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# Design and Development of End Runner Mill for Ayurvedic Medicines

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**Abstract –** *Nowadays, the pharmaceutical companies use the end runner mill machine for preparing Ayurvedic medicines. In this, components of machine mainly are mortar and pestle which are normally made up of steel and pestle of rock. The raw material used for preparation of Ayurvedic medicines in suspension or powder form or cream, this conversion of raw material into final medicine there are some acidic chemicals are produced, these were reacted with the steel mortar and forms the holes on its surface, causing the leakage of suspension. The pestle is made of wooden material which is directly rest on mortar. The pestle is hold by the chain. The speed of the machine is more which tends to make a non-homogeneous mixture of medicine. There is an issue with the maintenance of machine, the maintenance of gear box is difficult because the mortar is directly attached to the gear box shaft and lifting of mortar is not possible at the time of cleaning as it is directly fixed with the shaft. Time required for the maintenance is more due to complicated assembly. The cleaning of all machine components requires more time. The movement of machine is also difficult and to move more than one person is required.*

*In this project gives solution to the above-mentioned problems. Granite material is used for the mortar and pestle, this will avoid acidic reaction problem. The granite is less reactive with the contents of medicine, hence there is no such problem of formation of holes on surface of mortar. For pestle same material used, to avoid the absorption moisture from the mixture. Drive system is designed which contains the motor, gearbox etc. Problem of maintenance is resolved by providing the couplings at required place. The mortar is not fixed to gearbox shaft directly as to provide ease of maintenance and it will easily detach. To minimize the effort required to lift the pestle, screw jack arrangement is provided. Wheels are provided to the machine for easy movement.*

***Key Words***: End Runner Mill, Ayurvedic Medicines, Design of Machine.

## 1.INTRODUCTION

End-runner mill (also known as Chilean mill or Roller stone mill) are the mechanized forms of mortar and pestle-type compression commination. This milling equipment consists of two heavy wheels made of either stone or metal, connected by a shaft. The wheels rotate at its axis in a shallow circular pan. The material to be milled is fed into the center of the pan and is worked outwards by the action of the wheels. Scrapers are employed in scraping the material constantly from the bottom of the wheel vessel after which it is feed to the wheel were it gets crushed to powders.

Nowadays, the pharmaceutical companies use the End Runner Mill Machine for preparing Ayurvedic Medicines. In this, components of machine mainly are mortar and pestle which are normally made up of steel and pestle of rock. The raw material used for preparation of Ayurvedic medicines is generally in solid form. This solid material is converted into powder or cream by using end runner mill. In this process various acidic chemicals are produced. These chemicals react with steel mortar and forms holes on its surface, causing the leakage of suspension. The pestle is made of wooden material which is directly rest on mortar. The pestle is hold by the chain. The speed of the machine is more which tends to reduce quality of mixture of medicine. There is an issue with the maintenance of machine, the maintenance of gear box is difficult because the mortar is directly attached to the gear box shaft and lifting of mortar is not possible at the time of cleaning as it is directly fixed with the shaft. Time required for the maintenance is more due to complicated assembly. The cleaning of all machine components requires more time. The movement of machine is also difficult and to move more than one person is required.

cream, for this mortar and pestle is used. The proposed project can produce Ayurvedic medicine with required quality. In this project the mortar speed will be reduced to 40 r.p.m., which will improve production rate and quality of medicine. We used 2 hp motor as a prime mover. We have used granite mortar, which avoids creation of holes because of chemicals. The life of machine will improve to great extent. We have designed machine to have less and easy maintenance work.

We have used Granite material in the formation of mortar because granite material does not react against acids during preparation of medicine as compared to other materials like steel etc. The advantage of using granite is, it has zero chemical. Its weight and slightly irregular surface make our work easy, such as crushing and grinding of herbs and even fibrous ingredients such as Kaffir lime leaves and lemon grass. Good mortar and pestles are must be hard enough to crush the substances rather than be worn away by it. The rotating speed of mortar is reduced according to application. We increased the size of mortar for preparation of large quantity in minimum time.

## 2. DESIGN OF SYSTEM

This article gives detailed design of different components which are used for the experimental set up of end runner mill. The specifications of different components of end runner mill are also explained in this article. Design of this system is to be done by taking considerations of end runner mill requirement for mixture of Ayurvedic raw material and mortar load and construction set up for a load above 500kg consideration.

### 2.1 Methodology

The end runner mill design method is considered for calculations of the amount of power required to drive the mill for 500kg load .In this design method , we considering the load as 500kg maximum in mortar , to drive this unit we will design and calculate different components as per the requirement .From motor the drive is given to motor , from motor it is going to gearbox in that the torque is multiplied and it will rotate the mortar and for required speed the mortar will rotate to make the homogenous mixture and fine particle pest of raw material.

