UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AN APPLICATION OF MICROPERFORATED NOISE SILENCER

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of
Mechanical Engineering Technology
(Maintenance Technology)(Hons.)

by

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TAJUK: **DESIGN AN APPLICATION OF MICROPERFORATED NOISE SILENCER**

SESI PENGAJIAN: **2015/16 Semester 1**

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Maintanance Technology) (Hons.). The member of the supervisory is as follow:

…….

(Ahmad Yusuf Bin Ismail)

ABSTRACT

Environmental noise is an issue that can affect human health. The solution is already represented and created, but the innovative idea is not contribute to the environment. This is due to the design of synthetic porous as acoustic silencer used in the industry. Therefore, this project found the alternative sustainable and environmentally friendly as silencers using micro perforated panel (MPP), which can reduce the noise. MPP selection was not only because of the green alternative but gives the results of accumulation from research literature on the silencer, which has been analyzed by researchers earlier. From there, a silencer with micro perforated panel application that green alternatives was designed and fabricated to surpass the problem of synthetics porous silencer. Test silencer will be made based on the industrial noise standards regarding sound insertion loss (SIL). The result was excellence which the noise transmitted through the silencer reduced drastically and tremendously after the sound of noise energy is removed due micro-perforated panel (MPP) and combination of reflection loss inside silencer.

ABSTRAK

Kebisingan adalah masalah persekitaran yang boleh menjejas kesihatan manusia. Penyelesaian sudah ada diketengahkan dan dicipta, namun idea inovatif tersebut tidak menyumbang kepada alam sekitar. Hal ini disebabkan oleh rekaan yang menggunakan bahan sintetik yang berliang sebagai penyenyap akustik yang digunakan dalam industri. Oleh itu, projek ini bertujuan mencari alternatif yang mampan dan mesra alam sebagai penyenyap bunyi dengan menggunakan panel berlubang mikro (MPP) yang boleh menggurangkan bunyi bising. Pemilihan MPP bukan hanya disebabkan alternatif hijau tetapi ini adalah hasil daripada pengumpulan kajian literatur mengenai penyenyap yang telah dianalisis oleh pengkaji-pengkaji terdahulu. Dari situ, sebuah penyenyap dengan aplikasi panel berlubang mikro yang alternatif adalah hijau direka dan difabrikasi untuk mengatasi masalah rekaan penyenyak sintetik berliang. Ujian penyenyap akan dibuat berdasar piawaian kebisingan tahap industri iaitu berkenaan kehilangan sisipan bunyi (SIL). Hasil yang sangat baik dimana kebisingan yang dihantar melalui penyenyap banyak berkurang malah dengan drastik selepas kehilangan tenaga bunyi yang dihilangkan pada panel mikro berlubang (MPP) dan juga kehilangan tenaga bunyi bising melalui kaedah pantulan dalam penyeyap.

DEDICATIONS

To my beloved family,

My supervisor,

and to all my friends,

Thanks for all support and ideas.

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Assalamualaikum w.b.t

Very grateful to Allah S.W.T because of Allah S.W.T endowment, I can execute this Final Year Report at the right time. I would like to take this opportunity to express my deepest heartfelt and thank to all those who have guided and supported me during my Final Year Project either directly or indirectly.

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LIST OF SYMBOLS AND ABBREVIATIONS

IL	=	Insertion Loss
LP_1	=	Sound Pressure Loss before Silencer
LP_2	=	Sound Pressure Loss after Silencer
NRI	=	Noise Reduction Index
Po	=	Acoustic Pressure obtained from the Microphone
P_{ref}	=	Reference Pressure
SPL	=	Sound Pressure Level
SPL_b	=	Sound Pressure Level of Compressor without Noise Barrier
SPL_o	=	Sound Pressure Level of Compressor with Noise Barrier
STL	=	Sound Transmission Loss
dB	=	decibels
g	=	gram
Hz	=	Hertz
kHz	=	kilohertz
mm	=	millimetre
mA	=	milliampere
Pa	=	pascal

CHAPTER 1
INTRODUCTION

1.1 Noise

Noise is a disturbance sound that can effect on physically and psychology. Characteristic of noise that people will hear and noticeable are tones or in another word is level of sound alter. The greater outstanding tone and greater sudden level of sound alter, the result influenced more significant noise. When measure the noise, the important thing need to know the type of noise. Thus, the parameter to measure can be determine, also the instrument used and measurement period. Usually noise firmly decide by human sensors is without making measurements and analyzing (Bruel, 2000).

1.1.1 Continuous Noise

Continuous noise or persist noise is produced by machine which in operation unaccompanied by interruption in the same mode, such examples compressor, pumps, blowers and other equipment process. Measures just need few minutes with operated without electricity are adequate to determine level of noise. In case the tone or sounds small frequency, the noise spectrum in frequency can measure for data and future noise analysis. Figure 1.1 show continuous noises.

