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Experimental Investigations on Noise Reduction of Centrifugal Blower with Rectangular Splitter Silencer

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Abstract—*In this work, experimental investigations on noise reduction of centrifugal blower are carried out. So, in order to reduce this noise generated by centrifugal blower, dissipative rectangular splitter type of silencer is used. Acoustic silencers are devices used to attenuate or absorb the air born sound waves propagated in flowing medium. Dissipative silencers uses a sound absorbing material to attenuate the sound waves. These types of silencers are commonly used in ducts to attenuate broadband noise emitting from an air moving device such as blower. The blower used in dissertation work, has 88.72 dBA Sound Pressure Level. This Sound Pressure Level is reduced with rectangular splitter silencer attached at the outlet duct. Noise reduction is done at attenuating octave band centre frequency 1000 Hz and at some other octave band frequency like 63 Hz, 125 Hz, 500 Hz, 2000 Hz and 4000 Hz. The silencers are designed for different configurations with 40 % and 80 % silencer open area, 500 mm and 900 mm length of silencer and Puff and Rockwool as sound absorbing materials. The noise reduction by silencer 40 % open area, 900 mm length and Rockwool material is observed maximum. So, noise level for this silencer validated with the use of software ANSYS acoustic tools.*

Keywords: *Noise Reduction, Centrifugal Blower, Splitter Silencer, Open Area, Sound Absorbing Material.*

Introduction

In the industrial HVAC applications blowers play important role. Centrifugal blowers are used in pneumatic conveying, water and waste water treatment, petroleum and chemical industry, central vacuum systems etc. though they have clean oil free operations, low operating cost compared to air compressors they gives high noise level. This noise level should be controlled in order to get the smooth running of blower as well as to control the industrial noise pollution. So, the causes of generation of noise from the centrifugal blower are well known but the reduction of the noise generated by it has vital importance. So, in this paper there is noise reduction after its generation. So, experimental investigation of noise reduction with the use of rectangular splitter type of dissipative silencer at the outlet duct is carried out. Aim of this paper is to reduce the noise level of centrifugal blower used in agricultural waste plant having capacity 700 m^3 / hr and Sound Pressure Level 88.72 dBA by using rectangular splitter type of silencer at the outlet duct.

Performance Parameters of Splitter Silencer

There are several parameters, on which the performance of splitter silencer depends which are,

i. Length of splitters
ii. Thickness of splitters
iii. Spacing between splitters
iv. Thickness of absorbing materials.

Table 1: Specifications of Blower

Parameter	Value
Capacity	700 m^3/hr
Working Temp	30^0C
Impeller size	ϕ 400 mm
impeller speed	2880 RPM
Inlet Velocity of air	12.6 m/s
Outlet Velocity of air	8.1 m/s

Design of Silencer

Any silencer used in a duct system should fulfill certain criteria. So, in this work there is design of splitter silencer for the outlet duct having dimensions as 120 × 200 mm^2 areas. According to theory studied a family of curves covering 25 %, 33 %, 40 %, 50 %, 66 % and 80 % open area ratios can be considered for the silencer area. But among these area ratios 40 % and 80 % has good results for noise reduction in one third octave band frequency. Rockwool and Puff material has more sound absorbing coefficient and economic. So in the work there is selection of Rockwool and Puff as sound absorbing material.

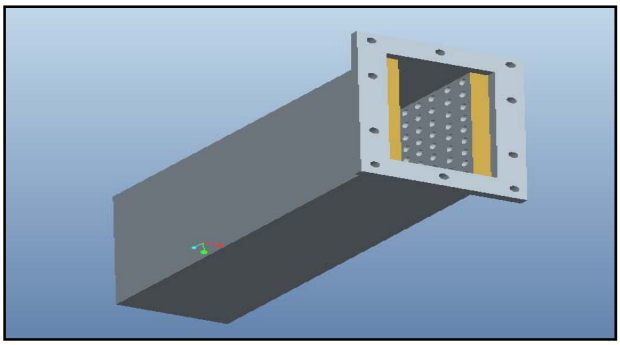

Figure 1: Modelling of 500mm length Silencer

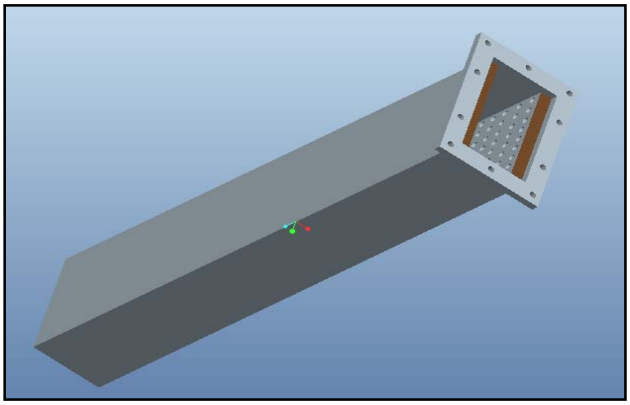

Figure 2: Modelling of 900 mm length Silencer

Experimentation

An experimental set up for noise reduction of centrifugal blower with splitter silencer is shown in figure 3. The Sound Pressure Level is measured by the FFT analyser.