### 2.2 Assumptions

Following are the assumptions considered for the design of the machine

- Amount of raw material of Ayurvedic medicine and water n some iron power etc. which are present in the mortar and the total weight is 500kg with considering the mortar weight.
- Required speed to make the homogenous mixture is 40 r.p.m.

## 3. SPEED AND TORQUE CALCULTIONS

### Motor Specifications: -

- 2 H.P.= 1.5 KW (single phase)
- N=1440 R.P.M.

Torque available at the outlet of motor,

Power = (2*Ⅲ*N*T) / 60……eqn (1)

Torque (Tinput) = 9.947 N.m = (9947.00 N.mm)

Required speed is 50 r.p.m., by considering gear ratio

G= input speed / output speed ……eqn (2)

= 1440 / 50

= 28.8

Torque available at the outlet of gearbox,

$T_{outlet} = T_{input} . G$

= 9947.00 X 28.8

= 286.47 X $10^3$ N.mm

## 4. DESIGN OF FRAME

- Taking the material for frame is AISI 1018 having c % 0.20-0.30.
- Properties of material: -
- Ultimate Tensile Strength = 440 N/mm$^2$
- Yield Strength = 370 N/mm$^2$

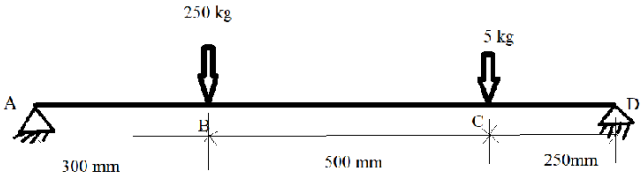


**Fig. 1 Line diagram of forces act on pipe**

### Taking summation of all the vertical forces,

**∑fy = 0**
$R_A + R_B$-250×9.81-5×9.81=0
$R_A + R_B$ = 2501.5 + 49.05
$R_A + R_B$ = 2501.55N
**∑$M_A$ =0**
$R_A$×0 +2501.55×300 – $R_B$ ×1050+ (5×9.81) ×800 +0
**$R_B$ = 738.08N**
$R_A + R_B$ =2501.55
$R_A$= 2501.55-738.08
**$R_A$= 1763.47N**

### Shear force calculations

$R_{AL}$= 0 N
$R_{AR}$= 1763.47N
$R_{GL}$= 1763.47N
$R_{GR}$= 1763.47-2452.5=-689.03N
$R_{HL}$= -689.03N
$R_{HR}$=-689.03-49.654=-738.087N
$R_{BL}$ = -738.08N
$R_{BL}$ = -738.08N
$R_{BR}$ = 0 N

### Bending moment calculations

$M_A = M_B$ 0
$M_G$ = 1763.47×300 = 529041N.mm
$M_H$ = 1763.47×800-2425.500 = 184526N.mm

## 5. MATERIAL OF PIPE

MS 1018
Ultimate Tensile Strength = 440 N/mm2

Yield Strength = 370 N/mm2

E = 205484 N/mm2

$\sigma t = \sigma b = \frac{S_{ut}}{F.S} = \frac{440}{2.5} = 176$ N/mm2

$Ƭmax = \frac{0.5 \times S_{ut}}{F.S} = 0.5 \times \frac{440}{2.5}$

Ƭmax = 88 N/mm2

$Ixx = \frac{1}{12}(BD3-bd3)$

$Ixx = Iyy = \frac{1}{12}(2a \times (2a)_{3-a} \times a3)$

$= \frac{15a^4}{12}$

$\Sigma b = \frac{M_b \times Y}{I}$

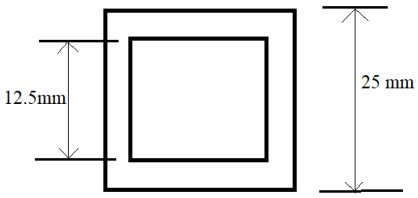


**Fig.2 Pipe cross section**

$176 = \frac{529041 \times a/2}{15a^4/12}$

α = 10.45mm = 12mm

2 α = 24mm = 25mm

## Analysis in Ansys

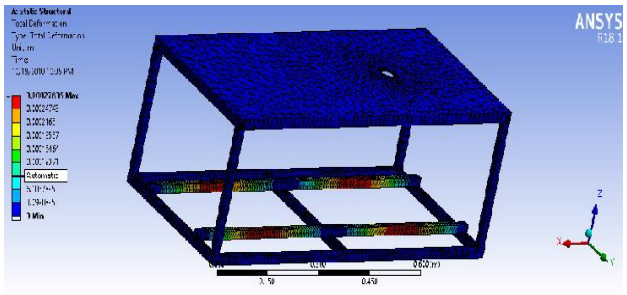


**Fig. 3 Analysis of frame**

## 6. DESIGN OF SHAFT AND COUPLING

- **Design of shaft under compressive force,**

Material is ANSI 1018,

$\sigma_c = F/A$ .....eqn(3)

