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COMPARISON BETWEEN COMBINATION SILENCER AND SINGLE TYPE
SILENCER FOR TWO-STROKE NOISE REDUCTION AND ITS EFFECT ON
ENGINE POWER CURVE.

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I declare that this report is my own work except for any summary or quotation from every single source is explained.

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To my beloved parents, family and friends.

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ABSTRACT

Combustion process in the internal combustion engine produces sounds. As for two-stroke internal combustion engines, the sound that were produce is higher compared with four-stroke engine. To minimize the sound produced from the engine, single type and combination type of silencer are used. This project is done to compare between the single type silencer and combinational type silencer on an A two-stroke engine experimentally by fabricating and test the actual sound produce by the silencers. The silencers effect to the engine power performance is also being tested on a dynamometer.

ABSTRAK

Proses pembakaran di dalam enjin pembakaran dalam menghasilkan bunyi. Untuk enjin pembakaran dalam dua-lejang, bunyi yang dihasilkan adalah lebih besar berbanding enjin empat lejang. Oleh sebab itu, peredam bunyi jenis tunggal dan gabungan digunakan untuk mengurangkan bunyi yang dihasilkan oleh enjin dua lejang tersebut. Kerana itu, eksperimen akan dilakukan untuk membandingkan peredam jenis tunggal dan gabungan terhadap enjin dua lejang. Malangnya, ini akan memberikan kesan kepada kuasa enjin dalam menghasilkan peredam jenis baru. Oleh itu, kajian terhadap kuasa enjin turut dijalankan untuk dinalisa dalam eksperimen ini.

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LIST OF SYMBOLS

p^{in}	= Sound wave from the source.
P^{r}	= Sound wave that was deflected.
P^{tr}	= Sound wave produced.
S	= Cross sectional area.
N_{h}	= Number of holes.
A_{h}	= Area of a hole.
A_3	= Sectional area of the pipe.
X	= Ratio number.
L	= Sound level (dB)
P	= Sound pressure at the measured place. (u bar).
P_o	= Pressure of air ($2 \times 10^{-4} u$ bar).
P_{Kw}	= Power in kilowatts.
$\tau_{\text{N}\cdot\text{m}}$	= Torque in Newton meters.
ω_{rpm}	= Rotational velocity in revolutions per minute.
L	=Length of the silencer,
D	= Diameter of the silencer,
d₁	= Diameter of the pipe,
l_{1out}	= Length of inlet outer pipe,

l_{1in} = Length of inlet inner pipe,

l_{2out} = Length of outlet outer pipe,

l_{2in} = Length of outlet inner pipe

CHAPTER I

INTRODUCTION

1.1 Project background.

This project is done to compare between a single type silencer of diffusion, absorption and a combinational type silencer diffusion and absorption. To do this, the silencer is fabricated and mounted to a two-stroke internal combustion engine where the effect of the sound produced from the silencer is experimented. Other than that, the effect on engine power also will be experimented.

In this project, the silencer is mounted on an 110cc two-stroke engine. The reason for choosing two-stroke engine is because this type of engine produces very high sound and considered a nuisance or a sound pollution. This has caused a large problem around the world. In Canada, the uses of snowmobiles which use two-stroke engines are prohibited by the court of Cuebec in the Mont-Tremblant due to the complaint by the residents who lives near the roads. Thus, this has caused the tourism industry near the mountains in jeopardy (Surpenant et al. 2005). Thus, this project will be done to compare what kind of silencer is the best between a single type and combine type of silencer.

The focus of this project is to run an experiment by making single type silencer (*diffusion* and *absorption*) and several combination type silencers (*diffusion* + *absorption*). Every silencer will be mounted to an 110cc motorcycle engine where the noise of each of them will be taken before and after various installations. Then, a dynamometer test will be done to see the effect of the silencer on the engine power. The best silencer will be chose after all the analysis is done.

1.2 Importance of the project.

Sound that is produce from an internal combustion engine especially from a two-stroke engine has become a problem especially in the European and northern American countries. It says that the noise produce from these engines are disturbing the wildlife and nearly banned especially in national park because it is usually used in the snowmobile. Therefore, the silencer has become our main focus in this project to reduce the noise emissions that is produces from the two-stroke engine. To reduce the noise emissions, an experiment will be done with a single type and combinational type silencer with an actual two-stroke engine. In theory, the combinational type silencer can reduces the engine noise, whether the low, medium, or high frequency better than the single type silencer. The engine power also will be test to study the effects on the two-stroke engine.

1.3 Objective.

The objective of this project is to study the effect of a single type and combinational type of silencer (diffusion and absorption) towards noise reduction of the two-stroke internal combustion engine and its effect on engine power curve experimentally.

