OIL PARTICLE ANALYSIS-MIYAZU 1

NIK MOHD FAIZAL BIN WAN ZULKIFLI

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

OIL PARTICLE ANALYSIS-MIYAZU 1

Thesis submitted in accordance with the partial requirements of the Universiti Teknikal Malaysia Melaka for the Degree of Bachelor of Engineering (Honours) Manufacturing (Engineering Material)

By

Nik Mohd Faizal Bin Wan Zulkifli

Faculty of Manufacturing Engineering

April 2008

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS TESIS*

JUDUL: OIL PARTICLE ANALYSIS-MIYAZU 1

SESI PENGAJIAN: 2007/08

Saya NIK MOHD FAIZAL BIN WAN ZULKIFLI
(HURUF BESAR)

mengaku membenarkan tesis (PSM/Sarjana/Doktor Falsafah) ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hak milik Universiti Teknikal Malaysia Melaka .
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (√)

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☐	TIDAK TERHAD	

Disahkan oleh:

(TANDATANGAN PENULIS)

(TANDATANGAN PENYELIA)

Alamat Tetap:
LOT 23, KG. TEBING, PGKLN. KUBOR,
16080 TUMPAT,
KELANTAN

Cop Rasmi:

Tarikh: _____

Tarikh: _____

DECLARATION

I hereby, declared this thesis entitled “Oil Particle Analysis-Miyazu 1” is the results of my own research
except as cited in references.

Signature : …….

Author’s Name : ……

Date : ……

APPROVAL

This PSM submitted to the senate of UTeM and has been as partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Engineering Material). The members of the supervisory committee are as follow:

……

(Main Supervisor)

(Official Stamp & Date)

ABSTRACT

. The main purpose for this research is 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 product. The main study for this research is to study the impurities or contamination in the oil that used as lubricating in stamping process. In order to achieve this, the study should be based on the foreign particle that is present in the lubricating oil using the Fourier Transform Infrared Spectroscopy (FT-iR) technique. This research emphasizes the analysis of contaminant level of oil based on the cycles or times of usage using FT-iR. This research will enhance the information of the level of oil contaminants in each cycle. The main objective 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. 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 into the oil. The analysis had been done according to the ASTME-2412 standard for petroleum crankcase lubricant. The analysis is based on analyze the water content, soot loading, oxidation, nitration, antiwear components, ethylene glycol and sulfate by product. The result from the analysis show that the oil added with chips from the compartment product is the greatest contaminated according to the standard. This show that the filtration used is not capable to filter the contaminated particle to enter the lubricant oil again.

ABSTRAK

Tujuan utama kajian ini dilakukan untuk mengkaji sama ada minyak yang digunakan sebagai minyak pelincir semasa proses membentuk besi menjadi penyebab kepada kerosakan seperti lekuk-lekuk pada produk yang dihasilkan. Tujuan utama mengkaji minyak ini adalah untuk mengetahui bendasing atau bahan tercemar yang terdapat di dalam minyak yang digunakan sebagai minyak pelincir itu semasa proses membentuk besi itu. Untuk mencapai segala objektif dan matlamat kajian ini dijalankan, kami telah bercadang untuk mempelajari dan mendalami tentang bendasing dan bahan tercemar yang terdapat dalam minyak pelincir itu menggunakan kaedah Fourier Transform Infrared Spectroscopy (FT-iR) yang terdapat di dalam Makmal Kimia Fakulti Kejuruteraan Mekanikal, Universiti Teknikal Malaysia Melaka (UTEM). Kajian ini juga menitikberatkan takat bendasing dan bahan tercemar dalam minyak pelincir tersebut berdasarkan pusingan kitar semula atau jangka masa minyak itu digunakan. Melalui kajian ini jugak, kita dapat memerhatikan tahap pencemaran itu setelah beberapa kali digunakan. Kajian ini dilakukan menggunakan sample minyak yang berlainan yang diambil dari mesin yang berlainan dan akan diimbas menggunakan FT-iR dan akan dibandingkan dengan minyak yang bersih untuk mengkaji bendasing dan bahan tercemar yang terkandung di dalam minyak pelincir tersebut. Zarah-zarah yang diimbas itu akan dianalisis untuk mengkaji sama ada wujud atau tidak hubung kait antara bilangan kerosakan pada produk dengan minyak yang digunakan. Selepas semua bendasing dan bahan tercemar itu dianalisi, kita hendaklah mengenalpasti apa bendasing dan bahan tercemar tersebut, bagaimana bendasing dan bahan tercemar itu boleh wujud dan cara mengatasi dari berlaku lagi perkara sedemikian. Analisis ini telah dilakukan mengikut ASTME-2412 standard. Analisis ini juga dijalankan berdasarkan water content, soot loading, oxidation, nitration, antiwear components, ethylene glycol and sulfate by product

