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Design and Construction of Honey Extractor

Onwuamaeze Ikechukwu Patrick[1], Joel Oluwayomi Oyejide[2]

[1] Department Mechanical Engineering, Petroleum Training Institute, Effurun, Nigeria

[2] Department of Mechanical Engineering, Federal University of Petroleum Resources, Effurun, Nigeria

Abstract
The traditional (manual) method of extracting honey leads to reduction in nutritional value and quality thus, a honey extractor. Honey extractor is a mechanical device used in honey extraction. It extracts the honey from the comb without destroying the comb by generating centrifugal force that helps in extracting the honey from the honey comb. In this research work, we successfully designed and constructed a honey extractor machine. The dimensions of the mild steel drum is (300mm x 900mm), shaft (920mm long), net (193mm x 40mm x 423mm), wooden frame (300mm x 200mm), Tap/outlet (30mm), Frame holder (320mm x 220mm). Design parameters such as power, torque, bending stress, shaft diameter, and centrifugal force were calculated for. The results obtained reveal that power of 2.5hp, centrifugal force of 4.5KN, bending stress of 11.2GN/m2, torque of 115.2Nm, etc. were required for proper functioning of the machine. Performance test evaluation results show that the machine was 68.16% efficient, it required processing time of 68secs, and a machine throughput capacity of 0.036okg/sec.

Keywords: *Honey extractor machine, traditional method, bees, honey, efficiency, machine throughput capacity, performance*

1. Introduction

Bee is a winged, flower-feeding insect which have branched body hairs. They are dependent on pollen as a protein source and on flower nectar or oils as an energy source. Bees are the most important pollinating insects. Their interdependence with green plant makes them an excellent example of the type of symbiosis known as mutualism; in which two parties of an unlike organisms benefits from each other. Bees generally produce honey mainly from the nectar of flowers, plant saps and honeydew. Honey is a mixture of sugars comprising of glucose and fructose, in addition to water (usually 17- 20%) [1-3]. It also contains very small amount of other substances like minerals, vitamins, proteins and amino acids. According to the National Honey Board; pure honey is so unique in taste that does not need the addition of any other sweetening substance [4-5]. Honey is the main ingredient in the alcoholic beverage meal (honey-wine or honey-beer; typically made with honey and water mixture with a pack of yeast added for fermentation) [6-7].

Honey has antibacterial and antiseptic constituent required in treating wounds and typically various ailments including gastric disturbances, ulcers, wounds, sore throat and burns [1, 7]. Honey helps to increase milk production in dairy cows, making donkey and race-horse poultry mesh and production of fish feeds. It is also used as a facial cleanser and making hand lotion [9]. Presently, honey is extracted from honey comb using tradition method. The traditional methods of extracting honey leads to reduction in nutritional value and quality; the unripe and capped honeycomb are collected at night [10], and the extraction is achieved by squeezing manually with the hand. It involves the use of bare hands with a knife to cut open the comb of the honey before extracting it into a container thereby damaging the honey comb. The local procedures of using bare hands include the use of buckets or containers, match, dry leaves or palm kernel shaft, torch light, because the operation is done at night. After sitting the bee comb, put the dry leaves or palm kernel chaff on the caped comb and heat for few minutes to kill both the queen and the drones. Thereafter, an extracting knife is used to pull of the uncapped comb and then put inside the bucket or container. After the extraction, the honey is then taken home and pressed with the hands to separate the honey from the residue. The raw honey is filtered with a sieve to remove the remaining particles after this the honey is ready and fit for consumption.

Although this techniques this seems to be the quickest for an average honey tapper who cannot afford a honey extractor or solar wax melter. However, the hand contaminates the honey and unripe honey ferments within few days after extraction, the materials collected are left untouched until the next morning and bee-wax which has become hardened at the top of the honey is removed and the harvested honey is later poured into bottles [11].

Generally, honey extracted traditionally does not meet up with international market standard; therefore, there is the need to construct and evaluate a honey extractor; a mechanical device that extracts honey from the honeycomb without destroying the comb. Honey extractor is a mechanical device used in honey extraction. It extracts the honey from the comb without destroying the comb. Extractors work by a centrifugal force. A drum holds a frame basket which rotates throwing the honey out of the comb. With this method, the wax comb stays intact within the frame and can be reused by the bees. This concept is very important to bee keepers. It is basically an electrical operated machine; the different components are made from available and affordable materials. This machine is designed to be used at any time of the day no matter the temperature or weather conditions. Bees cover the filled in cells with wax cap that must be removed. There are different types of electrically operated extracting machine; there is the twenty frame extractors loaded with four frames turning. Extracting machine is either tangential or radial depending on how the frames are put into the basket. The aim of this research work is to design and construct an honey extractor.

