RESEARCH ARTICLE OPEN ACCESS

AUTOMATIC DISH WASHER MACHINE USING TUMBLER MECHANISM

Anil H. Ingle[1], Sneha Shende[2], Shailendra Ahirkar[3]

[1]Associate Professor, Department of Mechanical Engineering, SRPCE Nagpur, anil_ingle943@rediffmail.com
[2]Department of Mechanical Engineering, SRPCE Nagpur, shendesneha06@gmail.com
[3] Department of Mechanical Engineering, SRPCE Nagpur, shailendra.ahirkar9@gmail.com

Abstract- Washing dishes are very difficult by hand in a minimum time. In market the fully automatic dish washing machines are available at high cost. We design the new type of semi-automatic dish washing machine which is less costly than other automatic dish washer machines. This paper discusses about reducing the human efforts, save energy and save water. It save the time of washing utensils and large amount of work can be done in lesser time. In automatic and conventional dish washing process large amount of water and human power is used. In twenty first century work are going too fast, in our day to day life we can see that in marriage ceremony, restaurants, big hotels, and any big programs where large kitchen are used workers are clean the dishes by hands and lots of money is spend to complete the work. For reducing this entire semi-automatic dish washer machine is developed.

Keywords;Tumbler, Motor, Utensils rack, Regulator, V Belt Pulley

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1. INTRODUCTION

This represents the new and simple design of semi-automatic mechanical dishwasher. This design over comes the high cost and large space required to previous dishwasher Main objective of semi-automatic dishwashing machine is to reduce the cost of fully automatic dish washing machine and give good cleaning performance. It requires less energy and less water consumption. Time of washing dish can be adjusted as per customer requirement. It cleans utensil from all side.In today‘s world of Automation Era it is barely possible to find any field that implemented atomization which reducesHuman effort, improves Production rate and also increases Efficiency. Then it could be the biggest manufacturing industry,Pharmaceutical industry, Hospitality field and even Household or Kitchen automation. But still our country is not getting enoughbenefits from automation and the reason behind this limitation is less Knowledge about automatic products, High device cost kind ofnascence feeling about atomized devices. However this fear is not seen in the product which does not involves much Sensors,Complex Electronic Circuits, and simple easy User Friendly devices. Thisautomatic dishwasher is used on mass scale in foreign countries however the same is rarely seen in our country

2. DESIGN CALCULATION

In this project, it must to calculate for belt design which is used to run the fabricated model.

2.1 V-Belt Drive

Fig.1:- V-belt

Rated Power=100w

Diameters of driver pulley = 16cm
Speed of the driver pulley = 3000rpm
Diameter of driven pulley = 46cm

Speed of driven pulley = 1000rpm
Centre distance = 46cm

Step1. - Design Power

From Design Data Book
$(P)_d = (P)_r \times k_l$
$(P)_d = 100 \times 1.10 = 110\text{Watt}$
$(P)_d = 0.11\text{Kw}$

With respect to(P)d and D1 selecting Designation of V-belt
Designation – A
Nominal width (w) = 13mm
Nominal thickness (t) = 8mm
Std. D1 =75mm
Suggested range of power = 1Kw
Bending stress (Kb)

$\text{Kb} = 17.6 \times 10^3$
$\text{Kc} = 2.52$

Step2. – Find power rating per belt

$$\frac{\text{Power}}{\text{Belt}} = (\text{Fw} - \text{Fc}) \times \frac{e^{\mu \times \theta / \sin(\frac{\alpha}{2})} - 1}{e^{\mu \times \theta / \sin(\frac{\alpha}{2})}} \times \text{Vp}$$

Where, F w = Working load

$\text{Fw} = \text{W}^2 = 13^2 = 169\text{N}$

Fc = Centrifugal tension

$$Vp = \frac{\pi \times \text{D1} \times \text{N1}}{60}$$

$$Vp = \frac{\pi \times 75 \times 3000}{60 \times 1000}$$

$\text{Vp} = 11.78\text{m/s}$

$\text{Fc} = \text{Kc} \times (\frac{(\text{V})\text{p}}{5})^2$

$= 2.52 \times \left(\frac{11.78}{5}\right)^2$
P/161 – heck Vp + 300 to 1500 m/min

$\theta = \pi - (\frac{\text{D2} - \text{D1}}{\text{C}})$
$\theta = \pi - (\frac{460 - 75}{460})$
θ = 2.80 rad.
μ = CoefficientofFriction
μ = 0.3
α = Cone angle (30^0 to 40^0)
$\alpha = 30^0$

$$\frac{\text{Power}}{\text{Belt}} = (169 - 13.957) \times \frac{e^{0.3 \times \frac{2.3}{\sin(\frac{30}{2})}} - 1}{e^{0.3 \times \frac{2.3}{\sin(\frac{30}{2})}}} \times 11.78$$