yang terdapat dalam minyak pelincir tersebut. Dari keputusan ujian yang dijalankan, minyak pelincir yang dicampurkan dengan bahagian besi yang dikikis dari produk yang dihasilkan menunjukkan kadar bendasing dan pencemaran yang paling tinggi. Ini menunjukkan system penapisan yang digunakan tidak berfungsi dengan baik yang mana system penapisa itu tidak berjaya menghalang pencemaran dan bendasing dari kembali memasuki minyak pelincir itu dan menyebabkan minyak pelincir itu tercemar dan terdapat bendasing yang boleh menjejaskan produktiviki dan kualiti produk.

DEDICATION

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

ACKNOWLEDGEMENT

Crucial thanks to all individuals for their support and motivation to me in ensuring a successful occurrence and flow of activities throughout the duration of thesis. Also big thanks for Mr. Fairuz Dimin, my supervisor for his guidance and encouragement for spending quite some time with myself and providing a lot of guidance and ideas for my thesis research. His knowledge and experience really inspired and spurred myself. I truly relished the opportunity given in working with him. Last but not least, my appreciation to the entire person that involved to complete this thesis project. Finally, my sincere appreciation is dedicated to my parent and family and as well as the friends for their priceless assistance and motivation for me to complete the research for my thesis.

CHAPTER 1

INTRODUCTION

1.1 Background of the company involve in the research

Figure1.1: Miyazu (Malaysia) Sdn. Bhd.

Miyazu (Malaysia) Sdn. Bhd. in collaboration with Proton Holding Berhad, Miyazu Seisakusho (Japan) and Sojitz Corporation is one of the largest and dies producer in Malaysia and located at Proton Holding Berhad, Batu Tiga, Shah Alam. The main

operations of this company are design and engineering the stamping dies for proton models such as Proton Wira, Proton Perdana and GEN2. In 2004, Miyazu went on to engineer and localize all the body parts for Proton's cars with a total of 712 dies. It subsequently produced dies for Proton Persona and began exporting dies to Takao Thailand and Mazda in 2005 and 2006 respectively.

In April 2006, Miyazu expanded its portfolio to include stamping parts production and thus commenced the implementation of TPS in collaboration with TABM to enhance its production capability in order to qualify to meet TABM supply standards. In April of this year, Miyazu launched an A-Class Tooling Plant in Proton City, Tanjung Malim, further transforming the company into a key automotive tools manufacturer in the ASEAN region. Miyazu's new tooling plant marks Malaysia's entry into the highly specialized and technology intensive industry of designing, engineering and manufacturing of automotive tools.

Miyazu Malaysia's position as an anchor Class A large dies and moulds producer is expected to pave the way for the formation of Tool Maker clusters. This in turn will result in the creation of an even bigger supporting industry such as casting, hard chroming, machining, production of dies components, logistics and calibration, to name a few. The company has a paid up capital of RM17.5 million with strength of 250 personnel based at its Class A automotive tooling plant at the Proton Tanjung Malim Vendor Park in Tanjung Malim.

The 3,600-square meter plant, located on a 10.5-acre site, houses state-of-the-art design, engineering, machining and finishing facilities which include computer-aided design and manufacturing (CAD/CAM) applications, and double-column, coordinate-measuring and pressing machines. These are critical tools required to design, engineer and produce the dies and moulds for the production of automobile components such as roof, bonnet, fender, dashboard, and door, side and other body panels.

At full operational capacity, Miyazu Malaysia, together with its technology suppliers and business partners, is able to manufacture and localize over 400 dies annually, thus reducing dependency on foreign expertise in terms of the design, engineering and manufacturing of dies.