2. Materials and Method

2.1 Materials/Components

The complete design of the equipment consisted of the designed equipment components assembled to give parts which in turn were assembled forming the equipment. The components designed include frame, basket, frame support, housing stand, bearing housing, mountings, transmission system, central shaft, drive shaft, pulley, belt, bush bearings, drive mounting bracket, stands, housing column, bolts and nuts, heater nut and handle pipe. All the components designed were either machine or fabricated from stainless steel or nylon. The components were then assembled into parts such as cage assembly, drive shaft assembly, handle assembly and vessel assembly. The parts were eventually assembled to give one unit. The honey extractor is made with the following materials and components:

2.1.1 Drum

The drum is made with mild steel material. It encloses the bicycle rims shaped type metal steel and also serves as a means of collecting the product through the tap or outlet.

2.1.2 Shaft

This is the rod that is welded to the bicycle rim shaped type of steel metal which rotates the rim.

2.1.3 Bearing

The purpose of the bearing is to support the shaft in a relative constraint motion. The bearing serves as a turning point in the parts or joint of the machines.

2.1.4 Nuts and Bolts

They are used to tightening of those parts were welding are not required.

2.1.5 Honey Comb Frame

The honey comb frame helps to hold the honey together with the comb firmly in the wood cage. During the spinning of the shaft, the honey is extracted out of the wooden frame leaving the honey wax or comb behind.

2.1.6 Outlet /Tap

It is mounted at the bottom of the drum. It allows the honey to flow out of the drum.

2.1.7 Wooden Frame Holder

The wooden frame holders are circular shape with spaces radially and tangentially fixed to the rims. The rims also helps in the rotation of the honey comb frame, it also helps to hold the honey comb frame in position so that it does not fall off during spinning.

2.1.8 Net

The net is tightly fixed to both sides of the honey comb wooden frame. The net helps to separate the honey from the honey wax or comb.

2.1.9 Stand/Support

The stand or support holds all components above the ground level.

2.1.10 Bearing Housing

The purpose and function of the bearing housing is simply to houses the bearings.

2.1.11 Belt

The belt is used in the transmission of power generated by the electric motor down to the pulley shaft and other components of the honey extracting machines.

2.1.12 Electric Motor

Electric motor is the prime mover for the electricity and the pulley shaft.

2.1.13 Motor Pulley /Shaft Pulley

The motor pulley with the machine pulley is grooved mainly to accommodate the V-belt.

2.2 Description of Machine

The dimensioning of the mild steel drum is (300mm x 900mm), shaft (920mm long), net (193mm x 40mm x

423mm), wooden frame (300mm x 200mm), Tap/outlet (30mm), Frame holder (320mm x 220mm) and other dimension shall be listed in the process of designing of the machine. It makes use of an electric motor with a pulley connected by a belt to the pulley of shaft, which transmit torque /power to the honey extractor; thereby rotating the honey extracting machine in order to extract honey from the honey comb. This machine extracts honey from the bee wax or honey comb. The extractors are either tangential or radial extractors depending on how the frames are put into the extractor basket. It typically works on centrifugal action or force. During extraction process, the honey is forced out of the uncapped wax cells or combs, runs down the walls of the extractor and pools at the bottom of the extractor. A tap or honey pump allows for the removal of honey from the extractor.

2.3 Design Parameters

The design parameters include the following:

i. Drive transmission
ii. Selection of electric motor
iii. Minimum diameter of drive shaft
iv. Selection of bearing

2.4 Design Specification and Consideration

The equipment is designed to extract honey simultaneously from six frames using centrifugal force directed at the center of rotation of the central shaft. The broad terms in the preliminary specifications were expanded and translated into measurable quantities such as volume, size, and dimensions. The dimensions of both radial and tangential extractor vessels were determined by using the standard dimensions of the deep super frames. The manipulation of frame width, breadth and length gave the diameter and length of the extractor vessel. The following factors were put into consideration:

i. Weight of rotating cylinder
ii. Power required to turn the shaft

2.5 Detail Designed

2.5.1 Weight of rotating cylinder (W_r)

The rotating cylinder is made of mild steel with density 7850kg/m^3.To obtain the volume of the basket as per calculating for the weight we obtain an equivalent value of the rod used in constructing the rotating cylinder.

