UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF MONITORING PERFORMANCE TOOLS FOR LOCAL EXHAUST VENTILATION (LEV) SYSTEM

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DECLARATION

I declare that this project entitled “Development of Monitoring Performance Tools For Local Exhaust Ventilation (Lev) System” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in the candidature of any other degree

Signature : 

Name : Muhammad Adib Hakimi Bin Zam Azri

Date : 11 January 2023

APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (Refrigeration And Air-Conditioning Systems) With Honours

Signature :

Supervisor Name : Ts. Dr. Amir Abdullah Bin Muhamad Damanhuri

Date : 11 January 2022

Special Dedication to my amazing people who taught me that it's never too late to chase your passions,

Siti Norhasnisah Binti Alias,

Zam Azri Bin Mohamed Zam Zamil

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my friends, my fellow colleague and all faculty members

For all your care, support and believe in me.

ABSTRACT

Local exhaust ventilation (LEV) is an engineering technique that is commonly used in the workplace to protect workers from dangerous pollutants. LEV must be delivered by suppliers in a way that is suitable for the intended application, has been demonstrated to work, and will continue to work. The employer (owner of the LEV) is accountable for making sure that adequate controls are in place. The goal of this project is to create performance monitoring tools for local exhaust ventilation (LEV) systems with the use of a data collection system for the pressure, velocity, and flowrate parameters. Following the measurements, the data had to be manually entered into a form and calculated. With this strategy, the review process is dragged out and wasteful. Because of this, one of the several techniques in this proposal for assessing the performance of the LEV is the development of a monitoring performance tools approach. An automated operation for determining the approach pressure, velocity, and flowrate distribution is developed into the monitoring tools. The tool is for performance monitoring. The hood, which is attached to the local exhaust ventilation (LEV) system, is the point where the pollutant is collected or contained before entering the LEV system (LEV). This tries to reduce the risk of harmful air being blown into the workplace by draughts. Along with being appropriate for the sort of chemical being generated, the hood also needs to be appropriate for the activity being carried out. The performance of the Local Exhaust Ventilation System (LEV) will be able to be determined by the monitoring instrument that was built. By entering variable information into the monitoring tools, such as static pressure and velocity pressure, which will subsequently assess the LEV total pressure, this will be accomplished. The first monitoring tool method involves using Excel software to manipulate data like mathematical operations on a grid of cells arranged in numbered rows and letter-named columns. It contains a vast array of built-in features to handle statistical, technical, and financial demands. The more sophisticated monitoring performance tools for Local Exhaust Ventilation (LEV) systems, however, were also developed and worked in a manner similar to that of the excel programme, but they were more portable and user-friendly for a variety of devices. These software work successfully with the data parameter required and also use to signal the performances of the Local Exhaust Ventilation (LEV) system thanks to some simple JavaScript text that is funded in the calconic application. The study's conclusions might be applied to a normal workplace with a small LEV system depending on the actions carried out and the arrangement of the regions covered. A collection of typical design features is also developed to provide a more precise estimation for data measurement of the effectiveness of the local exhaust ventilation (LEV).

