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Design and Modification of Oil Skimmer

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Abstract: Today, all manufacturing companies need to minimize the effect of waste water in the farm and human health. It is depending on removing the oil and grease from the water. The Dr. Naganath Anna Nayakavadi H.K.A. Sugar factory placed Walwa. about E.T.P. section where worker removes oil manually and he told about scrap oil skimmer. Before scrap the oil skimmer it working but it problem when which is can not continuous remove oil from water and machine problem is that while the oil skimmer is not work properly Sum percentage of oil also goes on E.T.P section. When in the E.T.P they change the P.H value. They also effect on the farm. We have decided the make the arrangement at a time two oil skimmers run one motor.

I. INTRODUCTION

The oil and grease contents in water effect on land as well as on the human being. Due to chemical present in waste, the water-lives are on the edge of destroying. Oil spillage problems mainly occur in the industries like oil are refineries, sugar factory and petrochemical industries etc. In the sugar factory spillage of oil mainly contribute from the mill section .daily 70-75 litres of oil per day is used for lubrication of heavy gears in every sugar factory in mill section. Whenever oil spills over water, it forms an emulsified layer. At the Effluent Treatment Plant (E.T.P.) in every sugar factory –recovery of oil is big problem as it seriously affects the quality of treated effluent water. Other than mill oil other types of oil are used. But they do not mix with gutter water because they are continuously circulated. This oil is used for following purpose. Turbine bearing, Febrile bearing, Gear box, Hydraulic system and continuous centrifugal m/batch type centrifugal m/c And Air compresso.This oil mix with wastewater only when they leak due to failure of oil seals, chocking of filter or any other reason.

Today, all manufacturing companies need to minimize the effect of waste water in the farm and human health. It is depending on removing the oil and grease from the water. The Dr.Naganath Anna Nayakavadi.H.K.A. sugar factory placed Walwa. about E.T.P. section where worker removes oil manually and he told about scrap oil skimmer. Before scrap the oil skimmer it working but it problem when which is used to remove oil but that machine can not continuous remove oil from water. They told us there is an “oil skimmer” but that machine problem occurs at the time scrap condition oil skimmer is continuous removing the oil. The problem is that while the oil skimmer is not work properly such as they cannot remove maximum percentage of the oil from water. Sum percentage of oil also goes on E.T.P section. When in the E.T.P they change the P.H value. They also effect on the farm. We have decided the make the arrangement at a time two oil skimmers run one motor.

II. DESIGN OF MODIFED OIL SKIMMER MACHINE

A. Design of Shaft

Mainly shaft is used to mount and rotate the drum. Actually, there is very small driving load on the shaft. But weight of drum and licit tension will exert the force at the centre of shaft and thus there is tending moment on shaft. Therefore, we have designed the shaft for both bending and torsion.

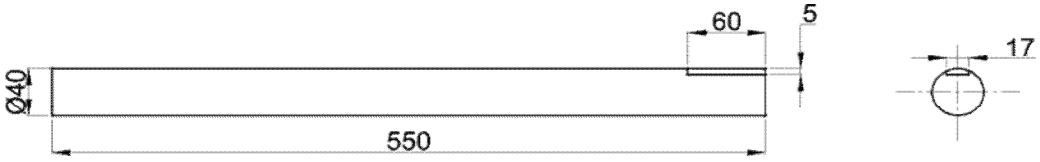


Fig.1 Modelling of shaft on CAD

1) Maximum tension on tight side of belt-

T_1 =max stress ×c/s section area

$= F_1 \times B \times T$

$=1.5\times10^{6}\times.34\times5\times10^{-3}$

= 2550 N

$T1 / T2 = e\theta\mu$
$2550/T2 = e0.3\times3.14$
$T2=994.11N$
$Tm = (T1-T2) \times R$
$= (2550-994.11) \times0.17$
$=264.50N$

2) Torque on shaft $T_t = (P\times60000)/2\times3.14\times20$
$=1068.37N.m$
$T_e=\sqrt{(T_m)^2 + (T_t)^2}$
$=1100.70 N.m$
Fs =Allowable shear stress =ultimate shear stress/3
From design data ultimate shear stress=500mpa
Fs=500/3
=166.66Mpa

3) Diameter shaft (d),
Te =∏/16×Fs×d3
= ∏/16 ×166.66× d3
d=32.31=40mm

Fig 2. Actual shaft

B. Design of Belt

1) New modified design belt
Material- Canvas (tensile strength=700-900N/mm)
d= dia. Of driving pulley
D= dia. Of driven pulley.
N= speed of driven pulley in RPM
n= speed of driving pulley in RPM
Area of belt= width of belt *thickness of belt
=b × t
=340×5
=1700mm2