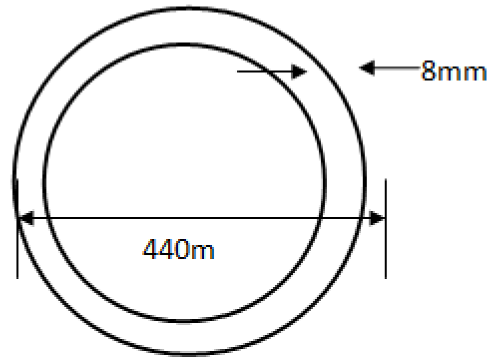

Fig. 1 Rotating Cylinder Rod

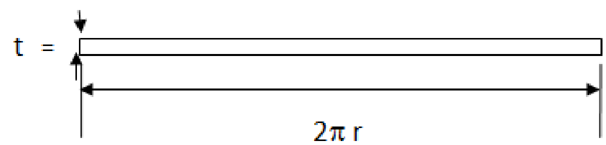

Fig. 2 Stretching Rotating Cylinder Rod

Volume of rotating cylinder = $\pi r^2 h$ (1)

But,

$h = 2\pi r$ (2)

where;

H = Perimeter of rotating cylinder which represent the height

r = Radius of rotating cylinder

Thickness (t) = Diameter =8mm

Radius(r) = Diameter/2 = 440/2 = 220mm

h= 2 x 3.142 x 0.22= 1.382m

r = 4mm = 0.004m

Thus,

Volume = 3.142 x 0.004 x 0.004 x 1.382 = 6.95 x 10^{-5}m^3

But since the volume is at the top and bottom (Fig. 3)

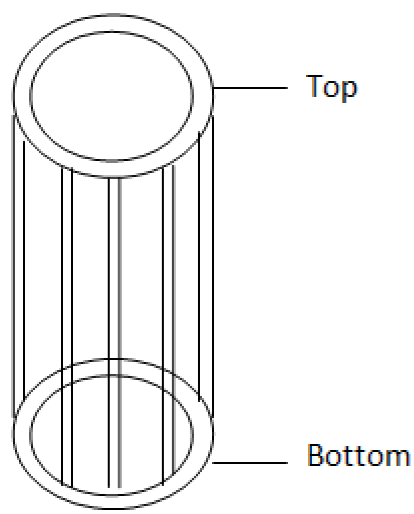

Fig. 3 Honey Extractor rotating cylinder

Since there are two (2) rotating cylinder
Required volume = 2 x 6.95 x 10^{-5}m3
= 13.9 x $10^{-5}m^3$
But,
Mass = Density x volume (3)
Density for mild steel = 7850kg/m^3
Volume of Basket = 13.9 x $10^{-5}m^3$
Thus,
Mass of rotating cylinder = 7850 x 13.9 x 10^{-5} = 1.1kg
Also,
W_B = mg (4)
where;
W_B = Weight of rotating cylinder
g = Acceleration due to gravity = 9.81
W_B = 1.1 x 9.81=10.8N

To obtain the mass of the column (Figure 4)

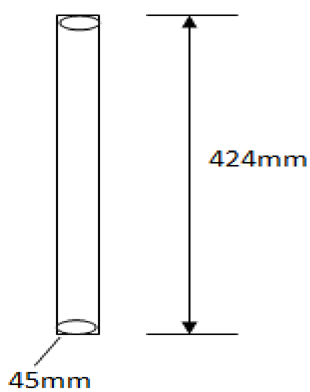

Fig. 4 Rotating Cylinder Column

Volume of column = $\pi r^2 h$
where,
h = height = 424mm,
r = radius = 22.5mm
Volume = 3.142 x 22.5^2 x 424 = 674430.3mm3 = 0.0006744m3
Using Equation (3) where density remain the same
Density of mild steel = 7850kg/m^3
Volume = 0.0006744 m^3
Mass = Density x Volume
Mass of column = 7850 x 0.0006744 = 5.29kg
But column are four in number therefore we obtain total mass as 4 x 5.29kg = 21.16kg
Weight (W_C) = 9.810 x 21.16 = 207.6N
For the top surface of rotating cylinder (Fig. 5)

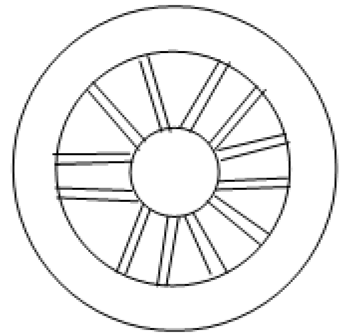

Fig. 5 Top surface of rotating cylinder

One horizontal rod was model as a cylinder
Volume = $\pi r^2 h$
Recall that,
Radius = 4mm
Height of rod = 194mm
V = 3.142 x 4 x 4 x 194 = 9752.768mm^3
= 0.000009752m^3
Mass = 7850 x 0.000009752
= 0.076kg
For both up and down horizontal Rod (24 rod), Therefore mass would be = 24 x 0.076
Mass = 1.85kg
Weight (W_R) = 9.81 x 1.85 = 18.14N

