

**STAMPING OIL CONDITIONING MONITORING AT MIYAZU
USING FT-IR: WATER PEAK MONITORING FOR LINE J**

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USING FT-IR: WATER PEAK MONITORING FOR LINE J**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Process) with Honours.

by

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This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Process) with Honours. The member of the supervisory committee is as follow:

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ABSTRACT

In metal stamping process, oil lubrication is very important to reduce a level of heat develop during the process. As we know, the stamping process will produce and transfer high heat and we need one way to act as a medium to reduce the level of heat produce in order to ensure that we can get the good surface finish of product and also increase a tool life. Otherwise, good lubrication oil should possess a function to trap any contaminant that is produced during the stamping process and remove it from the machine to avoid the process is disturb by it. The objective of this report is being produce is to determine a main factor that contribute to the problem happen such as dent that is appear on the surface of stamping product. On this research report, we will focus on oxidation to determine whether the oxidation will effect or not the surface finish of stamping product. The research is performed by implement the method of oil analysis. Oil analysis is the sampling and laboratory analysis of a lubricants properties, suspended contaminants, and anti-wear additives. Through this oil analysis, we can know the type of oil contaminant that is exist in oil and this is important finding in order to make a conclusion in a last chapter of this research report. The oil analysis will be perform by using Fourier Transform Infrared Spectroscopy (FT-iR) in the Chemical Lab of Mechanical Faculty Technical Malaysia Malacca University (UTeM). Lubricating oil that is need to use as a sample is collected from a different production line and for this research the oil sample is taken from J-line of production. The research scope is focus on one line and this is important to increase a chance in determining the factors contribute to a surface defect. The oil is then analyzed using Attenuated Total Reflectance (ATR) according to a standard of ASTM E2412-04. This concept is been use because it suitable with the condition of oil. By referring to a value of peak that produce through the oil analysis using FT-iR, the type of contaminant will be determine. Then the analysis data will be compared with a rejection data from J-line to determine their relation. At the last of this report, I expect to success in determining the exact time

when to change the lubrication oil. Otherwise, I also hope to know the factor that cause the oil becomes not efficient to remove burr from stamping machine and know the exact value of water in the oil. Then, according to the data and analysis that will be done, some suggestion to reduce and prevent the problem that has been state can be recommend.

ABSTRAK

Minyak pelincir dalam proses pembentukan besi amat penting dalam mengurangkan kadar haba semasa proses di jalankan. Seperti yang kita ketahui, proses membentuk besi menghasilkan haba yang tinggi dan kita memerlukan satu kaedah yang dapat mengurangkan kadar haba tersebut demi menjamin permukaan akhir produk adalah baik disamping meningkatkan jangka hayat alat. Disamping itu, minyak pelincir yang masih dalam keadaan yang baik bertindak untuk memerangkap lebih-lebihan besi yang terhasil semasa proses dan menyingkirkannya dari mesin. Tujuan laporan ini dihasilkan adalah untuk mengkaji faktor yang menyebabkan berlakunya kecacatan seperti lekuk yang terdapat pada permukaan produk yang dihasilkan yang mungkin disebabkan oleh minyak pelincir yang digunakan. Faktor yang ditumpukan pada laporan ini adalah pengoksidaan yang mana kajian akan menentukan samaada pengoksidaan dalam minyak menyumbang kepada berlakunya kecacatan pada produk. Penyelidikan dilakukan dengan menggunakan kaedah penganalisan minyak. Proses penganalisan minyak berkeupayaan mengkaji ciri-ciri minyak mahupun kandungan bendasing dalam minyak. Melalui penggunaan kaedah ini, jenis bendasing dalam minyak dapat ditentukan dan ini penting dalam membuat kesimpulan pada akhir bahagian pada laporan ini. Penganalisan minyak dapat dilakukan dengan menggunakan mesin yang dikenali sebagai “Fourier Transform Infrared Spectroscopy (FT-iR)” yang terdapat di dalam Makmal Kimia Fakulti Kejuruteraan Mekanikal, Universiti Teknikal Malaysia Melaka. Minyak yang digunakan sebagai contoh diambil dari barisan pengeluaran yang berbeza yang mana untuk laporan kajian ini minyak telah diambil dari barisan J (J-line). Pengkhususan kepada satu barisan penting untuk memberi lebih keupayaan dalam mengenalpasti faktor penyumbang kepada kecacatan produk. Minyak seterusnya dikaji menggunakan (FT-iR) berdasarkan konsep “Attenuated Total Reflectance (ATR)” mengikut piawaian ASTM E2412-04. Konsep (ATR) digunakan kerana ia sesuai dengan kondisi bahan yang hendak diuji iaitu minyak. Dengan menggunakan nilai

puncak bagi graf yang terhasil dari penganalisan minyak, kandungan bendasing yang terdapat dalam minyak dapat ditentukan. Data dianalisis untuk mendapatkan perhubungkaitannya dengan data kerosakan yang diperolehi dari barisan pengeluaran J. Di akhir laporan kajian ini, diharap kajian akan dapat menentukan masa yang betul untuk menukar mintak pelincir bagi mesin pembentukan besi. Disamping itu, faktor-faktor yang menyebabkan minyak hilang kadar kecekapan juga diharap dapat dikenalpasti selain mendapatkan kandungan sebenar air dalam minyak pelincir yang digunakan. Seterusnya, berdasarkan data yang diperolehi serta analisis yang dilakukan, satu bentuk cadangan diharap dapat dikemukakan .

