This paper investigates by experiment the absorption characteristics of several materials associated with the proposed acoustics impedance method using the combination of sound pressure and particle velocity sensors in various sound fields. This method is based on the concept of "ensemble averaged" surface normal impedance that extends the usage of obtained values to various applications such as architectural acoustics and computational simulations. The measurement technique itself is an improvement of the method using two-microphone technique and diffused ambient noise. A series of measurement in different sound fields was conducted to expand the relevant applicability of in-situ measurement using pu-sensor. The first part of the experiment aimed to confirm the reproducibility of the measured values of the method. Here, comparative round robin measurements in four reverberation rooms were conducted. The general tendencies and discrepancies of ten materials in the various reverberation rooms are discussed. In the second stage, the method was applied with four types of selected materials to examine material’s absorption characteristics at different sound fields such as in architectural spaces. This paper revealed the reliability, applicability and robustness of the method despite the room’s geometrical differences throughout the in-situ measurement.

INTRODUCTION

There are two well-known methods of laboratory measurement of absorption which have been described as international standards [1]–[3] in providing important information about the test material (i.e. reverberation room and tube method). A number of studies [4]–[9] have been conducted in order to check the effectiveness of the standards. In Europe, a set of round robin test was carried out in the past decade to investigate the accuracy of the measurement of the reverberant sound absorption coefficient [4]. Nevertheless, there still remain unresolved issues e.g. diffusivity in the reverberation room, edge effect of specimen, etc. Another series of round robin tests were carried out in Japan [5]–[6] to look into some of the aforementioned problems. Differences of measurement values due to the room volume, measurement instruments, etc. were kept central to the investigation to maintain a satisfactory level of accuracy.

Meanwhile, the accuracy of the performance of the tube method has also been reported [7]–[9]. Horoshenkov et al. [9] presented the dispersion of measured normal incident results of inter laboratory reproducibility experiments of the acoustical properties in Europe and North America. They highlighted the importance of the boundary conditions, homogeneity of the porous material structure and stability of the adopted signal processing method. However, similar mounting conditions are difficult to reproduce and this may affect the measured results.

In our previous paper [10], the theoretical development and concept of ensemble averaged surface normal impedance at random incidences were given. Several boundary element method (BEM) simulations of glass wool both at normal and at random incidences showed that ensemble averaging decreases the interference effect caused mainly by the specimen’s edges. The BEM simulation with anisotropy consideration [12]–[14] is compared with the measurement result to give an appropriate expected value of the surface normal impedance of the glass wool. Also, a series of measurements by proposed method using pu-sensor (Microflown, [15], [16]) is presented to investigate the considerable geometrical configurations e.g. the sensor height, and the sample size, in measuring the acoustics behavior of absorptive material [11].

Method reliability is one of the factors that needs to be taken into consideration while aiming toward an efficient in-situ