2) Maximum Tension in tight side of belt
T = f ×a
=1.5×1700
=2550 N

3) Mass of belt (M)
M=area × length × density
=0.17 × 3.7 × 1220
=2.07 kg/m

4) Total mass of belt=2.07×3.7
=7.79kg

5) Centrifugal tension in belt=M×V2
Velocity of belt = π ×d × n/60
=0.392 m/s
Tc =7.33×0.392
=1.17 N

6) Total tension in belt:
T1 = T-Tc
=2550-1.17
T1=2548.73 N

Ratio of Tension in the belt
T1/T2 =eθμ
2548.73/T2 =e0.3×3.14
T2=993.61N

7) Power Capacity of belt = (T1-T2) ×V
=606.49 Watt

8) Finding width of belt (w) = b × t × f
T = b × t × f
2550=1.5×106×0.005×b
b= 0.34 m

Length of belt-
L= (D + d) + α (D - d)+2c.cosα
L=+0+2c
L= + 0 + 3200
L= 3700mm
Thickness of belt= 5mm
Width of belt= 340mm

C. Motor Selection

The selection of motor is important aspects during selecting particular application. We have selected 3HP, 3-phase A.C. induction motor

Fig. 3 Motor

Motor Specifications

1) Power- 3HP
2) RPM- 1440
3) Voltage – 415V
4) Current -480A
5) Frequency – 50HZ

D. Gear Box

We need speed of the skimmer belt is to low. For that speed reduction is required. For this purpose, we have worm reducer from factory.

Specification
Made – Planetary Gear Box
Type- U500
Ratio -50:1

E. Speed Of Roller-

Speed of motor- 40rpm

1) Speed of roller (old machine) =

(Speed of motor × Number of teeth on motor wheel) / number of teeth on roller gear

$$= \frac{40 \times 18}{24}$$

= 30 rpm

2) Speed of roller(new coupled oil skimmer)=

(Speed of motor × Number of teeth on motor wheel)/
(Number of teeth on roller gear)

$$= \frac{40 \times 18}{36}$$

= 20rpm

Fig.4. Roller

F. Chain Design

Chain design (coupled oil skimmer)

z_1=speed of sprocket driver=18 Teeth
z_2= speed of sprocket driven=24 Teeth
No. of links in the chain (L_h)

$L_h = 2(a/p) + (z_1+z_2)/2 + ((z_2-z_1)/2\pi)^2 \times (p/a)$

$= 2(550/15) + (24+18)/2 + ((24-18)/2\pi)^2 \times (15/550)$

L_h =94.35 links=98links

Total length of chain (L) = $L_h \times p$

Total length of chain (L) =1470 mm

Chain design (Old)

z_1= Speed of sprocket driver=36 Teeth
z_2= Speed of sprocket driven=28 Teeth
No. of links in the chain (L_h)
$L_h = 2(a/p) + (z_1+z_2)/2 + ((z_2-z_1)/2\pi)^2 \times (p/a)$
L_h =78 links
Total length of chain (L) = $L_h \times p$
=1170 mm

G. Fabrication Details

The whole units were fabricated in factory workshop. The unit was fabricated in stages. First, the main frame was fabricated.

1) Frame Along With Motor And Gearbox Foundation

Material used- 2 inch angle-20 feet

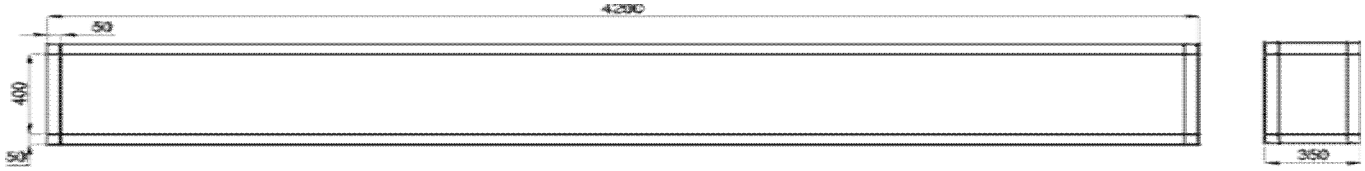
The standard 2 inch angle is used for frame. Angle was cut by gas cutter & was joined by welding. The frame was constructed of is 4200mm×400mm×500mm. precaution was taken that is perfectly vertical. The right angle checked it.

For foundation of motor & gearbox, same angle was used. The angle was welded and was drilled through with standard 0.5'' drill for the fixing nut & bolt of standard size 0.5'. Next to these 2' was welded to bottom of unit to fix their bottom plates. The angle was welded at the distance of 70mm from gearbox side.

