بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
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MONA MAGHRABY

Ain Shams University
Faculty of Women for Arts,
Science and Education
Physics Department

Investigating the Geometrical Distribution Effect of Micro-Perforated Panel Orifices on its Acoustic Behavior

A Thesis

Submitted By

Hatem Khalaf Mohamed Teleb

M.Sc.of Science in Physics

To

Physics Department,

Faculty of Women for Arts, Science and Education,

Ain Shams University

For the degree of Doctor of Philosophy of Science in Physics

Supervised by

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(2021)

Ain Shams University
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Approval Sheet

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The Degree of Doctor of Philosophy of Science in Physics

This Thesis has been approved by Supervisor committee

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Dedication

For my Father's soul , my Mother and my Wife

Thesis Summary

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Title of Thesis: Investigating the Geometrical Distribution Effect of Micro-Perforated Panel Orifices on its Acoustic Behavior

Institution: National Institute of Standards – Acoustics Department.

Noise pollution has become one of the most pressing concerns affecting humanity in recent years, as it has a negative impact on both mental and physical health, as well as posing psychological dangers.

Development an effective technologies to combat all types of pollution is one of the principal axes of the Egyptian 2030 strategic plan in order to work towards sustainable improvement of quality of life and raising awareness about the protection of the environment and providing clean and healthy surroundings.

To satisfy this necessity, a lot of eco-friendly studies are being done in many fields. This trend is also obvious in the field of acoustics, where there are great efforts to replace the traditional sound absorbing materials such as porous and fibrous sound absorbers with fiber-free materials such as micro-perforated panel absorbers (MPP).

MPP is regarded a promising absorber for noise reduction because it has a lot of benefits for instance; high strength, good wash-ability, elegant appearance, low manufacturing costs and can be used in severe environmental circumstances. They consist of a distribution of minute orifices of diameter "d" on a panel of thickness "t" with perforation ratio "σ" in front of an air layer of thickness "L". Where, these parameters are controlling the value of the sound absorption coefficient, and the bandwidth of the frequency range of interest.

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The purpose of this study is to obtain a wideband low frequency sound absorber. And that can be satisfied by investigating theoretically and experimentally the effect of geometrical distribution pattern of orifices (holes) on the panel surface, geometrical hole shape, hole diameter, perforation ratio, panel thickness and interstitial air gaps on the acoustic behavior of single and double metal MPP sound resonators.

Maa's theoretical model was used to calculate the acoustical properties of designed MPP absorber resonators which perforated using laser technique, and experimentally validated using a two-microphone impedance tube method over the frequency range from 100 Hz to 1000 Hz. The experimental measurements were carried out according to ISO 10534. Also, the reverberation time of the best model that provided the optimum sound absorption was measured in the reverberation room.

For an application in severe environment, standing wave tube according to ISO 10534-1 will be established in order to study the influence of heat on the sound absorption ability of MPP resonators.

Thesis outlines:

Chapter one

Introduced the physics of sound, the negative effects of noise on human, and strategies for noise control. It also provided the different types of sound-absorbing materials, their work mechanisms and some of the used applications. At the end of this chapter, the aim of this study was reviewed.

Chapter Two

Introduced the theoretical aspects of single and double micro-perforated panel sound absorbers and the theoretical considerations regarding the

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methods used for measuring the sound absorption coefficient. Moreover, it provided a review of previous studies regarding the thesis subject.

Chapter Three

Introduced the preparation and design of the measured MPP resonators, MPP samples specifications, designing the single and double MPP resonators and the used technique in drilling the MPP samples. Also, it described the measuring methods and instruments that are used in the sound absorption coefficient measuring of MPP resonators.

Chapter Four

Introduced the theoretical and experimental results of the effect of the geometrical distribution patterns of holes and the influence of geometrical hole shapes on the sound absorption behavior of single and double MPP resonators. As well as the reverberation time of the best model that provided the optimum sound absorption was measured in the reverberation room. For an application in severe environment, standing wave tube according to ISO 10534-1 was established in order to study the influence of heat on the sound absorption ability of MPP resonators.

This thesis concluded that the acoustical properties of the best model which provided the optimum sound absorption in the frequency range of interest are not affected by high temperatures, which means that it is preferred to be used in the automotive industry. Also, the multiple measurements on each sound absorber contributed to obtaining high measurement accuracy. And reduce the errors of measurement and thus improve the estimated uncertainty value.