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ARTICLE

Reducing Occupational Noise Propagated from Centrifugal Fan through Dissipative Silencers: A Field Study

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ABSTRACT

Acoustic performance of dissipative silencer was evaluated to determine the effectiveness of perforated duct porosity and absorbent material density in reducing occupational noise exposure propagated from centrifugal fan. Design charts were applied to predict noise reduction and length of a dissipative silencer. Dissipative silencers with various punched duct porosity (14%, 30% and 40%) and sound absorbent density (80 Kg/m^3, 120 Kg/m^3, and 140 Kg/m^3) were designed and fabricated. According to ISO9612 and ISO11820, noise level was measured before and after installing all nine test silencers at fixed workstations around the discharge side of a centrifugal fan in a manufacturing plant. On average, the noise level at the discharge side of a fan without silencer was measured to be 93.6 dBA, whereas it was significantly mitigated by 67.4 dBA to 70.1 dBA after installing all silencers. Dynamic insertion loss for a dissipative silencer with 100 cm length was predicted to be 27.9 dB, which was in agreement with experimental ones. Although, there was no significant differences between insertion loss of silencers, the one with 30% porosity and 120 Kg/m^3 rock wool density had the highest insertion loss of 26.2 dBA. Dissipative silencers noticeably reduced centrifugal fan noise exposures. Increasing sound absorbent density and duct porosity up to a certain limit could probably be effective in noise reduction of dissipative silencers.

KEYWORDS

Absorbent density; dissipative silencer; fan; noise; porosity

1 Introduction

Noise is one of the most common physical agents in work and living environment which can be accompanied with various adverse health effects such as hearing loss, communication and efficiency interferences, poor motivation, stress, fatigue, irritability, high blood pressure, and heart rate [1–3]. Noise generation in fans can be categorized as mechanically and aerodynamically. Mechanical noise which also is called non-aerodynamic noise is generated by failing in some mechanical components of fans like bearing, motor, fan unbalance and structural resonance. On the other hand, aerodynamic noise is predominantly caused by vortex generation, fan intake turbulence, fan geometry, and impeller rotation speed. Vortex noise is generated by pressure gradient and eddy formation on fan blades and solid surfaces. Turbulent air flow in fan and ducts connected to discharge and intake sides of a fan is another