 4) Urea 65 kg +Superphosphate 190 kg + muret of potash 50 kg
30+30+0	1) DAP 65 Kg + UREA 40 Kg OR 2) 20:20:0 -100 kg OR 3) Urea 45 kg +Superphosphate 130 kg
20+20+0	1) DAP 45 Kg + UREA 25 Kg OR 2) 20:20:0 -100 kg OR 3) Urea 45 kg +Superphosphate 130 kg
45 Kg N	100 kg Urea
40 Kg N	90 kg urea
30 Kg N	65 kg urea
20 Kg N	45 kg urea

Table no. 5: (4.5) Fertilizer proportion for cotton crop [12]

4.2.1.2 Maize

The maize crops quantity in one hectare and fertilizer providing duration is given in following table.

Sr.no	Types of crops	Number of crops in one hectare	Fertilizers providing duration and quantity		
			At time of sowing N:P:K (Kg/Hectare)	After 30 days N (Kg/Hectare)	After 50 days N (Kg/Hectare)
1	Maize	80,0000	40:60:30	40	40

Table no. 6: (4.6) The maize crops quantity in one hectare and fertilizer providing duration [12]

4.2.1.3 Sweet Maize

The maize crops quantity in one hectare and fertilizer providing duration is given in following table.

Sr.no	Types of crops	Number of crops in one hectare	Fertilizers providing duration and quantity		
			Before sowing DAP (Kg/Hectare)	After 30 days N (Kg/Hectare)	After 30 days N (Kg/Hectare)
1	Sweet Maize	50,000	500	125	125

Table no.7: (4.7) The sweet maize crops quantity in one hectare and fertilizer providing duration [12]

4.2.1.4 Safflower

The Safflower crops quantity in one hectare and fertilizer providing duration is given in following table.

Sr.no	Types of crops		Number of crops in one hectare	Fertilizers providing duration and quantity	
				Before sowing N:P (Kg/Hectare)	After 30 days N (Kg/Hectare)
1	Safflower	Dryland		25:25 (125 kg Ammonium sulphate + 150 kg single phosphate)	
		Horticultural	49408	20:40	20

Table no. 8: (4.8) The Safflower crops quantity in one hectare and fertilizer providing duration [12]

4.2.1.5 Capsicum or Chilies

The Capsicum or Chillies crops quantity in one hectare and fertilizer providing duration is given in following table.

Sr.no	Types of crops		Number of crops in one hectare	Fertilizers providing duration and quantity			
				Before sowing (Kg/Hectare)	After 30 days N (Kg/Hectare)	After 77days N (Kg/Hectare)	After 91 days N (Kg/Hectare)
1	Capsicum or Chillies	Horti-cultural	27763	N:P:K 40:50:50	40	40	30
		Dryland	37037	N:P 25:25	25		

Table no. 9: (4.9) The Capsicum or Chilies quantity in one hectare and fertilizer providing duration [12]

4.2.1.6 Okra

The Okra crops quantity in one hectare and fertilizer providing duration is given in following table.

Sr.no	Types of crops		Number of crops in one hectare	Fertilizers providing duration and quantity	
				Before sowing N:P:K (Kg/Hectare)	After 30 days N (Kg/Hectare)
1	Okra	Rainy	37037	N:P:K 25:50:0	25
		Summer	74112	N:P:K 25:50:0	25

Table no. 10: (4.10) The Okra quantity in one hectare and fertilizer providing duration [12]

4.2.1.7 Aubergine

The Aubergine crops quantity in one hectare and fertilizer providing duration is given in following table.

Sr.no	Types of crops	Number of crops in one hectare	Fertilizers providing duration and quantity	
			At time of sowing N:P:K (Kg/Hectare)	After 30 days N (Kg/Hectare)
1	Aubergine	22213	30:50:0	30
		17772	30:50:0	30

Table no. 11: (4.11) The Aubergine quantity in one hectare and fertilizer providing duration [12]

4.2.1.8 Tomato

The Tomato crops quantity in one hectare and fertilizer providing duration is given in following table.

