

A Study of Noise Level with Acoustic Insulation Foam Applied to Hand Dryer

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Keywords: Noise Level; Acoustic Sound Proof; Hand Dryer

ABSTRACT – High airflow hand dryers as becoming common in public restrooms nowadays as an alternative to paper towels. However, the device is producing undesired noise that potential danger of hearing loss. The aim of this study is to investigate the effectiveness of noise produced by hand dryers with additional sound insulation foam. The noise insulation foam with the wedge and pyramid shapes and egg carton installed in the wall of hand dryer unit. Hand dryer noise (dB) was measured with a sound level meter at the nozzle. ANOVA was used to determine the significant difference of noise effect among each method statistically. The study shows the application of noise insulation form with any shape able to reduce noise from 85dB to 76 dB. The wedge shape insulation form was able to reduce noise emission significantly.

1. INTRODUCTION

High-speed hand dryers are widely used in public restroom. It produces high frequency noise which is undesired form of sound [1]. High level of noise can affect indirectly to the human being which prone to hearing problems [2]. In industries, it is crucial to find out effective yet harmless methods for noise control since noise is an occupational hazard to workers in a long run [3]. Generally, the fastest the hand-dryer air flow, the louder the sound will be [4]. Exposure to prolong unwanted noise causes stress, discomfort, and even worse disorder to an exposed individual, which may potentially affect their work performance [5]. The daily exposure limit for personal does not exceed 85 dB(A) [6]. Excessive occupational noise has a variety of negative effects, including lower efficiency, more difficult communication, permanent hearing loss, and a rise in health conditions and hearing-related injuries among workers [7]. Most of the modern hand dryer equipped with high velocity motor. Both fan speed and air jetting produce extreme noise level. If the high fan noise levels are inevitable, then ways to reduce the acoustic energy should be in consideration [8]. Study by University of Michigan and 3M Corporation's Acoustical Laboratory reported the commercial popular model of hand dryer produced 90-100 dB on noise [9]. Hence, many people want to reduce the noise level by adding soundproof panel and even the DIY and cheap methods by looking at egg cartons. Therefore, this study

is initiated to mitigate the noise emerging from hand dryer by applying these sound insulation methods inside the hand dryer body.

2. METHODOLOGY

The measurement of noise level is done in campus hostel restroom at an approximately distance of 0.8 meter, a distance of human during use the hand dryer. Measurements were taken with a digital sound level with the accuracy of ± 2 dB. 9 number of run were conducted to measure noise at different foam noise insulation type and egg carton. The measurement was repeated three times as to get average value. It was compared with the default condition (hand dryer without foam noise insulator). The response data then will be evaluated by ANOVA as to confirm the significant of parameter to the response (noise). The P-value less than 0.05 will be considered significant statistically. The experimental set up is shown in Figure 1.

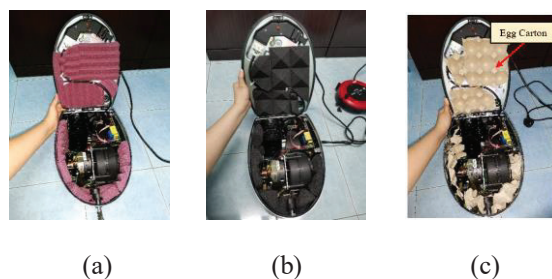


Figure 1 Acoustic foam sound insulation inside hand dryer cover (a) Wedge foam, (b) Pyramid foam, (c) Egg carton

3. RESULTS AND DISCUSION

The result of measurement of sound intensity is shown in Table 1, it is observed that the noise level able to be reduced significantly with the noise insulator (wedge, pyramid). The default hand dryer without insulator produces 85 dB which reaches the noise permissible limit. It was found the egg carton only reduce 4 dB which consider not significant effect. It was consistent with the finding by Jim [10]. However, the acoustic insulator foam found to be better effect. It can

reduce noise by 6-7 dB so that the noise falls within acceptable threshold limit. The least intense sound recorded throughout all the experiment was 76 dB with the wedge type insulator (Figure 2). Table 2 shows the ANOVA of noise effect. The P-Value of 0.0361 indicating the significantly of the insulator effect to noise emission.

Table 1 Measurement noise level of hand dryer in dB.

Type of Nozzle Design	Type of Insulation	Average Noise Level (dB)
Chrome Nozzle	No insulator	85
	Egg carton	81
	Wedge	78
	Pyramid	79

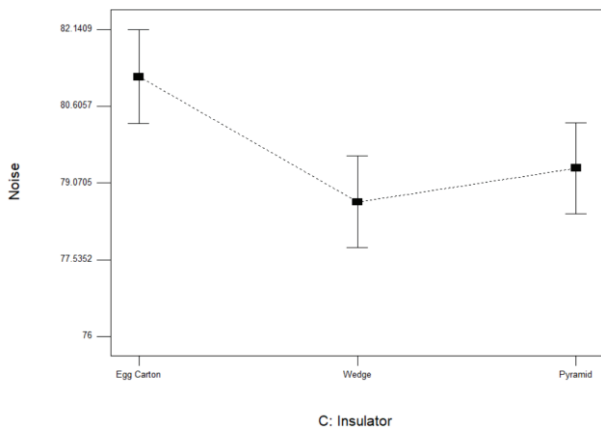


Figure 2 The effect of insulator type on noise emission

Table 2 ANOVA table for noise effect

ANOVA for Response Surface Linear Model						
Analysis of variance table [Partial sum of squares]						
Source	Sum of Square	D F	Mean Square	F Value	Prob. > F	
Model	31.49	5	6.29	25.88	0.011	significant
Flow Nozzle type	0.38	1	0.38	1.56	0.299	significant
Insulator	7.59	2	3.80	15.60	0.026	significant

4. CONCLUSIONS

The study shows the hand dryer original from manufacturer produce slightly higher of exposure limit. Noise cannot be avoided since the device involves rotating motor and high velocity air flow. However, the exposure to noise can be reduced by eliminating and contain the source of noise. There are several alternatives to reduce of noise. One of the strategies by adding noise foam insulator inside the hand dryer casing. The study proven by applying foam insulator, a significant reduction of people exposed to harmful noise can be achieved.

ACKNOWLEDGEMENT

The authors would like to express deepest gratitude to the Advanced Manufacturing Center, Universiti Teknikal Malaysia Melaka and Top Empire Sdn, Bhd. for providing technical, equipment and financial support through grant (JURNAL/2019/AMC/Q00043).

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