EXPERIMENTAL INVESTIGATION ON REDUCING ENERGY COST BY IMPROVING SHAFT MOTOR COUPLING ALIGNMENT

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This report is submitted
in fulfillment of the requirement for the degree of
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DECLARATION

I declare that this project report entitled “Experimental Investigation on Reducing Energy Cost by Improving Shaft Motor Coupling Alignment” is the result of my own work except as cited in the references

Signature : .....

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Date : .....

APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (With Honours).

Signature :. .....

Name of Supervisor : DR REDUAN BIN MAT DAN

Date : .....

ABSTRACT

Misalignment of shaft is the most common fault happens on rotating machinery. Several studies have shown that misalignment of shaft motor coupling has introduced up to 15 percent extra energy consumption by motor to rotate the shaft. In addition, misaligned rotating machinery has increased the cost due to repair and replacement to a new machinery and also on the manpower involvement. In this study, an analysis of energy losses caused by misalignment of shaft motor coupling will be carried out, with the main objective of finding correlation between energy consumptions with different degrees of misalignment of shaft by experimental investigation. A Machine Fault Simulator, MFS was be utilized to carry out the experimental investigation under different degrees of misalignment. The additional tools, ammeter clamp, and multimeter will be included in this study and will be used to analyse the results. This study also includes on the remedial for the misalignment of shaft, either by using straightedge or dial indicator or laser indicator in order to achieve the objective of reducing cost initiative proposal due to early damages to the machinery causes by misalignment of shaft motor coupling the industry. To simplify, this study at the end, embarks the result of how degree of misalignment affects the energy consumed by motor to rotate the shaft. This shows how a preventive and predictive maintenance is beneficial with the objective of reducing energy consumption by initiatively proposing initiative in improving the misalignment of shaft motor coupling to reduce the cost in industry.

ABSTRAK

Penjajaran aci yang salah adalah kesalahan yang paling biasa berlaku pada mesin berputar. Beberapa kajian telah menunjukkan bahawa penjajaran aci yang salah telah memperkenalkan sehingga 15 peratus penggunaan tenaga tambahan oleh motor untuk memutarkan aci. Di samping itu, jentera berputar yang tidak jelas telah memberi kesan kepada kos untuk meningkat disebabkan pembaikan dan penggantian kepada jentera baru dan juga penglibatan tenaga manusia. Dalam kajian ini, analisis kehilangan tenaga yang disebabkan oleh penjajaran aci yang salah akan dijalankan, dengan objektif utama mencari hubungan antara penggunaan tenaga dengan darjah penyelarasan aci yang berbeza dengan siasatan eksperimen. Simulator Kerosakan Mesin, MFS akan digunakan untuk menjalankan penyelidikan eksperimen di bawah tahap penyelarasan yang berbeza. Alat tambahan, pengapit ammeter, dan multimeter akan digunakan juga dalam kajian ini dan akan digunakan untuk menganalisis hasilnya. Kajian ini juga merangkumi pemulihan bagi penjajaran aci yang salah, sama ada dengan menggunakan lurus atau penunjuk indikator atau penunjuk laser untuk mencapai matlamat mengurangkan cadangan inisiatif kos kerana kerosakan awal kepada punca-punca jentera yang disebabkan oleh pemisahan gandingan motor aci industry. Untuk mempermudah, kajian ini pada akhirnya, memulakan hasil sejauh mana ketidakseimbangan menjejaskan tenaga yang digunakan oleh motor untuk memutarkan aci yang kemudian menggambarkan kelebihan apabila metodologi pencegahan dan ramalan dilaksanakan dengan tujuan untuk mengurangkan penggunaan tenaga dengan mencadangkan inisiatif dalam meningkatkan penjajaran aci yang salah untuk mengurangkan kos dalam industri.