176= (500*9.81)/ (Ⅲ/4 *D^2)

D = 5.96mm

- **Design of shaft under torsional load,**

T = (Ⅲ/16)* Ƭ*d^3 .....eqn(4)

286.47*10^3 = (Ⅲ/16)*88* d^3

d = 25.49 mm =30 mm

- **Design of flange, hub, bolts, keyways,**

**1)** Design of hub ( D1)

D1 = 2*d = 60mm

Length of hub (L1)

L1= 1.5 *d = 45mm

Hub as hollow shaft transmitting the same torque as that of shaft same so,

T= (Ⅲ/16)* Ƭ*D1^3*(1-k^4) ..... eqn(5)

286.47*10^3 = (Ⅲ/16)* Ƭ*(60^3)*0.9375

Ƭ = 7.20 N/mm2

This is less than 10 N/mm2(permissible stress), so it is safe.

**2)** Design of flange

Thickness of flange (Tf)

Tf = d /2

= 30 / 2

= 15 mm

Flange under shear stress,

T= Ⅲ* D* Tf* Ƭf*(D/2) ..... eqn(6)

286.47*10^3 = Ⅲ*60*15* Ƭf*30

Ƭf = 3.37 N/mm2

This is less than 10 N/mm2(permissible stress), so it is safe.

Outer diameter (D2)

D2 = 4*d = 120mm

**3)** Design of bolts

T = 4*(3.14/4)*dc2* Ƭb*(D1/2) ..... eqn(7)

Dc=4.79mm =5 mm

Do =dc/ 0.84 = 5.94 mm =10mm.