1.2 Background of the research

The objective of this project is to determine whether the oil that used for lubrication during stamping process at Miyazu (Malaysia) Sdn. Bhd. is causing the defect such as dent and the like on its product. In order to achieve this, we have planned to study the foreign particle that is present in the lubricating oil using the Fourier Transform Infrared Spectroscopy (FT-iR) technique that is available in the Chemistry Laboratory in Faculty of Mechanical Engineering, Universiti Teknikal Malaysia Melaka (UTEM).

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, water and other unwanted material in the oil that may cause the defect of the product.

1.3 Problem Statement

In Miyazu (Malaysia) Sdn. Bhd., the metal stamping process is the main process involves in producing body part for automobile. For metal stamping process, oil is used as lubrication to prevent scoring and galling during stamping. The dusty environment will cause a lot of problem or defect on the product produce where the dust will mix into the oil and caused contamination. The oil used for metal stamping process also been used repetitively and recycle. Up to several time of usage, the oil has to be changed to maintain the cleaning quality. At the moment, there are limited studies to detect the level of contaminant for each cycle of oil. This research emphasizes the analysis of contaminant level of oil based on the cycles or times of usage using FT-iR. This research will enhance the information of the level of oil contaminants in each cycle. The results of

the study also can be used to predict the suitable time to replace the oil. Beside that, the research will also look into different production line to determine which line is more likely to cause the defect due to the contamination of the lubricating oil.

1.4 Research Objectives

The objective 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 ASTME-2412 standard.

1.5 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 to ensure a repeatable result from the FT-iR. The spectrum of the clean oil sample is used as a base line spectrum.

Compatative 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 into the oil.

Figure 1.1: The sample has been taken from the stamping machine.

CHAPTER 2
LITERATURE REVIEW

2.1 Metal Stamping Process

2.1.1 Introduction of Metal Stamping

Metal stamping is a process where the sheet of metal is stamp for manufacturing metal part according to the design that had be done. A metal alloy sheet is used as the stock and the stock is either stamped on a press using dies and punches or drawn into shapes on hydraulic deep drawing machines. Common product produce are automobile parts, electronic parts, aerosol spray can and also household ware product such as pots and pans.

Sheet metal can be mold into various shapes according to the design or drawing that provided for the product. The metal must be malleable and needs to flow easily in order to mould into shapes. Types of metal that can be done this process are Aluminum, Zinc, Steel, Nickel, Bronze, Copper and other alloys. This stamping process is used widely because it is chip less manufacturing and can manufacture large volume of product with semi-skilled labor and low cycle time.

Figure 2.1: The metal stamping machine that used for stamping process

2.1.2 Metal Stamping Operation

In metal stamping process, dies and punches are used to cut the metal into the required shape which is called male components for the punches and the female component for the dies. Press machine tools are used in the stamping process. The punch, made of hardened tool steel or carbide, also matches the contour of the part but is slightly smaller to allow clearance between the die and the punch. It is mounted in the head or the turret, which moves down and punches the metal. The thickness of the sheet metal doesn't change during this process.

Design and manufacture of dies and punches is a highly skilled process and master craftsmen use precision jig boring, grinding, EDM, and lapping machines to produce

highly accurate dies. Progressive stamping is used to design complex profiles. In this process, the profile is cut in steps with a series of different sized die and punch combinations. The first punch in the series cuts a smaller profile and the next punch finely polishes the metal to obtain a desired shape. Tumbling process or deburring is used to remove any sharp edges and burrs. All through the process it is important to maintain a minimum wall thickness for the punched hole.

The metal may be plated with palladium, nickel or tin to protect it from oxidization. Plating improves the durability and solderability of the product. For additional shelf life, the sheet metal is also pre-plated before the actual stamping process. The product is then cleaned to dispose of excess oils, grease, films or other materials used during the stamping process. The heating process follows the cleaning process to enhance the toughness of the metal product.

2.1.3 Metal Stamping Technique

In metal stamping process, there are several types of stamping process occur. The most common stamping processes are:

(a)Fine Blanking

For high accuracy and smooth edge of the product, it is better to use the Fine Blanking process. This process is used to produce final shape parts that do not require subsequent finishing operations. Fine blanking process is a single step operation and proves to be a cost effective.