DEDICATION

This thesis is dedicated to my mother, all of my lecturers and all of my friends for their support, advice and encouragement in completing this thesis. For my mother, thank for all of the spiritual and support for me in order to fulfill the requirement for my studies.

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LIST OF ABBREVIATIONS

JOAP	-	Joint Oil Analysis Program
DIN	-	Deutsches Institut für Normung @ (German Institute for Standardization; similar to US ANSI)
FT-iR	-	Fourier Transform Infrared Spectroscopy
ATR	-	Attenuated Total Reflectance
PSM	-	“Projek Sarjana Muda”
DTGS	-	Deuterium Tryglycine Sulfate
MIR	-	Multiple Internal Reflectances
ZnSe	-	Zinc Selenide
Ge	-	Germanium
KRS-5	-	Thallium–iodide

CHAPTER 1

INTRODUCTION

This research is performed at Miyazu (Malaysia) Sdn Bhd located at Shah Alam, Selangor. This research is head for oil condition monitoring in order to prevent and overcome some problem in their manufacturing process. The problem is actually occur in stamping process and as a result part that involved in stamping process possess some defect such as dent. The stamping lubrication oil used in industries is usually to give a cleaning mechanism on the stamping machine die. The oil usually cleans the burr at the surface of the die. So that, when stamping operation is done, the product produced did not have a defect such as dent at their surface. The oil used in cycle way and the process undergoing in several year without changing the oil maybe reduce the effectiveness of lubricating oil. As lubricating oil is suspected to cause the defect in stamping product, analysis of oil will be perform. The important parameters to monitoring the oil in this research are water peak, moisture in oil, degradation of oil, and also oil contamination. These parameters are used in the research to find the problem occurred in the stamping process that have done in line J. The main problem that needs to overcome using this research is dent that happen on the product such as car body produced at Miyazu (m) Sdn. Bhd.

1.1 Oil Analysis

Oil analysis involves sampling and analyzing oil for various properties and materials to monitor wear and contamination in an engine, transmission or hydraulic system. Sampling and analyzing on a regular basis establishes a baseline of normal wear and can

help indicate when abnormal wear or contamination is occurring. Oil analysis works like this. Oil that has been inside any moving mechanical apparatus for a period of time reflects the exact condition of that assembly. Oil is in contact with engine or mechanical components as wear metallic trace particles enter the oil. These particles are so small they remain in suspension. Many products of the combustion process also will become trapped in the circulating oil. The oil becomes a working history of the machine.

Particles caused by normal wear and operation will mix with the oil. Any externally caused contamination also enters the oil. By identifying and measuring these impurities, you get an indication of the rate of wear and of any excessive contamination. An oil analysis also will suggest methods to reduce accelerated wear and contamination. The typical oil analysis tests for the presence of a number of different materials to determine sources of wear, find dirt and other contamination, and even check for the use of appropriate lubricants. Early detection with oil analysis can allow for corrective action such as repairing an air intake leak before major damage occurs. Probably one of the major advantages of an oil analysis program is being able to anticipate problems and schedule repair work to avoid downtime during a critical time of use.

On this research, the analyzer machine that will be use is Fourier Transform Infrared Spectroscopy (FT-iR). The Spectro FT-iR Oil Analyzer (figure 1.1) is specifically designed for the molecular analysis of lubricating oil to determine oil degradation and contamination. It was developed and optimized for predictive maintenance programs according to JOAP and DIN standards for the rapid determination of oxidation, nitration, sulfation, water, coolant, fuel dilution, soot and wear additive depletion in used lubricating oils. When coupled with an optional autosampler, the Spectro FT-iR Oil Analyzer is ideal for condition monitoring laboratories with large sample loads. The system is easy to use and requires little training for operation since it is optimized for one application: used oil analysis. It features continuous online diagnosis of all spectrometer components and automatic control of selected measurement parameters. The Spectro Oil Analysis FT-iR Spectrometer is equipped with a zinc selenide transmission flow cell. The transmission cell has high infrared throughput, is optimized

for used oil analysis and is easy to clean. The cell assembly is mounted in a pre-aligned base plate for fast and reproducible exchange.