1.4 Scope.

There are several scopes that need to be followed:

- Finding a suitable two-stroke engine.
- Produce silencers (based on suggestions from PSM 2 2008/2009).
- Study the engine noise before and after various silencer installations (experimental).
- To produce rig for dynamometer testing.
- To study the effect of silencer on engine power (experimental).

1.5 Problem statement.

This project is done to produce a silencer which is effectively to reduce the noise of a two-stroke engine. The noise which was produce from a two-stroke engine is very loud compared to a four stroke engine. Therefore an experiment is done to compare between a single type silencer of diffusion silencer and absorption silencer

with a combination of both diffusion and absorption type silencer. After that, an experiment of the effects on the power of the engine is also tested.

CHAPTER II

LITERATURE REVIEW

2.1 Types of Silencer

Silencer or also known as muffler is device that reduces amount of noise that is produce by a machine, in this case an engine. There are many types of silencer in the market, but there are three basic types of silencer, diffusion, absorption and resonance. For this project, we will only focus on experimenting diffusion, absorption, and combination of these silencers.

2.1.1 Diffusion Silencer.

Diffusion silencer works as a sound deflector which produced by the wave sources. The sound from the source will go through a small pipe which then enters a

closed cylindrical chamber before entering to another small pipe at the end of it. Here is where the sound will be deflected by the sound wave from the engine simultaneously due to the different of cross section area that the sound wave has to go through.

The standard design for a diffusion silencer basically has an inlet pipe, a closed cylindrical chamber and an outlet pipe. This type of silencer is widely used for all internal combustion engines especially cars and motorcycles. It's effectively muffled sound at low frequency which is suitable for a high performance engine and can withstand a low reversal pressure.

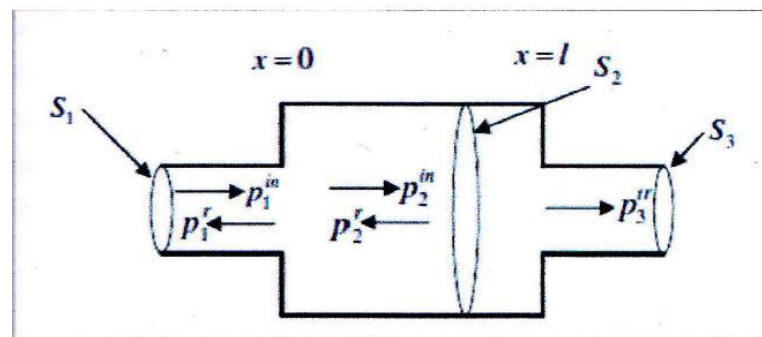


Figure 2.1: Sound wave reflection inside the silencers chamber (Josh Seslar, 2005).

2.1.2 Absorption Silencer.

Absorption silencer works as the sound wave from the engine went across the absorption materials such as rock wool, placed between the pierced exhaust pipe and the housing, which dissipates the exhaust gases energy into heat by its vibration. This happens when the sound wave went through the air holes between the absorption materials, where the air will rub against the absorption materials and the sound will

change into heat. With this we can eliminate the wideband noise at the medium and high frequency.

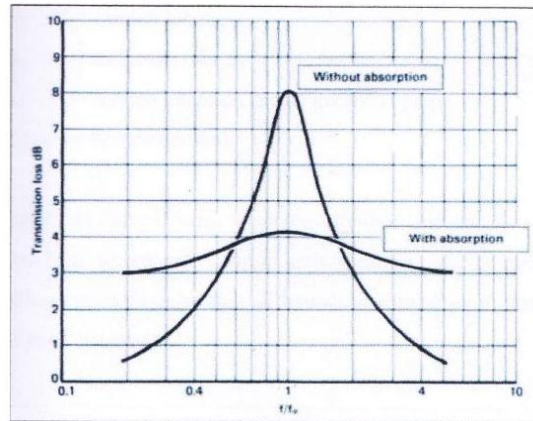


Figure 2.2: Transmission loss graph of silencer with and without absorption material (Taylor & Francis, 1991).

The silencer consists of absorption material which is placed in a closed cylindrical chamber with a hollow pipe in the middle. Selection of materials as an absorption device also plays an important role to make sure it can work properly. Usually it has a certain lifespan. Therefore the material needs to be replaced at a certain amount of time when it reaches its lifetime. If not, the silencer will not work accordingly or failed to work.

2.1.3 Combination Silencer.

Combination silencer is a silencer that consists of both absorption and diffusion silencers in one silencer. This is made to muffle both high and low frequency sounds but it depends on the characteristics of the silencers. Thus, the silencer can muffle more sounds better and become much more effective. Thus type of silencer is a