2.5.2 Weight of honey (W_H)
Weight of honey = Volume of total net x Density of honey x Gravity
$W_H = \rho vg$ (5)
Density of honey = 1420kg/m^3
V = Volume of net =?
g = acceleration due to gravity = 9.81m/s^2
N = number of net = 6
Volume of net = length x breadth x height
Height of net = 423mm
Length of net = 193mm
Width of net = 40mm
Volume of net = 193 x 40 x 423
V = 3265560mm^3= 0.00327m^3

Weight of honey = Density of honey x volume of net x gravity x number of net
$W_{H=}$ 1420 x 0.00327 x 9.81 x 6 = 273.3N

Therefore the net weight is the sum of all the weight that is required to driven by the electric motor.
That is,
$W_T = W_r + W_R + W_C + Ws + W_H$
W_T = 10.8 + 18.14 + 207.6 + 13.86 + 273.3
Total Weight = 523.7N
Therefore Total weight to be driven is 523.7N

2.5.3 Required Power

To obtain the power to drive the weight of the system;

Power = T x ω (6)

where,

T = Torque

Ω = Angular velocity in rpm

But,

Torque = Force (weight) x r (7)

where,

r = radius of the driven system

Diameter of rotor system = 440mm

r = D/2 = 440/2 = 220mm

r = 220mm = 0.220m

Torque = 523.7 x 0.220

Torque = 115.2Nm

To obtain Power (W)

Required speed = 850rpm

$$\omega = \frac{\pi DN}{60} \quad (8)$$

$$\omega = \frac{3.142 \times 0.440 \times 850}{60} = 19.59 rad/s$$

Therefore power to run this system

Power = T ω = 115.2 x 19.59 = 2247W

Power = 2.2KW

Therefore the power required to drive the system is 2.2Kw. From the calculation above it show that the minimum power required to drive the entire system is 2.5hp

2.5.4 Centrifugal Force

To obtain the centrifugal force at which the system will rotate about its center we apply the formula:

$F_c = mv^2/r$ (9)

where,

F_c = centrifugal force

m = mass of the rotating system

v = velocity of the rotating system

r = radius of the rotating system

From our design;

r = 220mm = 0.22m

Mass = Total weight of the system / gravity

m = 523.7 / 9.81 = 53.4kg

But

v = ωr (10)

where,

ω = Angular velocity of rotating part

r = 0.22 m

ω = πDN/60 (11)

ω = (3.142 x 0.44 x 850)/60

ω = 19.59 rad/s

By substitution

v = 19.59 x 0.22

v = 4.31m/s

Thus,

$F = (53.4 \times 4.31^2) / 0.22$

F_c = 4508N = 4.5KN

2.5.5 Design of the Drive Transmission System

The transmission system of the honey extractor consist of various parts, of which the belt and pulley are the major parts, in our work, the pulley and belt was design with length, thickness, and other properties in consideration

2.5.6 Design of Pulley

The power is transmitted from the electric motor through the pulley (driver) that is connected to it, to the vertical shaft which have a driven pulley. Formula related to pulley is given below when belt creep is neglected;

$N_1 X D_1 = N_2 X D_2$ (12)

where,

N_1 = Speed of the motor rpm)

D_1 = Diameter of the driver (motor) pulley (mm)

N_2 = Speed of the driven pulley (rpm)

D_2 = Diameter of the driven pulley (mm)

2.5.7 Speed required to drive the system (Driven speed)

Since the pulley is connected to the electric motor arbor, therefore it has the same speed of the electric motor which is 850 rpm.

We have that;

Centrifugal force of the system (F_C) = 4508N

Velocity of the system (v) =?

Total mass to be rotated = total weight to be driven / acceleration due to gravity

Recall that;

Total weight =523.7N

Gravity =9.81m/s

Total mass = 523.7 / 9.81

Total mass =53.4kg

Centrifugal force = total mass x velocity of the system

$4508 = 53.4 X V_2$

Velocity of the system = 84.4m/s

Angular velocity of the system (ω) = Velocity of the system (v) x radius of the rotating system (r)

where,

r = 220mm = 0.22m

V_2 = 84.4m/s

ω = 84.4X 0.22 =18.6rad/s

From;

$\omega = 2\pi r N_2 / 60$

$18.6 = 2 X 3.142 X 0.22 X N_2 / 60$

$\therefore N_2$ =706rpm

Therefore, the minimum speed required to drive the entire system is 706rpm

From the calculation, we were able to estimate the size of the driver and the driven pulley to transmit the speed required.

N_1 = speed of the motor = 850rpm
D_1 = diameter of the driver (motor) pulley = 50mm
N_2 = speed of the driven pulley = 706rpm
D_2 = diameter of the driven pulley =?
$N_1 \times D_1 = N_2 \times D_2$
$850 \times 50 = 706 \times D_2$
$\therefore D_2 = 60.1mm$

Therefore the diameter of the driven pulley is 60.1mm when a 50mm diameter driver pulley is used.

