Performance evaluation of tribological properties of castor oil for piston pump

Mayur .V. Avhad[1], Prof.R.S Shelke[2]

[1] Mayur .V. Avhad, Student, Design Engineering, SVIT, Maharashtra, India
[2] Prof.R.S Shelke, Assitant Prof., Mechanical Engineering, SVIT, Maharashtra, India

ABSTRACT

Environmentally friendly lubricants have been gaining interests worldwide. Vegetable oils have potential to be used as the base stock for these lubricants when blended with proper additives or other oils. The investigation of Lubricated Friction and Wear is an extended study. The aim of this study is to investigate the friction and wear characteristics of castor oil by using Ball on disc Wear Testing Machine under different load condition and different rotating speed for 30 min operation time. In this study, SAE
40 was used as a reference base lubricant. As a bio lubricant various blends like 10%,
20%, 30%, 40% and 50% of castor oil were mixed with the base lubricant (SAE 40). The lubricants were characterized by viscosity. This chapter provides a review of the fundamental research works carried out on tribotesters to investigate the effectiveness of vegetable oil (castor oil) in piston pump application.

Keyword : *Lubricatn,Optimazation Process,Taguchi Method,ANOVA,Load,speed,Sliding Velocity.*

1. INTRODUCTION

A substance which is capable of reducing the friction between two surfaces which are sliding over one another is known as lubricant. The friction developed by the motion of two contacting surfaces reduced by lubricant. The lubricant act in number of manners assign forms a thin film between the rubbings surfaces thus rubbing surfaces do not come in contact with each other .It also act as coolant, as heat of friction generated due to rubbing of surfaces.
The depletion of world's fossil fuel reserve, increasing fossil fuel price and other issues related to environmental, unknown petroleum reserve and the increasing consumption, which made concern to use petroleum based lubricant thus, to find the alternative lubricant to meet the future demand is an important issue. Therefore, vegetable oil can be played a vital role to substitute the petroleum lubricant as it possesses numerous advantage over base lubricant like renewability, environmentally friendly, biodegradability, less toxicity and so on It has been reported that yearly 12 million tons of lubricants waste are released to the environment . However, it is very difficult to dispose it safely for the mineral oil based lubricants due its toxic and non- biodegradable nature. To reduce the dependency on petroleum fuel, legislations have been passed to use certain percentage of bio fuel in many countries, such initiative also required for lubricant as well.

1.1 PROJECT DEFINATION

Application selected for work i.e. rigid flange used in chemical handling pipelines or equipments, requires surface roughness value generally between 0.5 to 1.8 µm This work is started with the aim to optimize surface roughness value for process parameters i.e. wheel speed, feed (table speed), and depth of cut. Optimum value of surface roughness is also depending on material removal rate (MRR), but practically MRR and surface roughness value are opposite parameters or they are inversely proportional to each other. So work is defined to optimize surface roughness value by considering above mentioned parameters.

1.2 OBJECTIVE

Currently, petroleum demand is high due to increasing industrialization, modernization, and development. The depletion of world's fossil fuel reserve, increasing fossil fuel price and other issues related to environmental Petroleum based lubricant is not renewable and has a limited source for fuels. The disposal of crude oil leads to the pollution and has been proven that its combustion is responsible for emission of traces of metals such as calcium, phosphorus, zinc, iron, nanoparticles and magnesium. To solve these problems, lubricants should be produced from

vegetable oil derivatives which are renewable, biodegradable and environmentally friendly in nature. Unknown petroleum reserve and the increasing consumption, which made concern to use petroleum based lubricant thus, to find the alternative lubricant to meet the future demand is an important issue. Therefore, vegetable oil can be played a vital role to substitute the petroleum lubricant as it possesses numerous advantages over base lubricant like renewability, environmentally friendly, biodegradability, less toxicity and so on

2. METHADOLOGY

2.1 TAGUCHI METHOD

As the number of factors considered at multi-levels increases, it becomes increasingly difficult to conduct the experiment with all treatment combinations. To reduce the number of experiments to practical level, only a small set from all the possibilities is selected. The method of selecting a limited number of experiments, which produces the most information, is known as a practical fractional experiment, but there are no general guidelines for fractional experiments that cover many applications. This method uses a special set of arrays called orthogonal arrays. These standard arrays stipulate the way of conducting the minimal number of experiments, which could give
the full in formation of all the factors that affect the performance parameter. The crux of the orthogonal arrays method lies in choosing the level combinations of the input design variables for each experiment.

Ex.No.	Load	Speed	Sliding Velocity.
1	A	P	L
2	A	Q	M
3	A	R	N
4	B	P	L
5	B	Q	M
6	B	R	N
7	C	P	L
8	C	Q	M
9	C	R	N

Table -1: Orthogonal Array

2.2 ORTHOGONAL ARRAY

Total Parameters-3

1) Rotational speed- e.g. A, B, C

2)Feed (Table speed) - e.g. P, Q, R

3)Depth of cut- e.g. L, M, N

2.2 PROCESS PARAMETER RANGES

Sr. No.	Process Parameter	Range	Level 1	Level 2	Level 3
1	Load	1-6 Kg	1	3	6
2	Speed	100-900 rpm	100	500	900

3	Sliding Velocity	0.27-2.5 m/s	0.27	1.36	2.45

Table -2: Process parameter ranges.

3. TRIAL EXPERIMENTS

A. Material used: The material used for disc is EN 31 and for the ball is chrome steel

B. Input parameters: The input parameters are Speed, Load and Sliding distance

C. Responses: Responses considered for the investigation are Wear rate and frictional force
For conducting the trial experiments varying load condition are used, the responses and parameters as shown in table

Trail No.	Speed (rpm)	Load (N)	Wear (µm)	Frictional Force (N)	COF
1	200	10	2.05	0.0536	0.00536
2	200	20	3.26	0.064286	0.00321
3	200	30	3.37	1.266429	0.04221
4	200	60	8.25	2.505714	0.04176

Table -3: Process parameter ranges.

4. SUMMARY

A detail literature review has been carried out to understand the methodology equipment and test used by the investigator
A trial experiments were conducted and observed the relationship between responses and input parameter
Various strategies for experimentation were identified and planned
The detail experimentation according to DOE with the help of strategically techniques will be carried out on the suggested materials to investigate the Performance of tribological properties of castor oil for piston pump

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