DEDICATION

To my beloved parents

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LIST OF SYMBOLS

P	-	Energy Consume
I	-	Current
V	-	Voltage
Hz	-	Frequency
Pa	-	Pascal
A	-	Ampere
º	-	Degree

LIST OF ABBREVIATIONS

MFS	Machine Fault Simulator
AC	Alternative Current
VFD	Variable Frequency Drive
DMM	Digital MultiMeter
VOM	Volt-Ohm Milliammeter
DVOM	Digital Volt-Ohm Milliammeter

CHAPTER 1

INTRODUCTION

1.1 Background

Misalignment of shaft is an abnormality location of the virtual shaft from location of driven shaft determined at energy transmission point, where the driver machine shaft is not on same centreline as the driven machine shaft. Misalignment causes vibration problems to more than 70% of rotating machinery (Behera, Behera and Naikan, 2014). Misalignment may happen to the machine internally or externally. Angular Misalignment and Parallel Misalignment are the two types of misalignment. Angular Misalignment is when the driven and the driver shafts intersect at an angle while Parallel Misalignment is when the centrelines of the driven and the driver shafts are parallel (Liu et al., 2017). In reality, the combination of both types mostly causing misalignment of shaft (Ferrando Chacon et al., 2014).

From a view of maintenance and reliability in industrial plant, alignment of rotating machinery is the most highlighted topic in determining answers in lowering costs and increasing reliability (Jesse et al., 2017).Other than that, as said in the study, two answers that highly support the energy consumption to be decreased are firstly decreasing of loads on mechanical parts, for example couplings, bearings, and seals with improved misalignment. Moreover, decreased loads result in lower operating temperature, lesser wear on mechanical systems, lower noise and vibration and also decrease stoppage due to breakage. Thus, the operating life span of equipment will longer and more reliable. Secondly, by improving misalignment, the energy efficiency will increase too.

The project study the impact on energy consumption in improving misalignment of shaft motor coupling. It will reduce cost and increase the operating life of the machine by reducing vibration and parasitic loads due to misalignment. When coupling and bearing of shaft operating in a misaligned condition, energy consumption will increase thus acting against mechanical systems which causing machinery damages thus requires high amount of money to either repair or replace. This defectively misaligned machine has introduced up to 15% extra energy (Dockyard and Watson, 2012). Therefore, by removing high energy vibration sources such as misalignment, can also lower the energy consumption of the machine up from 10 to 15 percent.

This study also proposes on the remedial of the misalignment of shaft that can be done manually or either way. As for manually, the method only requires to use straightedge, condition based maintenance program and dial indicators. Furthermore, the method requires to use laser guided tools. The remedial methods are comparable based on time consume, efficiency, accuracy and friendly usage.

1.2 Problem Statement

Misalignment is the incorrect arrangement or position of something in relation to something else. There are a lot of factors of misalignment of shafts occur, some are inaccurate assembly of parts, material of the parts expand due to surrounding temperature, excessive energy consumption and coupling failure. These factors have caused high energy consumption in rotating the shaft motor coupling. Thus, misalignment is crucial to be fixed because misaligned rotating machinery affects high cost to the industry. As misalignment causes early damages to the machinery, loss in production due to short operating life of the machine.

These problems will be long-term if it is not fixed or it will indirectly affect people, such as the workers need to work overtime, the owner of the industries as the cost will be high to support, the users or third parties will may be harmed due to unsafe machine or equipment to use. This study will prove the previous studies by an experimental investigation on reducing energy cost by improving shaft rotor coupling alignment.

1.3 Objective

This project embarks on the following objectives:

1. To study the impact on energy consumption due to the misalignment of shaft motor coupling.
2. To propose cost reduction initiative due to early damages to the machinery causes by misalignment of shaft motor coupling the industry.

1.4 Scope of Project

This study embark on experimental investigation to achieve its objectives in Condition Based Maintenance Lab of Fakulti Kejuruteraan Mekanikal, UTeM, using Machinery Fault Simulator and a few additional tools. This Machinery Fault Simulator and some additional electronic tools will give out measurements and data. The data is going to be used in plotting the chart of the energy consumption due to misalignment of shaft motor coupling against the degree of misalignment of shaft motor coupling.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter explains on previous researches which are related to this case study and few of basic theories which are to be used including machine fault simulator, misalignment of shaft motor coupling, types of misalignment, causes of misalignment, impaired of the misalignment, relation of misalignment with energy consumption of the motor and few additional tools.

2.2 Shaft Motor Coupling Misalignment

Misalignment is an abnormality location of the virtual shaft from location of the driven shaft determined at energy transmission point, where the driver machine shaft is not on same centreline as the driven machine shaft. Misalignment causes vibration problems to more than 70% of rotating machinery (Behera, Behera and Naikan, 2014). Figure 1 shows an image of shaft coupling. Shaft coupling is a device that connects two shafts together at their ends in order to conduct energy.

Figure 1 Shaft Coupling