(b)Progressive die stamping

Progressive stamping is a process where it can do punching, coining, bending and several other ways of modifying metal raw material, combined with an automatic feeding system. The metal is push to the progressive die by the feeding system and each of the stations performs one or more operations until a finished part is made per the requirements on the blueprint. Then it goes to the cutoff operation which is the product is separates from the carrying web. The progressive stamping

die is placed into a reciprocating stamping press. As the stamping press moves up, the progressive stamping die opens. When the stamping press moves down, the progressive stamping die closes. When the stamping press opens, the metal material is able to feed. As the stamping press closes, the progressive stamping die performs work on the raw material. With each stroke of the press, a completed part is removed from the die.

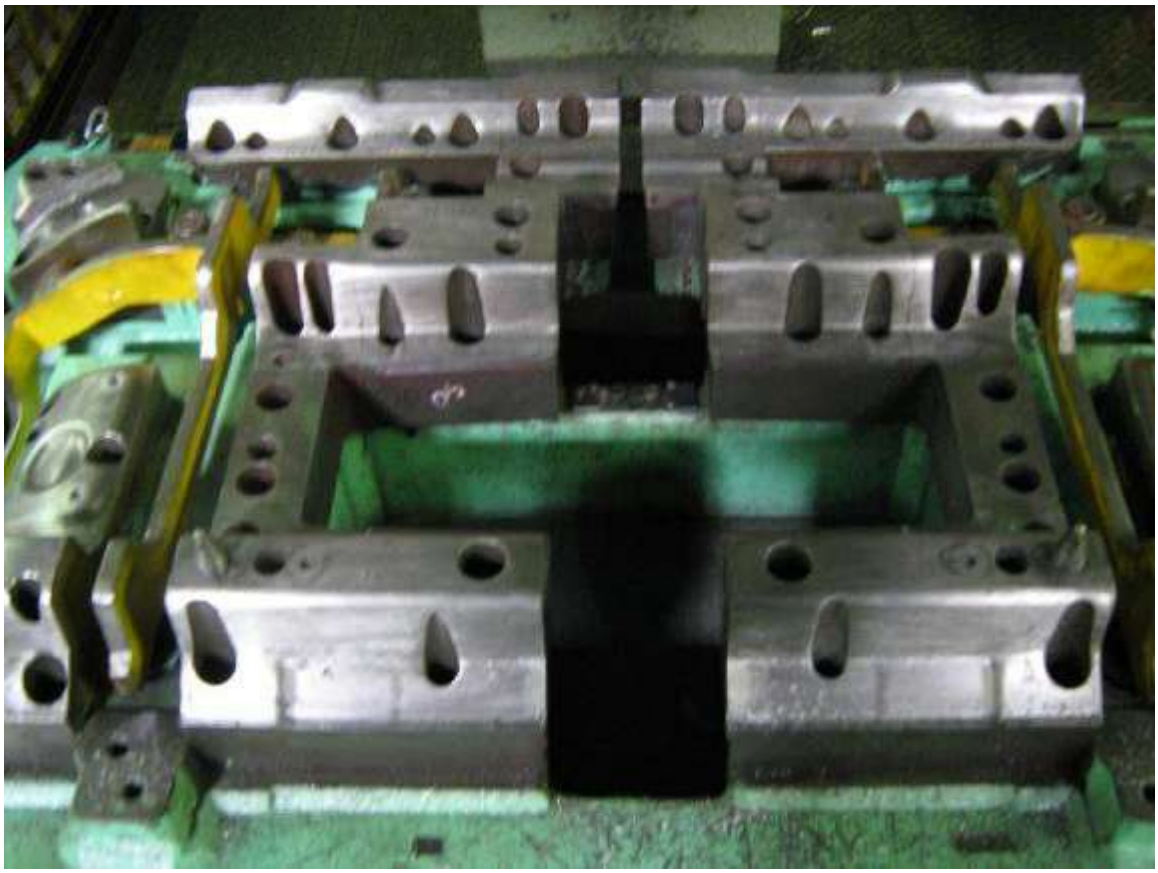

Figure 2.2: Progressive (punch and blanking) die with strip and punching.