Sr.no	Types of crops	Number of	Fertilizers providing duration and quantity

		crops in one hectare	At time of sowing N:P:K (Kg/Hectare)	After 30 days N (Kg/Hectare)
1	Tomato	37043	50:60:50	50
		27763	50:60:50	50
		22213	50:60:50	50

Table no. 12: (4.12) The Tomato quantity in one hectare and fertilizer providing duration [12]

4.2.1.9 Cauliflower

The Cauliflower crops quantity in one hectare and fertilizer providing duration is given in following table.

Sr.no	Types of crops	Number of crops in one hectare	Fertilizers providing duration and quantity	
			At time of sowing N:P:K (Kg/Hectare)	After 30 days N (Kg/Hectare)
1	Cauliflower	49408	50:50:0	50
		37037	50:50:0	50

Table no.13: (4.13) The Cauliflower quantity in one hectare and fertilizer providing duration [12]

4.2.1.10 Watermelon

The Watermelon crops quantity in one hectare and fertilizer providing duration is given in following table.

Sr.no	Types of crops	Number of crops in one hectare	Fertilizers providing duration and quantity	
			At time of sowing N:P:K (Kg/Hectare)	After 30 days N (Kg/Hectare)
1	Watermelon	5000	40:40:40	40

Table no.14: (4.14) The Watermelon quantity in one hectare and fertilizer providing duration [12]

4.3 Fertilizer require for single crop

Following table shows fertilizer require for single crop

Sr. No.	Types of crops	Fertilizer quantity required for single crops in gram		
		Nitrogen (N)	Phosphorous (P)	Potassium (K)
1	Horticultural Cotton	4.3	6.4	6.4
2	Melon	4.8	4.8	4.8
3	Watermelon	8	8	8
4	Tomato	2.2	2.7	2.2

Table no.15: (4.15) Quantity of fertilizers for single crop [12]

CHAPTER NO. 5

MACHINE DESIGN. [7]

The schematic diagram of machine is shown in fig.1.The parts used in machine are following. All dimensions are in mm.

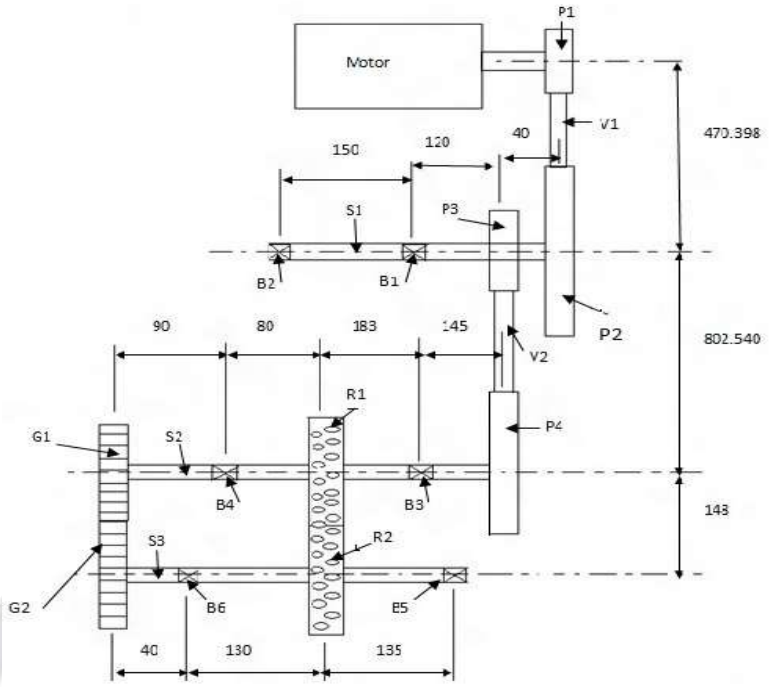

Fig. 5.1: Schematic diagram of machine.

