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Design And Creation Of Pin On Disc Wear Machine At Low Cost

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ABSTRACT

The Principal object of the present work is design and construction of a wear machine either pin or disc to hold in wear machine test rig. Which was used to evaluate the before and after wear of any sample it should sliding over with EN 8 disc or pin under dry condition. Another one object of this paper is varying speed with an aid of stepped pulley mounded between motor and disc. The advantage of the paper to explore the wear test with low cost fabrication in local workshop itself.

Key words : Steel (EN 8), Stepped Pulley, Motor, Disc.

1 INTRODUCITON

Many researchers are working to advance new materials that are being made and suggested for use in engineering, biomedical instruments, and electronics applications. However, we find that by using wear machine tests to quickly examine wear attributes, they have to spend a larger sum determining wear rate. [1]

The design and construction of inexpensive pin-on-disc tribometers for wear testing has been the subject of recent research. These tools seek to offer precise wear and friction data at a lower cost than those of professional tribometers [2] [1] According to Korcan Küçüköztaş et al. (2024), significant design considerations include portability, customizable parameters (load, speed, testing radius), and real-time data streaming capabilities.

For electronics and data collection, several designs make use of Arduino boards (Korcan Küçüköztaş et al., 2024; Harvinder Singh et al., 2020). Studies on surface contact testing looked at both lubricated and dry conditions; one design even permits dual-condition testing (Uhuami Abdulwahab et al., 2022) [3]

To guarantee adherence to current requirements, the hatamura technique has been used during the design phase (Dedi Rosa Putra Cupu & Oktaviandi Adeka Putra, 2022). When nanoparticle additions are added to lubricants, these inexpensive tribometers have been shown to dramatically lower wear rates and friction (Harvinder Singh et al., 2020). It has been investigated whether adding more compounds to ceramic materials can improve their wear resistance and lower their manufacturing costs.

Ucar et al. (2001) investigated the influence of SiO2 and MnO2 additives on the friction and wear behavior of alumina ceramic using a pin-on-disc machine. Köse et al. (2005) studied the applicability of ceramic coatings on ductile cast iron parts for wear resistance, finding that cr2o3 was the best coating material with a low wearing rate. Prasat et al. (2013) examined the tribological properties of hybrid metal matrix composites containing fly ash and graphite particles for improved wear resistance and mechanical properties. Sagar et al. (2018) utilized the taguchi method to optimize the wear rate and microstructures of aluminum alloy reinforced with beryl metal matrix composites.

Chen et al. (2018) investigated the friction and wear characteristics of 45 steel under oil lubrication using a pin-on-disc testing machine. **Borjali et al. (2019)** developed data-driven models using machine learning methods to predict the wear rate of polyethylene in pin-on-disc experiments for prosthetic hip implants. overall, research in the field of wear testing machines, such as pin-on-disc apparatus, has focused on enhancing wear resistance, optimizing wear parameters, and reducing manufacturing costs through the use of additional compounds and coatings in various materials.

Up to now, the research has tended to focus on portability rather than the low cost of manufacturing, which may limit the capabilities or precision compared to a professional tribometer. No literature is available on finding the basic design of the wear machine with simple calculations. This research will be very beneficial and helpful for indigenous materials to perform the basic wear test.

2 MATERIAL & METHODS

This research focus on the material used to develop basic wear machine using materials are enlisted below table 1

Table 1 Material used

S.No	Name of Material / Component	Exact grade / Power / Specification	Cost	Diagram
1	EN 8	Disc Outer diameter 250 mm Thickness = 5 mm	Rs 1000 /-	 Fig 2.1
2	Electric motor	Voltage - 230 V, Frequency - 50 HZ, 1PH PSC, AMPS - 2.5 AMPS, Power - ¼ HP, Watt - 180W, RPM - 1440rpm	Rs 1500 /-	 Fig 2.2
3	Shaft	12 mm Mild steel – 26 inch	Rs 300/-	 Fig 2. 3
4	Bearing	Angular Contact Ball Bearings BS ISO 12044 (without lubricant)	Rs 300/-	 Fig 2.4
5	Wire rope	IS 1856 : 2005 General Engineering Purpose	Rs 300/-	 Fig 2.5

2.1 Frame

Take into factors like size, materials, load capacity, and any extra features that are needed. Select where the pin and disc components should go and how the load should be applied.

2.2 Shaft

A shaft is a mechanical component used to transmit rotational motion and power between different machine elements. It is a cylindrical rod or bar that typically rotates about its longitudinal axis.

2.3 Motor

Direct connection, inexpensive, low-maintenance, and a straightforward, robust design certain applications are better suited for certain types of motors. A deeper comprehension of the features and design of AC induction motors is important.

2.4 Belt

Power is efficiently transferred using a polymer material belt that connects the pulley to the disc in various stepped pulley configurations.

2.5 Wire rope

In stricter senses the term "wire rope" refers to diameter larger than 3/8 inch (9.52 mm), with smaller gauges designated cable or cords.

2.6 Bearing

The balls roll between the inner and outer races of the bearing when it is in use, lowering friction and facilitating smooth movement of the components. Because of its design, ball bearings can withstand radial and axial loads, which makes them an adaptable part of various kinds of machinery.