ABSTRAK

Pengudaraan ekzos tempatan (LEV) ialah teknik kejuruteraan yang biasa digunakan di tempat kerja untuk melindungi pekerja daripada bahan pencemar berbahaya. LEV mesti dihantar oleh pembekal dengan cara yang sesuai untuk aplikasi yang dimaksudkan, telah ditunjukkan untuk berfungsi dan akan terus berfungsi. Majikan (pemilik LEV) bertanggungjawab untuk memastikan bahawa kawalan yang mencukupi disediakan. Matlamat projek ini adalah untuk mencipta alat pemantauan prestasi untuk sistem pengudaraan ekzos tempatan (LEV) dengan penggunaan sistem pengumpulan data untuk parameter tekanan, halaju dan kadar alir. Selepas pengukuran, data perlu dimasukkan secara manual ke dalam borang dan dikira. Dengan strategi ini, proses semakan terheret dan membazir. Oleh sebab itu, salah satu daripada beberapa teknik dalam cadangan ini untuk menilai prestasi LEV ialah pembangunan pendekatan alat prestasi pemantauan. Operasi automatik untuk menentukan tekanan pendekatan, halaju, dan pengagihan kadar alir dibangunkan ke dalam alat pemantauan. Alat ini adalah untuk pemantauan prestasi. Tudung, yang dipasang pada sistem pengudaraan ekzos tempatan (LEV), adalah titik di mana bahan pencemar terkumpul atau terkandung sebelum memasuki sistem LEV (LEV). Ini cuba mengurangkan risiko udara berbahaya ditiup ke tempat kerja oleh draf. Selain sesuai untuk jenis bahan kimia yang dihasilkan, tudung juga perlu sesuai untuk aktiviti yang dijalankan. Prestasi Sistem Pengudaraan Ekzos Tempatan (LEV) akan dapat ditentukan oleh instrumen pemantauan yang dibina. Dengan memasukkan maklumat berubah-ubah ke dalam alat pemantauan, seperti tekanan statik dan tekanan halaju, yang kemudiannya akan menilai jumlah tekanan LEV, ini akan dicapai. Kaedah alat pemantauan pertama melibatkan penggunaan perisian Excel untuk memanipulasi data seperti operasi matematik pada grid sel yang disusun dalam baris bernombor dan lajur bernama huruf. Ia mengandungi pelbagai jenis ciri terbina dalam untuk mengendalikan permintaan statistik, teknikal dan kewangan. Walau bagaimanapun, alatan prestasi pemantauan yang lebih canggih untuk sistem Pengudaraan Ekzos Setempat (LEV), turut dibangunkan dan berfungsi dengan cara yang serupa dengan program excel, tetapi ia lebih mudah alih dan mesra pengguna untuk pelbagai peranti. Perisian ini berfungsi dengan jayanya dengan parameter data yang diperlukan dan juga digunakan untuk memberi isyarat kepada prestasi sistem Pengudaraan Ekzos Setempat (LEV) terima kasih kepada beberapa teks JavaScript mudah yang dibiayai dalam aplikasi calconic. Kesimpulan kajian mungkin digunakan untuk tempat kerja biasa dengan sistem LEV kecil bergantung pada tindakan yang dijalankan dan susunan kawasan yang diliputi. Koleksi ciri reka bentuk biasa juga dibangunkan untuk menyediakan anggaran yang lebih tepat untuk pengukuran data keberkesanan pengudaraan ekzos tempatan (LEV).

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LIST OF SYMBOLS AND ABBREVIATIONS

D,d	-	Diameter
m/s	-	Meter Per Second
Q	-	Volumetric Flow Rate
CFM	-	Cubic Feet Per Minute
$N.m^2$	-	Newton Meter Square
%	-	Percentage

LIST OF FORMULAS

CHAPTER 1

INTRODUCTION

1.1 Background

LEV stands for local exhaust ventilation, and it is an engineering system that captures pollution at the root of the derivation and shuttles them to a point where wastes can be controlled safely, or to a strainer or scrubber. This helps to reduce the amount of exposure that workers have to airborne pollutants in the workplace, such as dust, mist, fume, vapour, and gas. Employers, designers, suppliers, and installers, as well as workers, need to work together in order to appropriately minimise employees' exposure to airborne pollutants [1].

A classification of control strategies must be considered in effort to stop employment exposure to toxic chemicals. These methods begin with the elimination or replacement of the hazard, and then move on to the control of the hazard through engineering means if the first two options are not viable solutions. A good example of this kind of engineering control strategy is something called local exhaust ventilation (LEV). LEV must be delivered by suppliers in a manner that is fit for the proposed use, that has been proved to function, and that will continue to function. It is the responsibility of the employer (the owner of the LEV) to ensure that sufficient controls are in place[3]. Everyone, including those who supply the LEVs and those who use them, is required to have understanding of the LEV system.

Local exhaust ventilation can be an efficient method of managing dust particles. Local exhaust ventilation necessitates the careful planning and placement of comparatively small vent inlets, sometimes commonly referred to as exhaust nozzles. The nozzles of the exhaust system are placed quite near to the sources of contamination. Local exhaust ventilation

nozzles collect much of the dust created, even when expelled at high speeds, because of the higher velocity of the inputs and near location.