2) Channels

Material used- 320mm long×110mm thick M.S. plate in 2 numbers.

The guide plates were manufactured from the mild steel sheet. Firstly, these are cut to dimensions 320mm×110mm with the help of gas cutter and then they are made to 300mm long and 110mm wide with the shaping operation on the shaping machine. The guide plates manufactured as per following procedure. Making exact dimensions. Gas cutting to the dimension shaping operation.



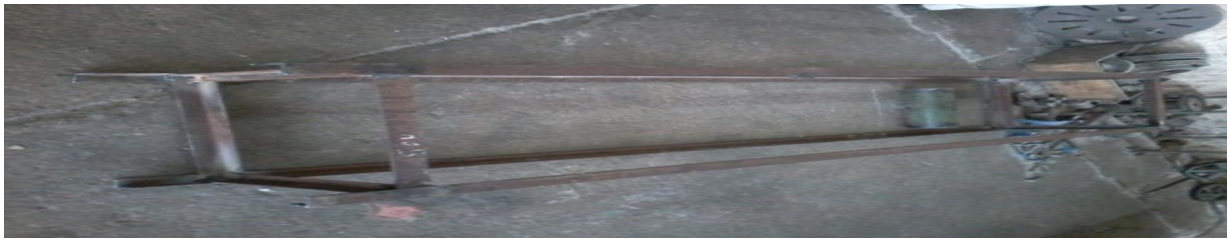


Fig.5.Channel

3) Tighten Screw

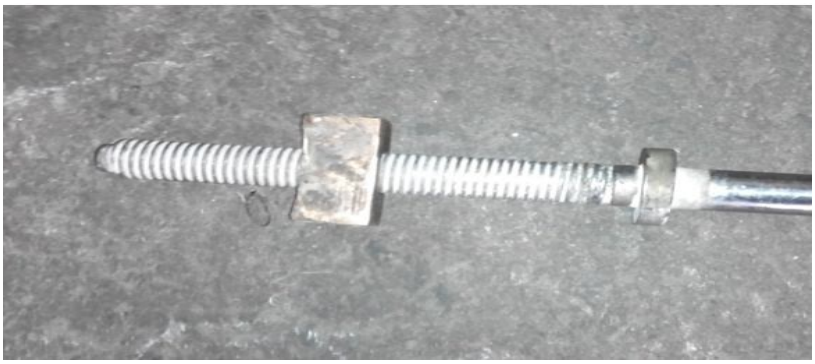


Fig.6. Tightening screw

Tightening screw Material used- 600mm long×15mm dia. M.S. in 2 num.Tighting nut shown in photograph 7.5

Various components of tightening arrangement are-

a) Channels
b) Guide slots
c) Locking screw

Fig.7. Sub-assembly of tightening arrangement

H. Drum

The drum is fitted on the shaft and is used to rotate the belt. It is 300 mm long & having diameter of 195mm was taken which was available in the scrap. The swirls were made on the drum to avoid the slip of the belt over the drum. We use another having diameter 210mm to lower side.

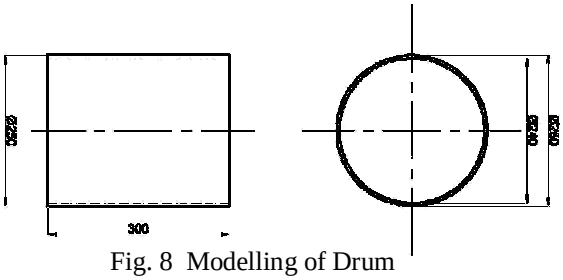


Fig. 8 Modelling of Drum

III. MODIFIED OIL SKIMMER MACHINE

The machine is installed and appropriated height adjusted. The two-oil skimmer is connected to one motor by chain drive