Where,

P_1= Pulley on motor

P_2=Pulley on intermediate shaft S1

P_3=Pulley on intermediate shaftS1

P_4=Pulley on first roller shaftS2

V_1=Belt on P_1 and P_2 pulley

V_2=Belt on P_3 and P_4 pulley

G_1=Gear on first roller shaft S2

G_2=Gear on second roller shaft S3

S_1=Intermediate Shaft for reducing rpm

S_2=first roller Shaft

S_3=Second roller three

B_1=Bearing no. one on intermediate shaft S_1

B_2=Bearing no. two on intermediate shaft S_1

B_3=Bearing no three on first roller shaft S_2

B_4=Bearing no four on first roller shaft S_2

B_5=Bearing no five on second roller shaft S_3

B_6=Bearing no six on second roller shaft S_3

R_1=Pocket roller first on S_2

R_2=Pocket roller second on S_3

5.1 DESIGN OF HOPPER [7]

The hopper designed for this machine is like square pyramid is shown in Fig.1. dimensions are in cm.

By using property of similar triangle

$$\frac{x}{(45+x)} = \frac{15}{50} \quad \text{……..(1)}$$

x = 6 mm

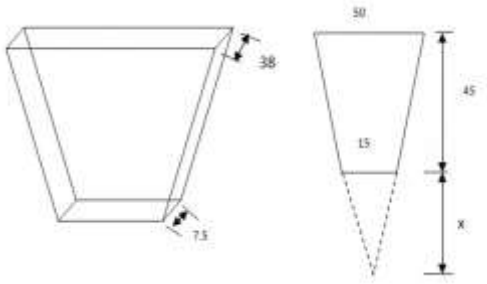

Fig. 5.2: The Hopper. [7]

Volume of hopper = Volume of big square pyramid – Volume of small square pyramid

$$V = \frac{50 \times 38 \times 51}{3} - \frac{15 \times 7.5 \times 6}{3}$$

$$V = 32075\ cm^3$$

$$V = 3.2 \times 10^{-3}\ m^3$$

5.2 DESIGN OF GEAR. [7]

For 20° full depth involute system

Centre distance between two gear is a=148 mm

M_t =Torque = 468920.832 N.mm

$$\text{Speed ratio} = \text{i} = \frac{d_g}{d_p} = \frac{N_p}{N_g} = \frac{Z_g}{Z_P} = \frac{1}{1}$$

Material SAE 1095

S_{ut} =913 N/mm^2

E = 202×10^3 N/mm^2

BHN =300

Where,

a = Centre distance between two gear

d_g = Pitch circle diameter of gear

d_p = Pitch circle diameter of gear

Z_p = Number of teeth of pinion

Z_g = Number of teeth of gear

M_t = Torque transmitted by gear

C_s = Service factor

E =Modulus of elasticity

S_{ut} =Ultimate tensile strength

BHN = Brinell hardness number

P_t =Tangential force due to rated torque

Y = Lewis form factor

V = Pitch line velocity (m/s)

C_v =Velocity factor

P_{eff} = Effective load

S_b =Beam strength of gear tooth (N)

b = Face width of gear tooth (mm)

K = Load stress factor (N/mm^2)
(N/mm^2)

E_p = Modulus of elasticity of pinion

α = Pressure angle

$б_b$ = Permissible bending stress (N/mm^2)

S_w = Wear strength of gear tooth (N)

Q = Ratio factor

$б_{es}$ = Surface endurance strength of the material

E_g = Modulus of elasticity of gear

Pinion and gear diameter

$$a = \frac{1}{2}(d_p + d_g)$$

$$148 = \frac{1}{2}(d_p + d_g)$$

$$148 = \frac{1}{2}(d_p + d_p)$$

$$d_g = d_p = 148\ mm$$

Static load,

$$P_t = \frac{2M_t}{d_p} = \frac{2 \times 468920.832}{148}$$

$$P_t = 6336.768N$$

Effective load,

It is assumed, C_s =1.25

$$V = \frac{\pi d_p N_p}{60 \times 10^3}$$

$$V = \frac{\pi \times 148 \times 33}{60 \times 10^3}$$

$$V = 0.256\ m/s$$

$$V < 10\ m/s$$

Therefore,

$$C_v = \frac{3}{(3 + V)}$$

$$C_v = \frac{3}{3 + 0.256} = 0.921$$

$$P_{eff} = \frac{C_s P_t}{C_v}$$

$$P_{eff} = \frac{1.25 \times 6336.768}{0.951}$$

$$P_{eff} = 8600.391 \text{ N}$$

Beam Strength

Since the same material is used for pinion and gear, then pinion is weaker than gear.