**4)** Keyway

Width of key = d/4 = 7.5 mm

Thickness of key = d/6 = 5mm

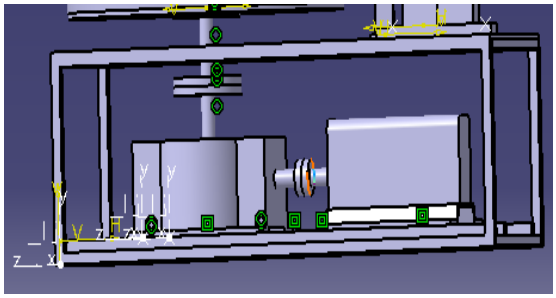

**Fig. 4 Assembly of shaft, couplings**

## Analysis of bar

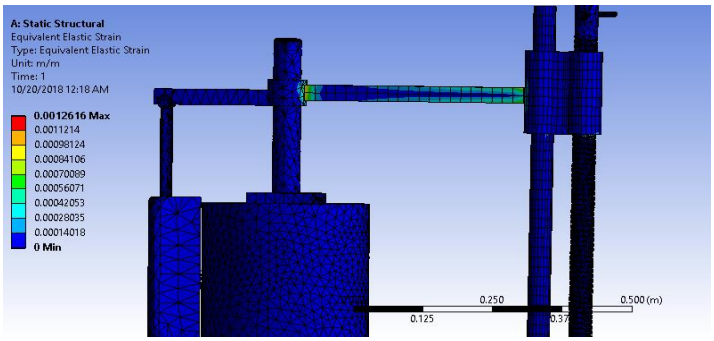


**Fig. 5 Analysis of bar**

## 7. DESIGN OF PESTLE SUPPORTING SHAFT UNDER BENDING STRESS

Material for shaft is ANSI 1018,

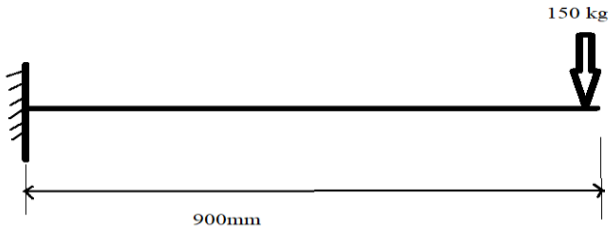


**Fig. 6 Dia. Of force acting on shaft**

Taking bending moment,

Ma = (150*9.81)*900

= 1324350 N.mm

**σb =** (Ma * Y)/ I

176 = (1324350 * 9)*d^3 *3.14

d= 42,47mm = 50mm

**Catia model**

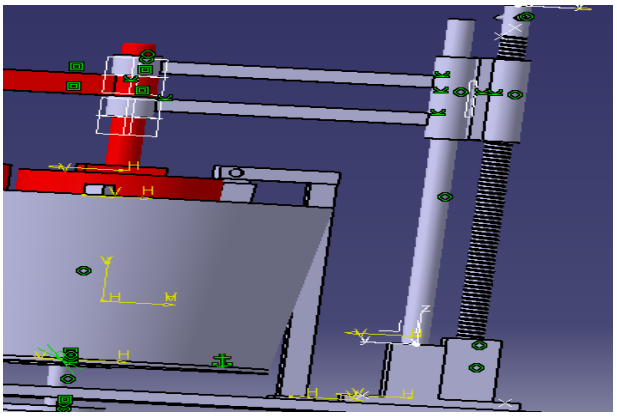

**Fig. 7 Catia model of pestle supporting shaft**

## 8. ANALYSIS OF SHAFT

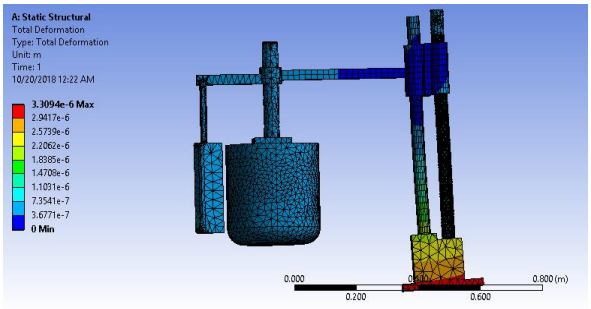


**Fig. 8 Analysis of shaft**

## 8. ANALYSIS OF PLATE

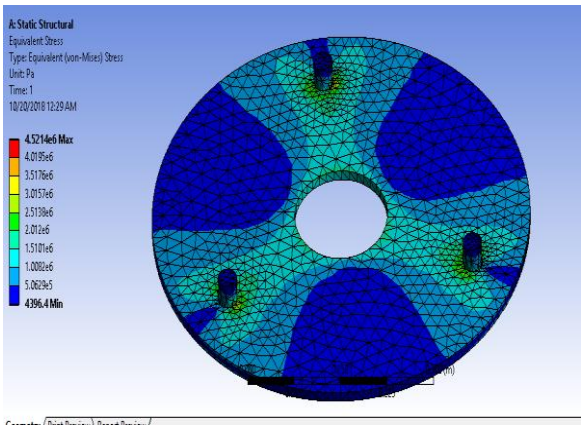


**Fig. 9 Analysis of foundation plate**

## 9. ASSEMBLY OF SYSTEM

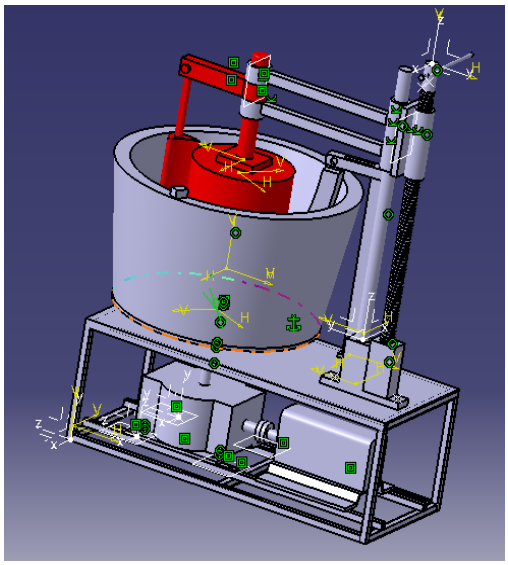

**Fig. 10 Assembly of the End Runner Mill Assembly**

## 9. CONCLUSION

Production of homogeneous mixture of raw material of medicine using the end runner mill can be high. In India use of Ayurvedic Medicines increasing very fast, as it has no side effects. This will fascinate to the industrialists to start up the business. project facilitate reduced the human effort, high production rate, easy to operate, easy maintenance, increase the machine life, no corrosion and wear resistance, less or negligible chemical affinity to mortar.

## 10. REFERENCES

1. Sushant Sud "Methods of Size Reduction and Factors Affecting Size Reduction In Pharmaceutics, Gujarat Ayurveda University, Jamnagar, Gujarat, India" [Published On 10th August, 2013].

2. V.G. Haach, G. Vasconcelos, P.B. Laurence & G. Mohamed, St Loui"Composition Study of a mortar appropriate for masonry cavities and joints" [ published on June5th 2007].

3. Intech GmbH, Russia" [published on 2018]

4. Kamath Archana Factors Affecting Size Reduction In Pharmaceutics, Gujarat Ayurveda University, Jamnagar, Gujarat, India" [Published On 10th August, 2013]

5. V. B. Bhandari "Design of Machine Elements" [Third Edition published on 2005]

6. Dr. Kirpal Singh " Automobile Engineering" [ volume one, Thirteenth Edition published on 2013]

7. R. S. Khurmi & J.K. Gupta "A Textbook of Machine Design" [published on 2005]

8. https://Www.Researchgate.com

9. http://intech-gmbh.com/runner_mills//