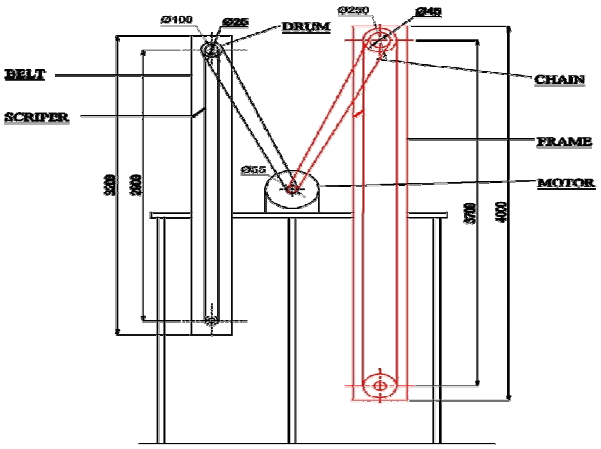


Fig.9. Modifying Oil Skimmer Machine

IV. CONCLUSION

1) The modified oil skimmer removes 630 liter/month oil from wastewater, and the existing machine was removed 360 lit/month.
2) It also helps to the factory economically. Total cost saved by using oil-skimming machine per season is 55,800 /- Rs
3) The PH of wastewater improved 5.4 to 6.1; it helps to control the water pollution.
4) It also prevents soil pollution in the agricultural field. If we drain this waste- water to agriculture, then there is no effect on soil.

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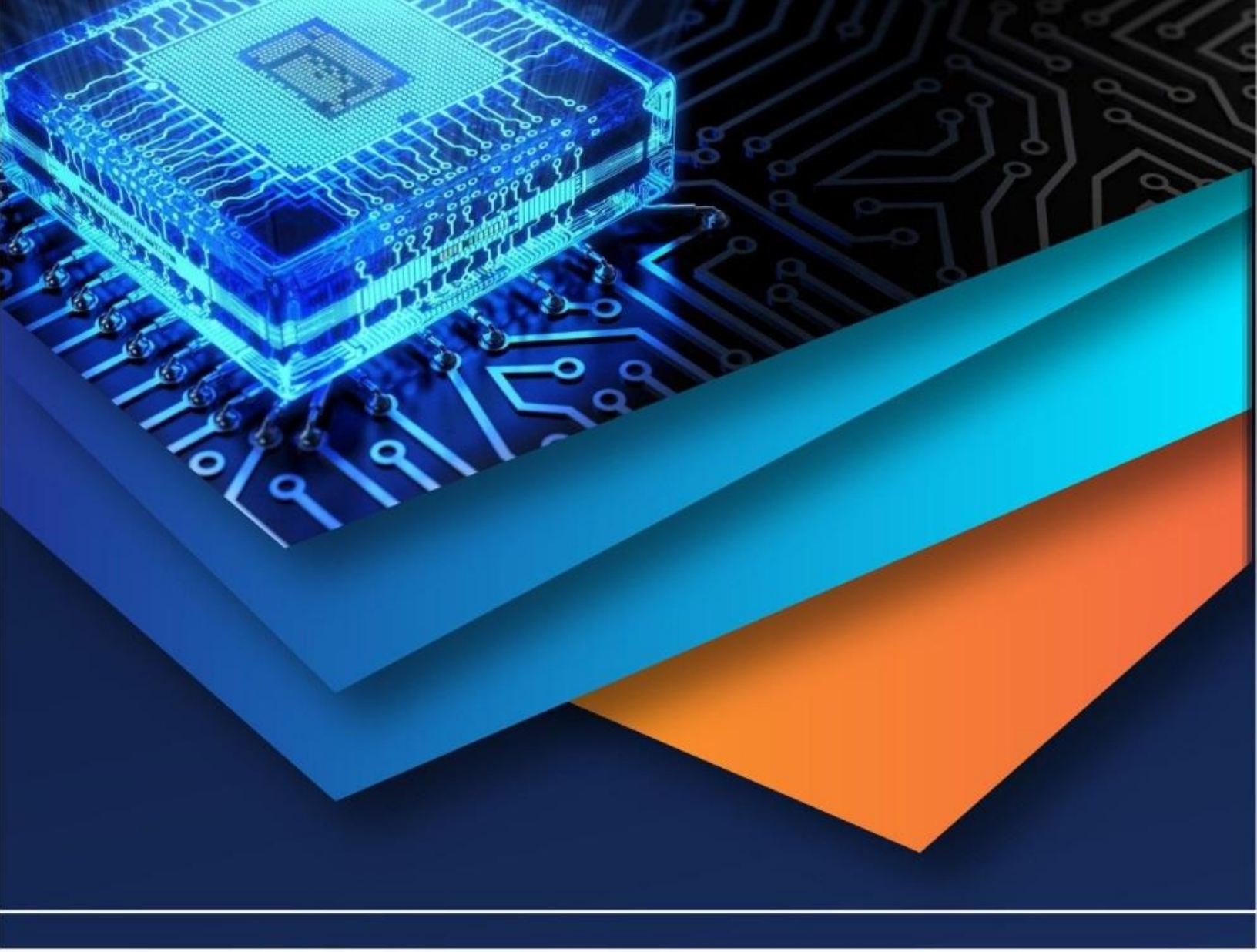

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