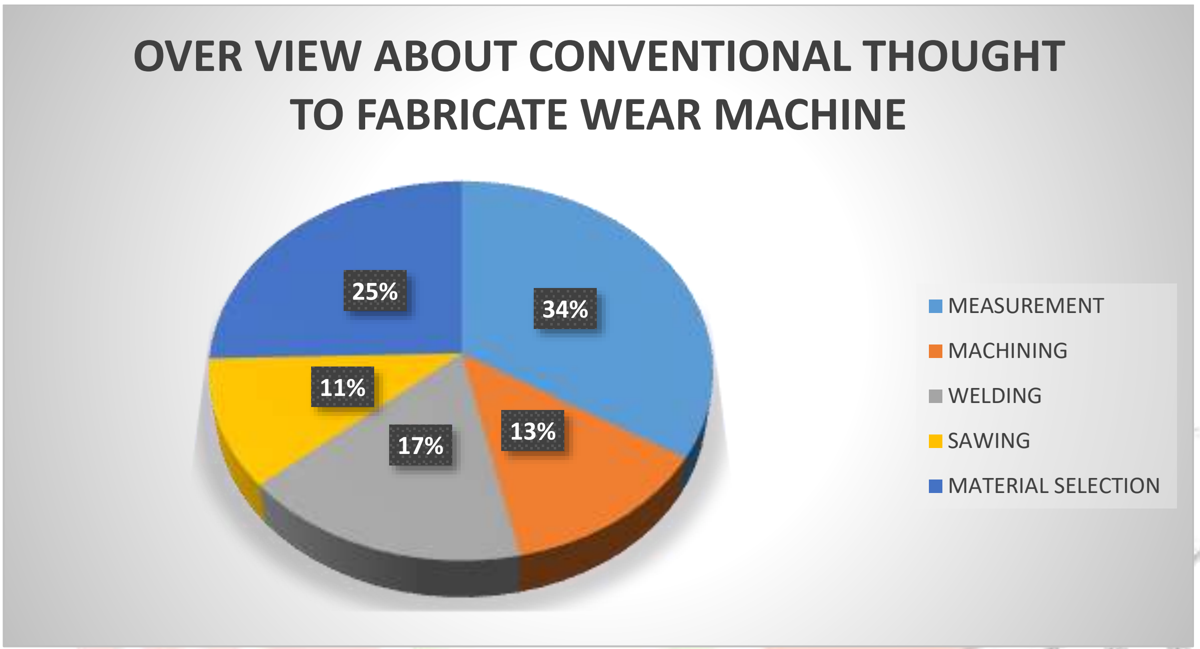

Figure 2.1 low cost fabrication thought used in method

3 Result and Discussion

3.1 Design Calculation

In order to measure wear rate, the current work uses an experimental design that can be used because it uses materials that are inexpensive. A design calculation was performed before the machine's fabrication.

3.1.1 TORQUE CALCULATION ON A CIRCULAR DISC

Diameter (d) = 300 mm

Thickness (t) = 5 mm

Speed (N) = 100 rpm

Let, Y.S. of mild steel (Y) = 250 N/mm^2

Now, Allowable Shear Stress(S) = Y * 0.5 =250 * 0.5 =125 N/mm^2

Let, F.O.S.(F)=2.5

Therefore, Allowable Shear Stress=S/F =125/2.5 = 50 N/mm^2

Also, Let Polar moment of Inertia is "J" and the Radius of shaft "R"

(also the maximum distance from center)

Now, the formula for torque is, Torque (T) = (J*S)/R

Now, J = (3.14*d^4)/32

= (3.14*300^4)/32

= 794812500 mm^4

Now, substitute all the values, T = (794812500*50)/150

= 264937500 N-mm

T = 265 KN-M

Now, the formula for power required, Power (P) = T*W

Where, W= angular velocity

Now, W = (2*3.14*N)/60

= (2*3.14*100)/60

= 10.5 rps

Now substitute the values, P = (265*10.5)

= 2774 KN-m/s

P = 2774 KW

After performed the design calculation, A way to model and create the machine in a semi-structured form that will be projected using Solid Works software in 2023 is to use design- and calculation-based methodologies. A sample calculation is displayed above. As per the safety factor we model the machine using 3D Model. Shown in Fig 3.1 & Fig 3.2

Figure 3.1

Figure 3.2

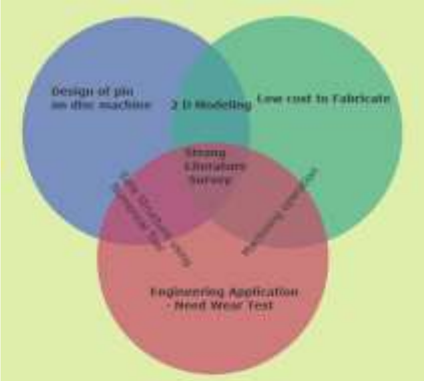

Figure 3.3

Figure 3.4

The main goal of the research project was to collectively express our thoughts to create a low-cost manufactured good. This goal was demonstrated in a process flow diagram for a low-cost wear machine using the following step shown in figure 3.3. and Figure 3.4

CONCULUSION

In this study, we selected materials, calculated designs, and created solid works designs for density calculations using materials that balance durability, affordability, and availability. In order to maximize performance and reduce design costs, we also visualised the entire design. We then concentrated our investigation on estimating the expected costs associated with manufacturing the machine. The wear machine should be built in accordance with the finished design and requirements by the machine fabrication. Then the extracted machine's operational state was confirmed. Test the machine to make sure it operates well and performs as planned. And lastly, building a low-cost wear machine included a series of steps, from the initial material selection to the final testing and operational capability verification.

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