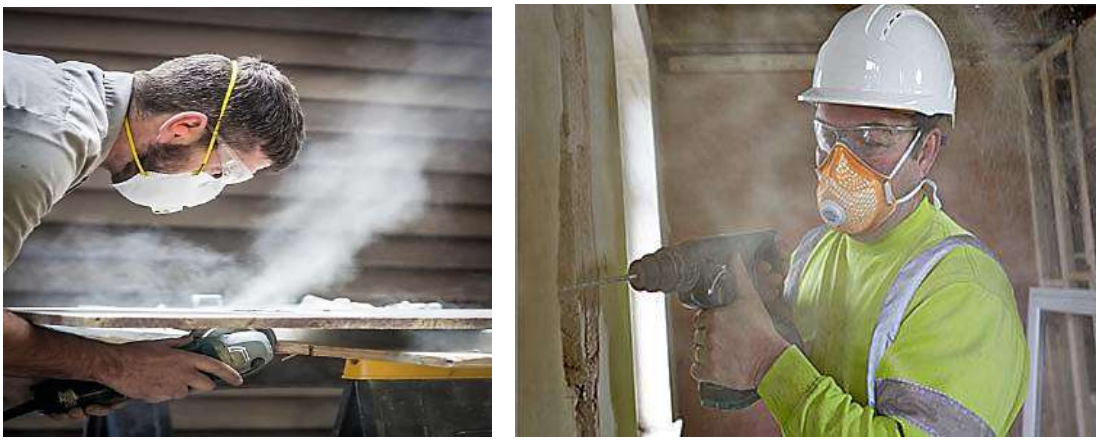

Figure 1.1 The employees are exposed to contaminants while working (Smitt,2018)

1.2 Problem Statement

When workers are put in situations where they are exposed to occupational hazards including dusts, gases, and vapours, they run the risk of experiencing negative effects on their health whether chemically or biologically agents. Employees can get occupational illnesses and diseases if they breathe and excessive exposure to contaminant sources such as dirt, smoke, or even other airborne contaminants in large amounts at work which happens a lot because control measures aren't in place or aren't effective enough.The severity of the health effects depends on the frequency, duration, and intensity of the exposure. [1]. The potential for exposure to any kind of chemical or biological danger should be evaluated at each and every location of business. Work in foundries, woodworking, welding, stonemasonry, engineering, pharmaceuticals, and biotechnology, as well as foundry work, chemical processing, and biotechnology and pharmaceuticals are all potentially impacted sectors [4].

A full inspection and analysis of the extraction equipment, including the ducts and hoods, will be part of an LEV test. Additionally, the technical performance of the LEV system will be measured, and its operational state will be evaluated. LEVs are now installed in every workplace, but the owner of the space frequently forgets to maintain them effectively or to use suitable design. The money was wasted as a result, and LEV lost its effectiveness. Therefore, regular inspections of each LEV component are required. To make sure system performance is appropriate, testing is necessary on a regular basis. According to prior researchers, there are numerous approaches to evaluate the performance of an LEV, including assessing the decay rate under access hoods, measuring tracer gas, watching smoke emission, measuring air velocity, and measuring face velocity. However, upon the completion of the measurements, the data had to be manually entered into a form and calculated. This approach lengthens and wastes the evaluation process. Because of this, creating a monitoring performance tools approach is one of the various methods in this proposal for evaluating the performance of the LEV. A metric is a rule for automatically calculating the data insertions of approach pressure, velocity, and flowrate distribution. It is a monitoring performance tool.

1.3 Project Objective

The primary goal of this research is to create a monitoring system for the entire system in order to check Local Exhaust Ventilation (LEV) performance. Specifically, the objectives are as follows:

a) To monitor the Local Exhaust Ventilation's (LEV) performance using excel software.

b) To develop Local Exhaust Ventilation's (LEV) monitoring tools using Calconic 2021 based on LEV monitoring form.

1.4 Scope of Project

The scope of this research is as follows:

i) The monitoring of LEV system was developed using excel software and calconic 2021 applications.

ii) The Local Exhaust Ventilation (LEV) at Bengkel Inovasi Dan PSM HVAC, FTKMP are in PVC round duct material.

iii) The monitoring tools of calconic are in the aid of basic JavaScript text.

iv) The JavaScript text uses the basic strings and operator desing for LEV system

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This section will concentrate on local exhaust ventilation (LEV) in general, which is a type of ventilation system with the goal of removing impurities at or very close to the point where they are produced. By utilizing this type of ventilation system, the likelihood of airborne contaminants spreading throughout the ventilated room is decreased. As it guides stale air in the direction of the exhaust, the hood is an essential component of LEV systems. The construction of the hood features a design that has a significant impact on the functioning of the LEV system. LEV system's act of optimizing is critical for both reducing pollutant exposure and conserving energy. In order to prevent the contamination of an area with potentially harmful or infectious compounds, it is usually necessary to have high rates of exhaust ventilation. Additionally, the building's sucked-out air cannot be brought back into it under any circumstances, which severely limits the number of possible energy recovery strategies and the extracted air must not be recirculated into the building, restricting energy recovery options.

2.2 Local Exhaust Ventilation (LEV) Effectiveness

Poor design and/or maintenance, for example, may result in workplace leakage, producing focused exposure in a small area as opposed to avoiding it altogether. It's possible for a system to be a costly waste of money and a source of potential risk if it's poorly designed, installed, misused, and maintained.