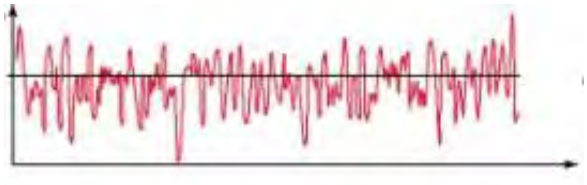

Figure 1.1: Continuous Noise (AEC, 2011).

1.1.2 Intermittent Noise

If the machine runs in cycles, or when single vehicles and aircraft gone, and reduced noise levels increase quickly. For each cycle engine intern source of noise, loudness levels can be measured just only in continuous noise. However, duration of frequency should be considered. Each vehicle passes by or aeroplane is called the events. Order to measure noise of an event, the noise exposure level is measured, combining duration and level into a singular parser. Maximum noise pressure level also can be used. Several the same events scalable for create a credible balanced. The Figure 1.2 had shown an intermittent noise spectrum.

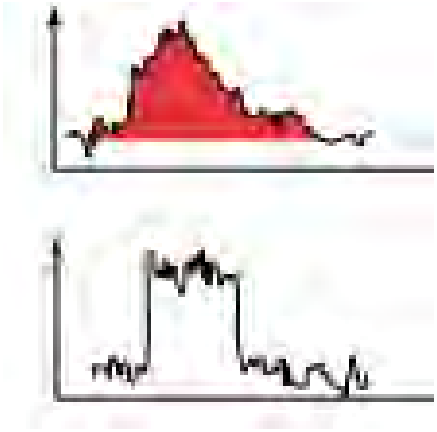

Figure1.2: Intermittent Noise Spectrum (Rashid, 2013)

1.1.3 Impulsive Noise

The sound of impact or explosion, for example, from a gunshot, pile driver or punch press, called as impulsive noise. It is concise and drastic, also the reasons for the shocking effect rage greater than expected from a simple measurement of sound stress levels. For quantities impulsive noise, the difference between responds in quickly and gently parameter can be used to respond as shown in Figure 1.3.

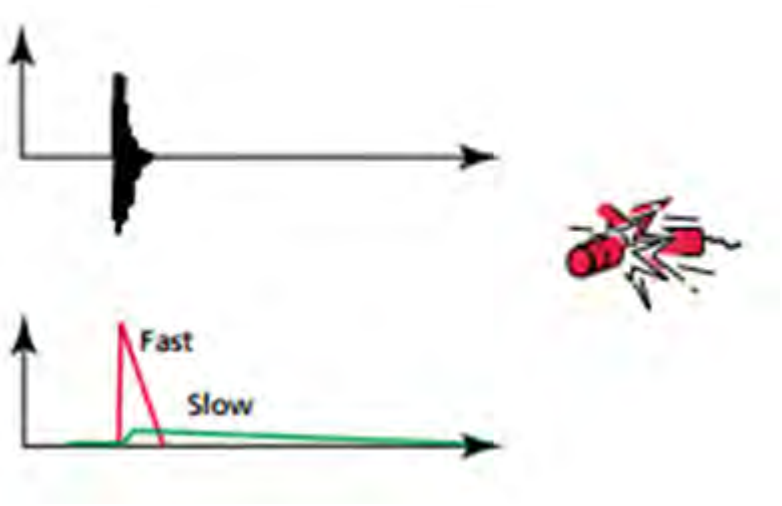

Figure 1.3: The difference between responds quickly and gently parameter (Rashid, 2013)

1.1.4 Tones in Noise

Noise tones are designed in two scenarios in machinery with rotating parts such as gearboxes, motors, pumps and fans often create tones. The impact on the disproportionate impact and repetitive is due to vibration transmitted through surfaces into the air and tone can be heard. Liquid and gas flow rate can also create tones, caused by combustion processes and blockage. The tone is identifiable a subjective basis by listening, and objectively using in frequency analysis. Audibility is the calculation by comparing the pitch level to the stage vicinity spectrum components. This can be seen in Figure 1.4.

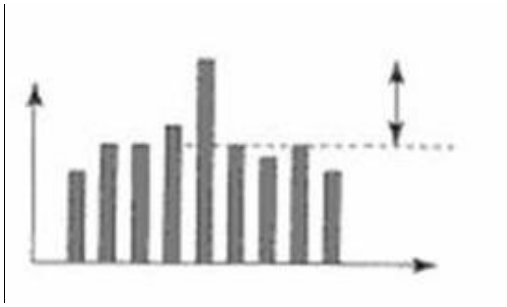

Figure 1.4: Tones in noise (Rashid, 2013)

1.1.5 Low Frequency Noise

Low frequency of noise as shown Figure 1.5 has a substantial acoustic energy in the frequency band from 8 until 100 Hz. Noise in this it is typical for a ships, power plants, in trains, and huge diesel engines also for noise which is hard to dim and spread easy out in all directions, it could be called for miles. Low frequencies sound is more irritating than fine-weighted noise pressure. To suppose audibility of low frequency sound components, the spectral are measured and compared with the entrance of hearing. Infrasonic has a spectral with substantial components below to the 20 Hz.

