



iARG Advance in Power Generating Sound Absorber

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ABSTRACT

Advance on development power generating sound absorber at iARG Physics Department Sebelas Maret University is presented. This iSAE code innovation is based on previous SPACYX technology which is featuring full spectrum sound absorber ability. iSAE has significant advantages compared to the existing similar technology. Its specific inner structure resulting higher fluctuation inside resonator cavity that drives piezoelectric membrane vibrates with higher amplitudes. This innovation has a very promising application especially for transportation and room acoustics for solving noise and renewable energy problem in a single comprehensive solution.

INTRODUCTION

Demand on effective noise control technology was increased according to the environmental issue and its health impact. In the other side, searching on new renewable energy innovation due to the limitation of fossil energy availabilities shows a significant growth in various kind and technologies.

Vibration based energy harvesting system is one of such innovation that currently facing very promising applications due to the advance on smart material and ceramic technology. Current achievement on nanopiezotronic researches including nanopiezowire for example, giving higher possibility for convert low strain into electricity^[1-6].

The most interesting challenge is then providing new technology that can solve both noise and green energy problems in a single comprehensive solution. This means a high performance sound absorber featuring vibration and noise driven power generating abilities.

SOUND ABSORBER INNOVATION

Research on noise reduction especially in low frequency range has been done by many researchers. Birdsong and Radcliffe improve acoustic response of a system by combination static resonator with active controller. Similar technique also utilized by Ross, and Randeberg which is resulting noise reduction up to 6 dB in 560 Hz – 670 Hz range.^[7-9]

Different approach provided Avilova by using porous metal for achieving a good performance on reducing noise below 200 Hz. Castagnede analysing the influence of compression on the absorption coefficient of porous layer, while Abrahams and Gorrenberg et al using perforated layer technique for similar purposes. Energy distribution based theoretical analysis and experimental approach on utilising parallel plate is conducted by Craig and Smiths and Fuchc et al respec-

tively that indicates a good performance for below 100 Hz.^[10-15]

The entire approach above has their own limitation especially related to its performance that works effectively only in a narrow frequency ranges and has no full spectrum sound absorption features.

Such full spectrum feature later includes in after market product Modex Plate of RPG Diffuser US. This product works on the principle of multilayer absorber. Similar feature also appears in US Patent 7395898 and in iARG SPACYX technology respectively.

SPACYX works on similar principle to mentioned US patent, but its structure consists of array pyramid shaped Helmholtz resonator. This innovation working well with the almost flat sound absorption coefficient up to 0.85 starting from 200 Hz.^[16,17]

ENERGY HARVESTING FEATURES

Energy harvesting features in a sound absorber introduced by Sheplak et.al, Horowitz, and Marion et al respectively. Noise induced power generating mechanism is related to the resonance of Helmholtz resonator which is contain piezoelectric compliant backplate and membrane inside its cavity respectively.^[18-21]

These innovations still has two limitation related to the working principle of Helmholtz resonator. The sound absorption ability is limited to narrow frequency range while tube shaped neck structure giving limited resonant amplitude especially when dealing with low sound pressure level disturbance.

Solution to such limitations then provided in iARG Sound Absorber with Energy Harvesting Element (iSAE) technol-

ogy. iSAE is a SPACYX-based sound absorber with giving it a very good full spectrum sound absorption performance. The other advantage is related to its specific shaped extended neck structure that working as noise disturbance booster for giving higher resonance amplitude inside resonator cavity and drive a higher vibration amplitude of pizeoelectric membrane.^[22]

The sound absorption performance is depicted in Figure (1) while inside cavity pressure fluctuation comparison between standard Helmholtz resonator and iSAE is depicted in Figure (2). This specific inner structure increase pressure fluctuation inside the cavity up to 2dB or hundred times to that one of conventional Helmholtz resonator.

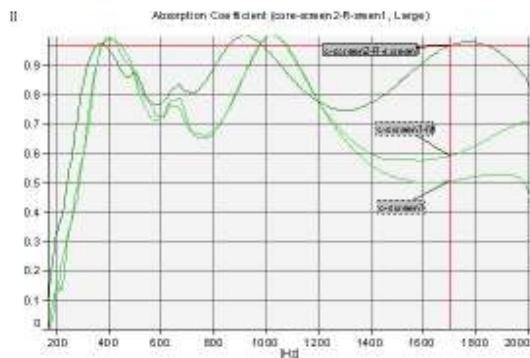


Figure 1. Sound absorption performance

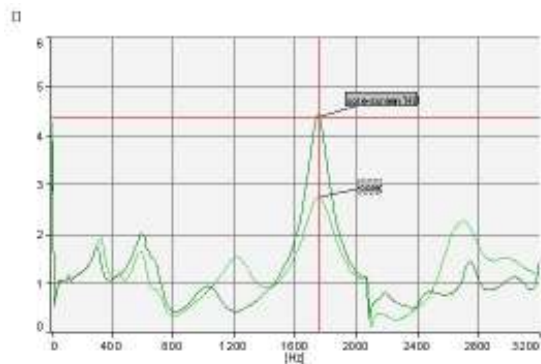


Figure 2. Inside cavity pressure level

Energy harvesting ability was analysed by using Mide Piezoelectric Energy Harvesting Element fitted inside iSAE cavity. The testing has conducted in two modes, acoustics driven by using impedance tube with random noise, and random vibration mode by using small exciter as vibration source. The maximum output is 1,2V and 5V respectively.

These results indicate the very a promising opportunity for application of iSAE technology, especially for transportations and building acoustics. The advantages could be more valuable with emerging advance on nanopiezotronic technology and ultrabright LED with iSAE. It would giving new opportunity for development of self sufficient energy system for lighting purposes in passenger car or train, and in the same time providing better comfort with its ability on noise absorption performance.

CONCLUSION

Research on power generating sound absorber has a very promising opportunity. It giving comprehensive solution for noise problem and in the same time providing smart solution for eco friendly life style, even it has a good commercial prospect.

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