2.1.4 Metals used in stamping process

A lot of basic and exotic metals can be used for stamping applications because of their malleable and ductile properties. The metal should not be very hard and ideally should have a low coefficient of flow. Some typical metals include:

- Ferrous metals - stainless steel stampings, and other iron-based metals
- Non-ferrous metals - brass stampings, bronze stampings, zinc stampings, and other metals that are not iron-based
- Exotic metals - beryllium copper, beryllium nickel, niobium, tantalum, and titanium stampings
- Precious metals - gold, silver, platinum, which are often used for decorative stampings

2.2 Oil particle analysis

2.2.1 Introduction

In the past, Ferrography technique is widely used for microscopic examination and analysis of wear particles in lubricating oil. The major types of Ferrography equipment are Direct Reading Ferrograph, Analytical Ferrograph and Ferroscope

But for this research, we will mainly used FT-iR to analyze the foreign particles present in the lubricating oil. Currently FT-iR is widely used to determine water, coolant contamination and foreign particle present in the lubricating oil. It is also used to identify and monitor the build up of oxidation products. A differential spectrum can be obtained by subtracting the spectrum of the new lubricant form that of used lubricant to clearly reveal the area of change.

2.2.2 Oil Analysis

There are many test can be done in order to do the oil particle analysis. The test is different for different aspect of the oil. By doing different test, we can obtain the different types of wear and contamination. That why different test is done for different aspect of oil. The test is divided into several types that are physical testing and spectroanalysis.

2.2.2.1Physical Testing

The physical testing is divided into two types that are viscosity and water content.

(a) Viscosity

The viscosity test measures the thickness of the oil. The oil is heated and run through the viscosity bath. The results are then compared to the new oil specification. This test is valuable in determining the condition of the oil and an indicator of water contamination and oxidation.

(b)Water Content

Water content above 1% is detected in the basic oil analysis.

2.2.2.2Spectroanalysis

Spectroanalysis is the analysis of the metal content and additive package. This test checks 19 elements and reports them in parts per million. These numbers represent the elements less than 5 microns in size. The spectrometers design limits its detection level to 5 microns and below. To evaluate the particulate larger than 5 microns, other test methods must be implemented. The spectroanalysis is used to look for bearing or bushing wear in the form of copper, lead, or tin. The spectroanalysis also looks at dirt levels in the form of silicon. Wear in pumps, housings, and other points of contact can be evaluated using this information. It is important to remember that these are small particulate. If there are large particles of metals in the oil, larger than 5 microns, the spectroanalysis will not detect them. The larger particulate will be detected in the particle count and or the filter

analysis, if the particulate are large enough. The additive package of the oil can be identified and evaluated using the spectroanalysis.

2.2.2.3Particle Analysis

The particle count is the single most important part of the report to measure the efficiency of the system filtration. The particle count measures all particulate in the oil larger than 5 microns. Particulate include dirt, carbon, metals, fiber, bug parts, etc. The particle count can be done using either laser (automated mechanical method) or optical methods (manual optical method). The laser method reports the quantity, size and distribution of particulate, but not what they are. The optical method gives a quantity, size, distribution and identification. Through the use of the two methods, we can provide the most representative analysis available.

(a)Laser (automated mechanical method)

This is the common method use in doing the particle analysis. This method employs a particle counting machine that uses some form of laser beam or light source to count the particulate.

a) Advantages

i. Easy to perform
ii. Requires limited technician training time
iii. Provides automatic graphing capabilities
iv. Fast

b) Disadvantages

i. Cannot count samples with high water content
ii. Some use high dilution factors that decrease accuracy
iii. No identification of particulate composition (What type of particle is it?)
iv. Photograph of contamination is not possible

(b) Optical methods (manual optical method)

This method is a method that follows Aerospace Recommended Practice ARP 598 and the particulate are then counted and identified using high power microscope.

a) Advantages

i. Can count samples with high water content
ii. Uses little or no dilution factor to increase accuracy
iii. Identifies the type of particulate
iv. Photographs of contamination are possible

b) Disadvantages

i. Requires highly trained staff
ii. No automated graphing system

2.2.2.4Other Test

Other tests are needed for some systems that have a low tolerance to water content or acidity levels. Additional testing is required in these situations. The following is a brief description of additional tests and the information they provide:

(a) Water by Karl Fisher – ASTM D-1744

This test is measuring water content down to 50 parts per million, which is .005%. It is used in turbine system analysis, servo systems and any other system that has low tolerance.

(b) Total Acid Number – ASTM D-664

This test measures the acidity level of a system. Over time the acidity level of the system increases. This can be detected with this test. In addition, some forms of contamination can also increase the acidity levels.