2.5.8 Length of the Belt Required

For an open belt drive, the length is calculated as follow;

$$L = 2C + 1.57(D_2 + D_1) + \frac{(D_2 - D_1)^2}{4C} \quad (13)$$

Given that,
Diameter of driver pulley (D_1) = 50mm
Diameter of driven pulley (D_2) = 60.1mm
Distance between pulleys (C) = 300mm
Length of belt (L) =?
$L = 2 \times 300 + 1.57(60.1 + 50) + (60.1 - 50)^2 / 4 \times 300$
= 772.9mm
The length of the belt required is 772.9mm, which is required to drive the two pulleys

2.5.9 Angle of Twist of the Shaft

Consider the free body diagram below in other to get the angle of twist and also the bending moment and twisting moment of the shaft;

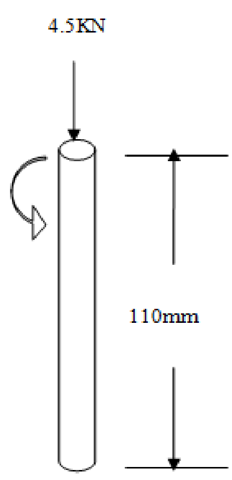

Fig. 6 Angle of Twist of the Shaft

$$\frac{T}{I} = \frac{\tau}{R} = \frac{C\Theta}{L} \quad (14)$$

where,
Torque (T) on shaft = 115.2NM
Modulus of Rigidity of mild steel shaft (C) = $80GN/m^2$
Angle of Twist (ϴ) =?
Length of shaft (L) = 110mm

$$I_p = \frac{\pi}{32} \times D^4 \quad (15)$$

Radius (R) = 7.5mm
Bending moment (M) = load (F) x length (L) (16)
Load on shaft (F_C) 4.5KN
$I_p = 3.142/32 \times (15)^4 = 4.97074 \times 10^{-9} m^4$
For Angle of Twist (ϴ) = $\frac{T \times L}{C \times Ip} = \frac{115.2 \times 0.11}{4.97074 \times 10^{-9} \times 80 \times 10^9}$
For Angle of Tw
Angle of Twist (ϴ) = 0.03^0
The maximum bending moment will occur at the mid-point, which is half of the length
Length (L) = 55mm = 0.055m
Bending moment at mid-point;
$M = F_C \times L = 4.5 \times 0.055$
Bending Moment 0f the shaft = 0.248KNm
This gives the bending moment of the shaft
Also for the bending stress;

$$\sigma_b = \frac{32M}{\pi d^3} \quad (17)$$

M=0.248kN-m, d=15mm=0.015m

$$\sigma_b = \frac{32 \times 0.248}{3.142 \times 0.015^3} = 11.2GNm^{-2}$$

Also for equivalent twisting moment T_e, which is the twisting moment which when acting alone, produces the same shear stress as the actual twisting moment.

$$T_e = \sqrt{M^2 + T^2} \quad (18)$$

M=0.248KNm
T=115.2KNm

$$T_e = \sqrt{0.248^2 + 115.2^2}$$
$$T_e = 115.2KNm$$

For equivalent bending moment M_e, which is the moment that acts alone produces the same tensile or compressive stress as the actual bending moment.
Using,

$$M_e = \frac{1}{2}[M + T_e] \quad (19)$$
$$M_e = \frac{1}{2}[0.248 + 115.2]$$
$$M_e = 57.7KNm$$

2.5.10 Bearing Design

The bearing is an already made component. Choice of selection will be dependent on the diameter of the shaft. The internal diameter of the bearings has to correspond to the diameter of the shaft.

2.5.10.1Factors Considered in Selecting the Bearing

i. The amount of load to be carried.
ii. The nature of the load (thrust or axial).
iii. Expected life of the bearing.
iv. Nature of the working environment.

Table 1 shows the dimensions of the ball bearings

Table 1: Dimension of Ball Bearings

Bearing Series	Bore Diameter (mm)	Outer Diameter (mm)
L00	10	26
200	10	30
300	10	35
Log	12	38
201	12	32
:	:	:
Lo6	30	55
206	30	62
306	30	72
:	:	:
Lo8	40	:

Lo6 series of bore 30mm was selected for the design. Ball bearing is chosen because it is easy to couple and uncouple and also, the cost is relatively low.

2.6 Construction Details

All produced parts were coupled together or fixed together to their position. Operations carried out include riveting, bolting, press-fitting of bearings, keying of pulleys and welding. The conceptual design selected for detained designs is the combined honey extractor and processor assembly, which will also act as a settling and filtering tank. All the operations of honey extraction, processing, settling and filtering that was usually carried out via four different equipment was carried out in this one unit equipment (the combined honey extractor and processor assembly). The equipment designed and constructed will extract honey from honey combs in frames by a centrifugal force, and process it by indirect heating through a heat transfer medium and settling and filtering in the same unit for packaging.