Figure 1.1: FT-iR analyzer

1.2 Background of Research

The objective of this project is to analysis the oil in order to determine whether the oil that used for lubrication during stamping process at Miyazu (Malaysia) Sdn. Bhd. is causing the defect such as dent on its stamping product. To fulfill this requirement, we have planned to study the lubricating oil using the Fourier Transform Infrared Spectroscopy (FT-iR) technique in Chemistry Laboratory in Faculty of Mechanical Engineering, Universiti Teknikal Malaysia Melaka (UTeM). This research will focus on oxidation analysis and this becomes a main thing to be determined.

By using the oil that is used before and after stamping process at various stamping machine, we will differentiate the spectrum obtained from the FT-iR and do the quantitative study of foreign particle especially contamination cause by oxidation in the oil that may cause the defect of the project. Lubricating oil samples is taken for the specific production line. For this research, the line is specified to J-line in order to find factor contributes to the problem.

1.3 Objectives

Objective of this project are to:

- (a) Determine a factor influence contamination in oil
- (b) Study the factor that caused the oil become insufficient to remove burr from stamping machine
- (c) Study the absorbance of moisture existed in the lubricating oil used.

1.4 Problem statement

The main process that involves in producing a body part for automobile is stamping process included for Miyazu Sdn. Bhd. For stamping process involves higher contact pressures at the tool-workpiece. Under these severe interface conditions, improper selection of lubricants may result in high rejection rates and galling in stamping production. Metal stamping processes require lubrication to minimize friction, dissipate heat, reduce tool wear and maintenance, and prevent galling. At Miyazu, the produced products have possessed some defect such as dent. The lubricating oil (refer to the Appendix A-1) used in the stamping operation at Miyazu (M) Sdn. Bhd. is maybe containing any particles that can cause dent problem on the material produced. The rejection rate at their production line is high and this research is to define whether stamping oil become not sensitive and do not functions well when doing the stamping process affect the product surface quality. There is possibility that the usage frequency and oil age will be a factor that causes the oil become less functional.

1.5 Research Scopes

The scope of this study is to identify and determine whether the lubricating oil used during the stamping process at Miyazu (Malaysia) Sdn. Bhd. is the main cause of defect such as dentist like on their components. Various oil samples from different stamping line will be scanned using the FT-iR and compared with the clean oil sample to identify the foreign particle that is present in the oil sample. The particle will then be analyzed quantitatively by using FT-iR to determine whether there is a relation between the numbers of defect on each machine with its present by using the ASTM E-2412 standard.

The project will focus on improvement on the quality of stamped work piece. In order to ensure the objectives are achieved, some of the important element must be considered:

- (a) The study will be done in Chemistry Laboratory at Faculty Of mechanical Engineering, Technical University of Malaysia Melaka.
- (b) To find contamination such as oxidation in stamping lubricating oil.
- (c) Using FT-iR (Fourier Infrared Spectroscopy) software, which will detect the moisture in oil.
- (d) The sample of oil will be taken at the production J-line at Miyazu (M) Sdn. Bhd.
- (e) The sample of oil will be taken before and after the filter. The oil then will be divided into two types. This is done in order to determine the differences between the clean and used oil.

1.6 Research Methodology

Used and clean oil sample were taken from several stamping machine at Miyazu (Malaysia) Sdn. Bhd. number of part defect caused by dent, dink and other were also noted for each machine for comparison analysis with the quantitative analysis of FT-iR spectrum. The oil samples were scanned using ATR method of FT-iR. Each sample

will be scanned 100 times and more to ensure a repeatable result from the FT-iR. The spectrum of the clean oil sample is used as a base line spectrum.

Competitive and quantitative study of each used oil spectrum from every stamping machine collected is conducted using the Perkin Elmer FT-iR Analysis Software. The FT-iR works by a spot on the specimen is subjected to a modulated iR beam and the specimen will transmittance and reflectance of the infrared rays at different frequencies will translated into an IR absorption plot peak. The result then will be analyzed and matched with known signatures of the peak of the material in the specimen in the FT-iR library where we can get it by online.

After the contamination in the oil had been analyzed, we need to recognize what is the contamination occur in the oil, where the contamination come out and how to prevent the contamination from occur again.

1.7 Organization

This research is also known as ‘Projek Sarjana Muda’ (PSM). PSM is divided to two parts, PSM one and PSM two. In PSM one, the chapter is include of Introduction, Literature Review and Methodology while PSM two consist of Result, Discussion and Conclusion so that, overall PSM should possess six main chapter as full report writing. Introduction in PSM one will describe about oil analysis by using FT-iR machine and will state a background, problem statement, objectives, scope, and methodology of project. In chapter two, literature review for a project title will briefly discuss. The written of the literature review will mostly refer to a journal that related to the project title. For this project, the literature review will focus on FT-iR spectroscopy, attenuated total reflection (ATR) concept, stamping process basics and also the description of lubricating oil used in stamping. The objective of literature review written is to help student to understand the title very well. Otherwise, literature review also acts as guidance for a student to conduct their project smoothly. Methodology in chapter three