= 1699.08 Watt/belt
Step3. – Find No. of Belts

$$\frac{(\text{P})\text{d}}{\text{Power/Belt}} = \frac{1000}{1699.08} = 0.588$$

No. of Belts = 1

Step4. - Find Total Power

Total power = No. of belt × (Power/Belt)
= 1 × 1699.08 = 1.6 Kw

Step5. - Find the proportion of V-groove pulley

Table XV-II
Groove section – A, $l_p = 11$
b=3.3mm, h=8.7mm, e=15.3mm, f=10, $\alpha = 38^0$
$D_p = 125mm$, Groove angle = 1^0

Step6. – L= width of pulley

L = (n-1) × e + 2f
= (1-1) × 15.3 + 2 × 10
L = 20mm

Step7. – Length of belt
$= \frac{\pi}{2} \times (D_1 + D_2) + 2C + \frac{(D_1 - D_2)^2}{4C}$
$= \frac{\pi}{2} \times (75 + 460) + 2 \times 460 + (75 - 460)^2/4 \times 460$
= 1840 mm

Step8. – Rim thickness
t = $0.375 \times \sqrt{D} + 3 \therefore D = D_1$
t = 6.24mm

2.2 Pulley Design

Material – Cast iron
Type of construction – Hub construction
Moment of each arm

$$\text{M} = \frac{(\text{F1} - \text{F2}) \times (\text{D2} - \text{D1})}{\text{n}}$$

1. Belt tension - F1,F2, (N)
(F1-F2) = $\frac{(P)d}{Vp}$ = 1000/11.78 = 84.38

2. Belt tension ratio

$$\frac{F1}{F2} = e^{\mu\theta} = e^{0.2\times2.8} = 1.99$$

F1=1.98f2

Put in eq.1 we get,

F1=170.60 N

3. Hub diameter

$D_h = 1.5 + 2$

Where, ds=Diameter of shaft

$$(P)d = \frac{2\pi NT}{60}$$

Torque calculation

$$T_d = \frac{1000 \times 60}{2 \times 3000} = 3.18\ Nm$$

$$T_d = \frac{\pi}{16} \times {d_s}^3 Sd_s$$

Design shear stress

Sds = Sys/fs
= 183/6 = 30.5mpa

$$3.18 = \frac{\pi}{16} \times {d_s}^3 \times 30.5$$

Ds = 0.80mm

Dh= 1.5 × ds + 25 = 1.5 ×0.8 + 25
Dh= 26.2mm

Length
Ln=1.5ds = 1.5×0.8 = 1.2mm

Moment on each arm

$$M = \frac{(f1 - f2)(D2 - Dh)}{n}$$

$$= \frac{(170.60 - 85.73)(460 - 26.2)}{1}$$

M = 36816.6 N-mm

2.3 Selection of Motor

We know,

$$P = \frac{2 \times \pi \times N \times T}{60 \times 1000}$$

Where, P = Power in KW
T = Torque in Nm
N = Speed in rpm

We Know,
Torque = Force x Perpendicular distance
Where,
Force = (Load applied on the rack + Mass of Tumbler) x Gravitational force
Let, the average load applied on the rack will be 12kg.the mass of rack will be 3kg.
We get,
Force = (12 + 3) x 9.81 = 147.15N
Perpendicular distance = 24cm = 0.24m
 Torque = 147.15 x 0.24= 35.16N-m
Now,
Power = 0.49KW = 0.5hp
Therefore, we select standard motor as 0.5hp.

2.4Dimension of rack

Height of the rack = 30cm
Length of the rack = 25cm,
Width of the Rack = 20cm

2.5Dimension of Tumbler

Height of tumbler = 31cm
Top diameter of tumbler = 46cm
Bottom diameter of tumbler = 39cm

Fig.2:-Tumbler

3.CONCLUSION

A comprehensive review of the literature on the semi-automatic dishwashing machine was successfully carried out on various aspects of energy analysis, time consumption and requirement of efforts. The design, construction and evaluation of a dishwashing machine were successfully carried out. The capacity of machine was 20 plates per 4 minutes. The design Dishwashing machine is very efficient & easy to operate. By knowing the failures from the machine, it is necessary to do some changes in this machine in future. In future the rack of the Dishwashing machine can be resolved by using the gear mechanism for more effective cleaning of utensils. Also by doing this, the less amount of water will be used by the machine for cleaning purpose.

4. ACKNOWLEDGEMENT

Authors of this paper are thankful to Associate Professor A. H. Ingle, Head of Department Dr. S. M. MowadePrincipal Dr. P. S. Lanjewar for constant support and motivation.We thank deeply to invaluable guidance rendered to us all occasion by all others to directly or indirectly contribute to our humble performance.

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