2.7 Finishing Operation

After all parts and sub-parts have been assembled, the machine was cleansed with emery cloth, greased at necessary parts such as the bearing and some parts painted. Standard components that suit our design were bought (Cost effective) as they were already made, such components like pulley, belt, bearings, bolt and nuts etc.

3. Results and Discussion

Test was carried out to determine the efficiency and performance of the electrical honey extractor. To carry out this test the various components comprising the electrical honey extractor such as drum, electric motor, structural basket, shaft, wooden frame and its holder etc., were checked for faults and found to be satisfactory. The transmission belt was connected between the main shaft pulley and the electric motor pulley and both were aligned accordingly. The machine is switch on and the honey comb placed inside the wooden frame and then slotted into the structural basket frame holder. With the aid of the centrifugal force, the honey extractor was able to spin out honey from the honey comb. An average mass of 2.45kg of honeycomb was used for the evaluation of the machine. This produced 1.67kg of honey with an extraction time of 68seconds. Equation (20), [12] and Equation (21) were used to calculate the machine throughput capacity and efficiency of the machine.

$$MTC = \frac{M_1}{T_m} \quad (20)$$

$$Efficiency = \frac{M_1}{M_2} \quad (21)$$

It was observed that the time taken for honey extraction had a significant effect on the weight of honey extracted, efficiency and capacity of the machine. The efficiency of the machine was obtained as 68.16% and this is an indication that the machine is efficient. Also, the machine throughput capacity was obtained 0.0360kg/sec. The summary of results of detail designed is show in Table 2. Volume of rotating cylinder, torque, centrifugal force, bending stress, required power, etc., were obtained as 13.10E^{-5}m^3, 115.2Nm, 4.5KN, 11.2GN/m^2, and 2.5hp respectively.

Table 2:

Designed Parameter	Values Obtained
Volume of rotating cylinder (m^3)	13.9E^{-5}m^3
Density of mild steel (kgm^{-3})	7850
Mass of rotating cylinder (kg)	1.1
Weight of rotating cylinder (N)	10.8
Weight of rotating column (N)	207.6
Mass of rotating column (kg)	5.29kg
Volume of net (m^3)	0.00327
Weight of honey (N)	273.3
Torque (Nm)	115.2
Required speed (rpm)	850
Required power (hp)	2.5
Centrifugal force (kN)	4.5
Load on shaft (kN)	4.5
Angle of twist	0.03

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Bending moment (KNm)	0.248
Bending stress (GN/m^2)	11.2
Bending moment (KN)	57.7