Assume Y =0.34 and b=10M

$$S_b = Mb(6_b Y)_p$$

$$6_b = \frac{S_{ut}}{3} = \frac{913}{3} = 304.333 \ N/mm^2$$

$$S_b = M(10b)(304.333 \times 0.34)$$

$$S_b = 1034.732 \ M^2 \ \ N$$

Estimation of module

Equating effective load and beam strength

$P_{eff} = S_b$

$$8600.391 = 1034.732M^2$$

$$M = 2.883$$

Take module M = 4 mm

Number of teeth,

$$Z_P = \frac{d_P}{M} = \frac{148}{4} = 37 \ mm$$

$$Z_P = Z_g = 37$$

$$b = 10M = 10 \times 4 = 40 \ mm$$

Check for design,

$P_{eff} = 8600.391$ N

For 20º full depth involute teeth

$$Y = \pi \left[0.154 - \frac{0.912}{Z_P}\right]$$

$$Y = \pi \left[0.154 - \frac{0.912}{37}\right]$$

$$Y = 0.406$$

$$S_b = Mb(6_b Y)_p$$

$$S_b = 4 \times 40 \times\times 0.406$$

$$S_b = 11410.874\ N$$

$$S_b > P_{eff}$$

Hence, The design is satisfactory.

Wear Strength,

$$Q = \frac{2\ Z_g}{Z_g + Z_P} = \frac{2(37)}{37 + 37} = 1$$

$$6_{es} = [2.75(BHN) - 70]$$

$$6_{es} = [2.75(300) - 70]$$

$$6_{es} = 755\ N/mm^2$$

$E_p = E_g = 202\times10^3$ N/mm^2

$$K = \frac{6_{es}^2 \sin\alpha \cos\alpha \left[\frac{1}{202 \times 10^3} + \frac{1}{202 \times 10^3}\right]}{1.4}$$

$$K = \frac{(755)^2 \sin(20) \cos(20) \left[\frac{1}{202 \times 10^3} + \frac{1}{202 \times 10^3}\right]}{1.4}$$

$$K = 1.814\ N/mm^2$$

$$S_w = bQd_PK$$

$$S_w = (40 \times 1 \times 148 \times 1.814)$$

$$S_w = 10738.880\ N$$

Since $S_w > P_{eff.}$ Hence, The design is satisfactory

Sr. No.	Parameters of gear	For 20° full depth involute system
1	Pressure angle	20°
2	Module	M =4 mm
3	Number of teeth	$Z_p = Z_g = 37$
4	Pitch circle diameter	148 mm
5	Addendum	M = 4 mm
6	Dedendum	1.25M =5 mm
7	Clearance	0.25M =1 mm
8	Working depth	2M =8 mm
9	Tooth thickness	1.5708M =6.283 mm

Table 16: (5.1) Gear parameter. [7]

CHAPTER NO. 6

METHODOLOGY

I. Determine size of tablet.
II. Design pocket roller.
III. Design of torque, force, rpm, power.
IV. Design of shaft, key, bearings, gears.

Fig. no 6: Methodology. [2]

CHAPTER NO. 8

ADVANTAGES AND DISADVANTAGES

8.1 ADVANTAGES OF MACHINE

- We can reduce the loss of fertilizer due to fertilizer dissolves in water fast; fertilizer tablet dissolves slowly in water.
- We can apply fertilizers near the root of the crop.
- The fertilizer saves up to 30 to 35%.
- The productivity of crop increases.
- We can avoid loss of fertilizer due to which economic loss of farmer avoided.
- Crop can get nutrient for longer time due to fertilizer tablet dissolve slowly.

8.2 CHARACTERISTICS OF MACHINE

- In this machine it is possible to make 500 Kg fertilizer tablet per hour.
- For making fertilizer tablet no need to add any adhesive in this operation.
- The fertilizer tablet produced is in uniform size and shape.
- This machine is run on electrical motor.

8.3 LIMITATION OF MACHINE

- The fertilizer tablet produced from machine has low strength.
- Due to low strength of fertilizer tablet, it make when we require.
- The stock of fertilizer tablet is not possible.
- The transportation of fertilizer tablet is difficult.

CHAPTER NO. 9

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