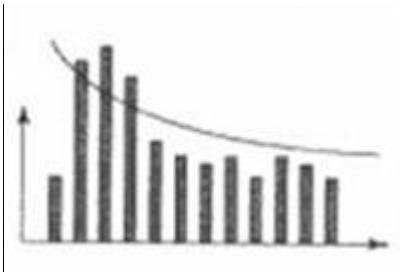

Figure 1.5: Low frequency noise (Rashid, 2013)

1.2 Noise Control Strategy

1.2.1 Silencer

A silencer is essential in control of noise element. It ability reduce in fan noise, machinery exhaust noise and also other noise of sound sources such as stream of gas. The other is sound barrier also, can be defined as an element in the flow channel that acts to reduce noise transmitted along the duct while allowing the free flow of gas through the flow channel. (Barron R. F., 2003)

According to Lewis, 1993 the main function of silencer to reduce the noise to an acceptable level which is not annoying for people to listen. It can reduce the sound energy by absorbing to types of material used inside of silencer which is known as sound absorption control. Besides that, noise can be reduce by sound transmission loss (STL) which is the power of sound ratio of the pressure wave at the inlet of the muffler to the power of sound transmitted pressure wave at the outlet of the muffler. Sound transmission loss used in muffler because mufflers achieve a good performance and effectiveness of loss the sound in the system.

Nowadays, the world shows the silencer is very important in usage. It currently used in automotive, industrial and special defend. In automotive silencer is used in vehicle exhaust system. It can reduce combustion noise and on modern vehicles now can also reduce harmful pollutants in the exhaust stream. Furthermore, in industrial silencer is installed within the equipment room as close as practicable to the exhaust outlets of the diesel engines. Also, silencer is made of double wall, welded sheet steel construction. Other than that silencer used in civil defence force. It is known as firearm sound suppressor which be necessary on any blower installation as gun. It helps reduce the noise of gunfire hearing safe levels when attached to the end of firearm barrel (Barron and Randall, 2003).

1.3 Problem Statement

Most manufacturers today produce anti-noise system which is mostly made from synthetic porous material that is not really suitable for the human health and the environments. In this study, the idea is to use green alternative silencer as a mechanical compound which have a characteristic of an eco-friendly and sustainable material to loss the noise transmission. With the combination of this metal material and the commercial absorber, the best mix composition to optimally suppress the noise as well as to reduce cost in production process will achieve.

1.4 Objectives

i. To fabricate a novel design of silencer by using micro perforated panel application.

ii. To test a novel design of micro perforated silencer intern of reflection loss.

1.5 Scope

i. Fabricating a novel design of silencer by using micro perforated panel application.

ii. Testing the performances and effectiveness a novel design by using micro perforated panel

CHAPTER 2
LITERATURE REVIEW

2.1 Silencer

Silencer is the device used to reduce the excessive sound energy. It decreases the input sound transmitted pass through the medium or panel to produce the output sound that is pleasant to environment and surrounding. It easily found at the exhaust of motor vehicle to reduce engine noise and to reduce the sound of the gun when fires up. The performance can be determined in four criteria such as insertion loss (IL), shell transmission loss (TL), self noise (SN) and pressure drop (ΔP) (Jim and Bill, 1993).

There are few type of silencer such as dynamic insertion noise (DIL), self noise (SN) and absorptive or dissipative silencer. Dynamic insertion noise (DIL) is a test insertion loss with the air flow involved. At higher line speeds by static entry loss can vary from a dynamic insertion loss with small margins, depending on the air flow direction compared to the direction of propagation of sound. For ordinary velocities associated with HVAC systems, static insertion loss and dynamic insertion loss is almost the same and can be considered the same. Besides that, self noise type (SN) is the sound power level in decibels produced by the sound when put in the air flow. The SN depending on the direction of flow that in forward or reverse (Owen and Mark, 2005).

Next, for the absorptive or dissipative silencer is using noise absorbing materials to weaken sound wave. Dissipative silencers widely used in the HVAC channel system. Dissipated silencer baffles ordinary configured in a parallel arrangement which can be seen in Figure 2.1. The acoustic baffle layer thickness is selected with reference to the main frequency sounds. Partly incident sound energy is converted to heat by causing the movement of the fibers in the passage through the material. Absorbing silencer including attenuators lined channels, wrapped cylinders