Figure 7 shows the exploded view of the machine

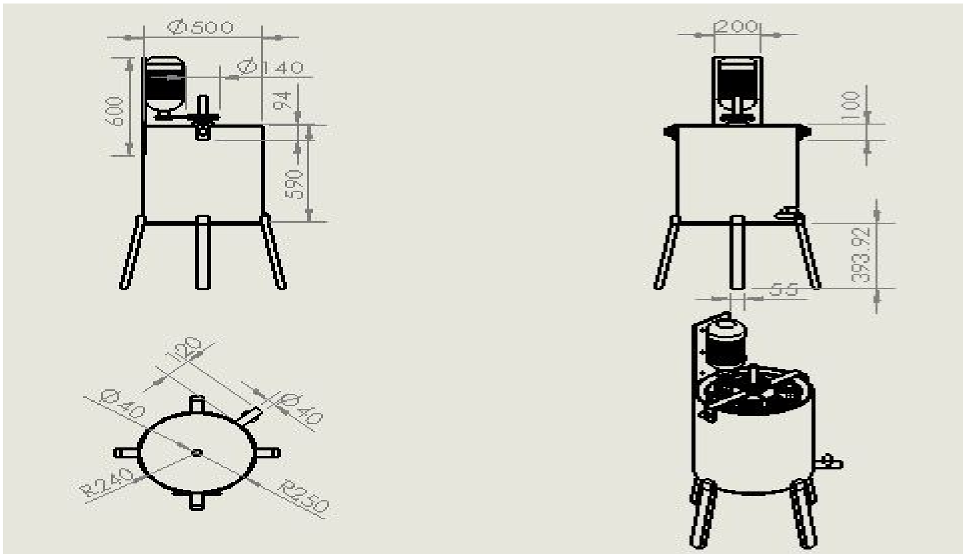

Fig. 7 Dimensioned view

Fig. 8 shows the isometric view of the machine

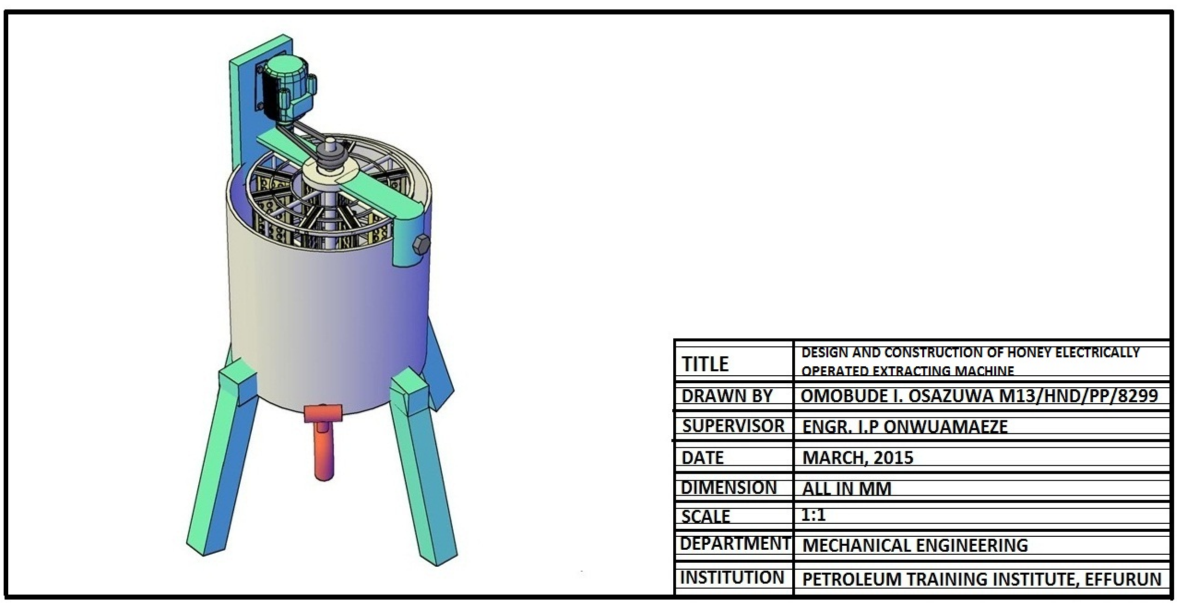

Fig. 8 Isometric view

Fig. 9 shows the exploded view of the machine

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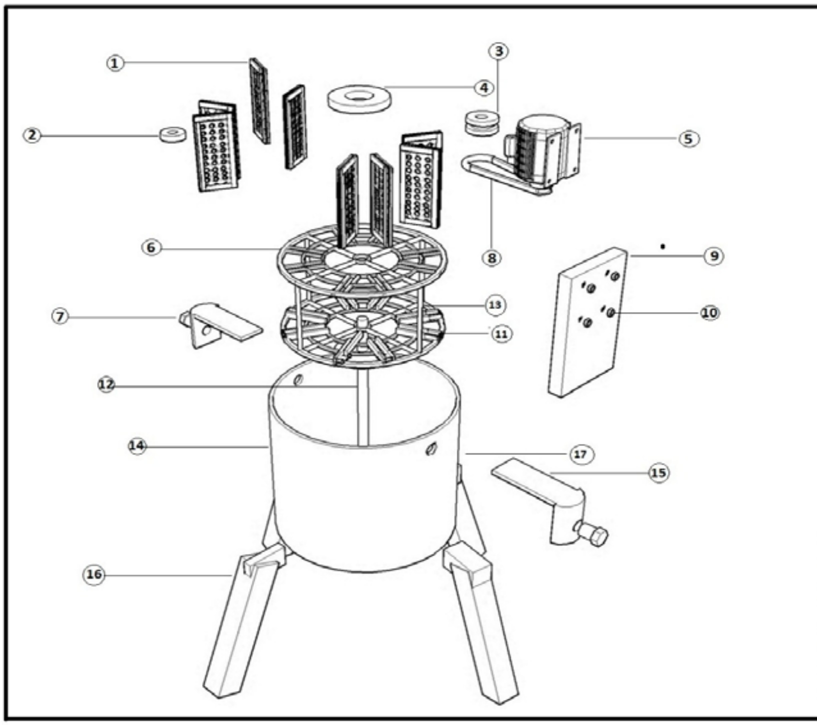