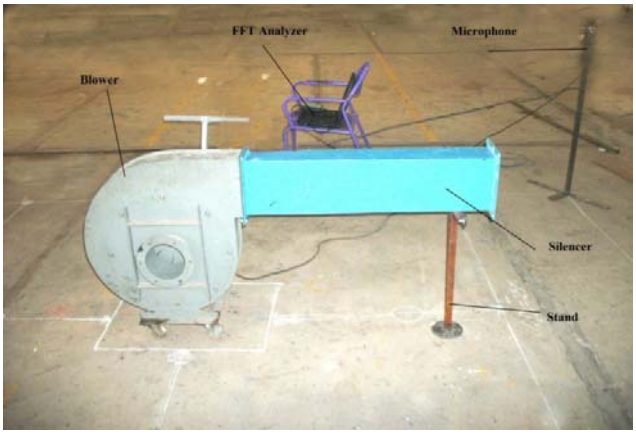

Figure 3: Experimental Set Up

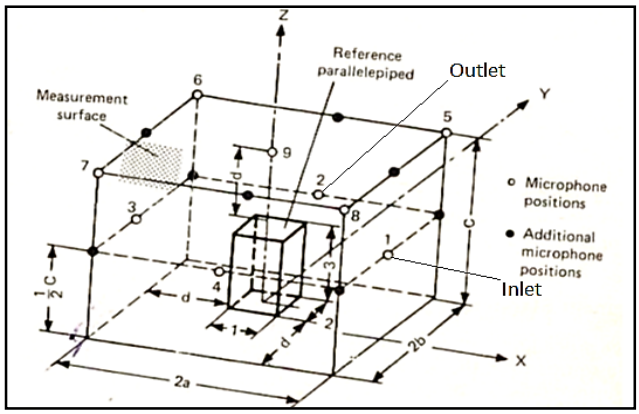

Figure 4: Microphone Position on the Imaginary Measurement Surface Area According to ISO 3744

Post-processing

At this stage the results of analysis are obtained numerically and graphically

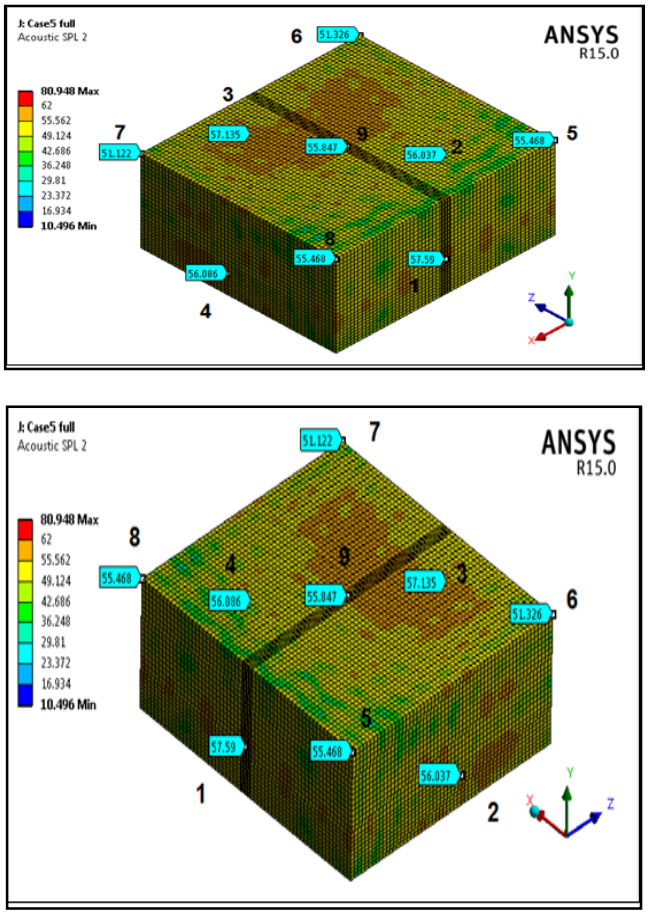

Figure 5: Validation of results by ANSYS software

Results

Table 2: Sound Pressure Level by Experiment and ANSYS software

Microphone Positions	Sound Pressure Level by Experiment (dBA)	Sound Pressure Level by ANSYS (dBA)
Position 1	60.28	57.59
Position 2	61.02	56.03
Position 3	59.05	57.13
Position 4	60.05	56.08
Position 5	61.41	55.46
Position 6	58.31	51.32
Position 7	59.65	51.12
Position 8	61.4	55.46
Position 9	62.95	55.84
Average Sound Pressure Level	**70.19**	**65.12**

Conclusions

The conclusions drawn from this dissertation work are as follows,

The maximum noise reduction is achieved with silencer of 40 % open area, 900 mm length and Rockwool material. Therefore this silencer is best suitable for the noise reduction of experimental blower. The maximum noise reduction is 18.53 dBA (26 %) for silencer with 40 % open area, 900 mm length and Rockwool material.

The maximum noise reduction is 15.84 dBA (21 %) for silencer with 40 % open area, 900 mm length and Puff material.

The difference in noise reduction with Puff and Rockwool material for 40 % open area and 500 mm length is 4.1 dBA.

The difference in noise reduction with Puff and Rockwool material for 40 % open area and 900 mm length is 2.69 dBA.

In the octave band center frequency, the noise reduction is maximum at the attenuating octave band center frequency 1000 Hz.From the lower octave band center frequency 63 Hz to attenuating octave band center frequency 1000 Hz there is increase in noise level. But thereafter for higher octave band center frequency there is decrease in noise level.

The sound absorbing material having greater sound absorption coefficient always gives better noise reduction. The noise level for silencer with 40 % open area, Rockwool material and 900 mm length is validated with help of ANSYS software, the average noise level is 65.12 dBA. The difference between experimental value and ANSYS value is 5 dBA.

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