PART NUMBER	PART DESCRIPTION	QUANTITY	MATERIAL SELECTION
01	FRAME	8	WOOD
02	BEARING	2	MILD STEEL
03	PULLEY	2	MILD STEEL
04	BEARING CASING	2	MILD STEEL
05	ELECTRIC MOTOR	1	CAST
06	FRAME HOUSING	1	STAINLESS STEEL
07	COVER BOLT	2	MILD STEEEL
08	BELT	1	FIBRE
09	MOTOR STAND	1	MILD STEEL
10	BOLT AND NUT	4	MILD STEEL
11	FRAME SUPPORT	8	STAINLESS STEEL
12	CENTRAL SHAFT	1	STAINLESS STEEL
13	HOUSING COLUMN	4	STAINLESS STEEL
14	HOUSING	1	STAINLESS STEEL
15	COVER BEAM	2	MILD STEEL
16	HOUSING STAND	4	MILD STEEL
17	TAP	1	STAINLESS STEEL

TITLE	DESIGN AND CONSTRUCTION OF HONEY ELECTRICALLY OPERATED EXTRACTING MACHINE
DRAWN BY	OMOBUDE I. OSAZUWA M13/HND/PP/8299
SUPERVISOR	ENGR. I.P ONWUAMAEZE
DATE	MARCH, 2015
DIMENSION	ALL IN MM
SCALE	1:1
DEPARTMENT	MECHANICAL ENGINEERING
INSTITUTION	PETROLEUM TRAINING INSTITUTE, EFFURUN

Fig. 9: Exploded view

Fig. 10 shows the orthographic view of the machine

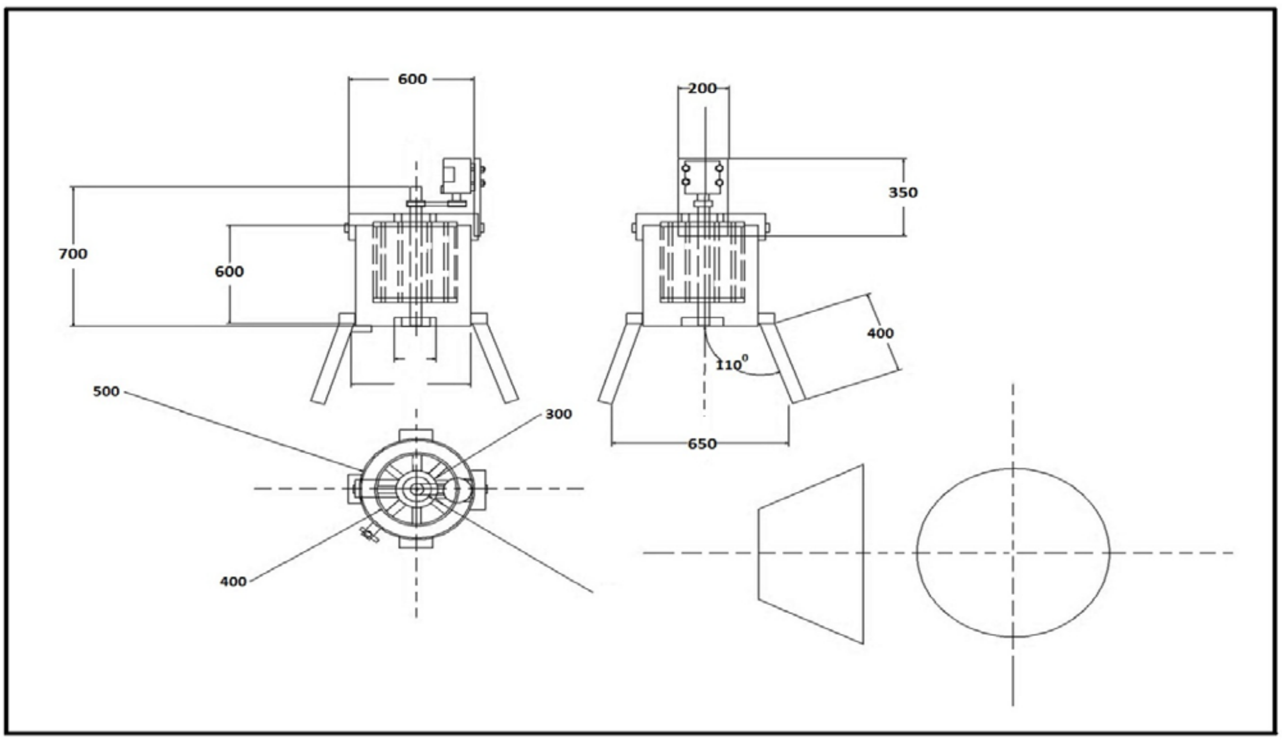

Fig. 10: Orthographic view

Fig. 11 shows the CAD modeled view

Fig. 11: CAD modeled view

4. Conclusions

A honey extractor was designed and constructed using easily accessed and available materials in order to reduce the cost of production of the machine. The machine is portable and can be operated without any special training or technical know-how. The values of weight of honey extracted, weight of honey comb , time taken, machine efficiency and capacity of the honey extractor were obtained as 1.67kg, 2.45kg, 68seconds, 68.16%, 0.0360kg.

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