

# International Journal of Innovative Research in Science, Engineering and Technology

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## Cost Effective Fume and Dust Cleaning System

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**ABSTRACT:** Welding processes produce fumes which are known to be dangerous to human health. In order for welders to work in a safe environment, a means of removing these fumes from the welding environment must be provided during the welding process. This is the purpose for which this paper has been developed. Fume extractors are generally known to be fixed to the walls of factories and places where fumes need to be extracted from. With the increase in welding needs outside the workshop environment, the need to have mobile fume extractors has become imperative. This need has been addressed in this paper. Materials for design and fabrication of the fume extractor were selected based on cost, safety, functionality, ease of availability and affordable maintainability. The fabricated fume extractor was tested on several welding sites and found to be very effective in extracting fumes from welders breathing zone. It was also observed that the function of the extractor did not adversely affect the welding process.

**KEYWORDS:** impeller, fume extractor, dust cleaning

### I. INTRODUCTION

Fumes and particles are released into the operator's breathing zone during welding operations, or when using flux with solders. These fumes can lead to occupational asthma and other allergic reactions when inhaled. Intense testing by health institutes have shown that specialized equipment for extracting and filtering of dangerous fumes are necessary to prevent fumes from getting into the operators breathing zone. Welding fumes consist of 99.5% particles and 0.5% of gases. Particles in welding fumes that are a threat to human health are lead particles (in dust and smoke) larger than 0.1 micron and fumes of aliphatic aldehydes and isocyanides. The most common health challenges are short and irregular breathing, coughing, and tightness of the chest in combination with irritation of the eyes, headaches, dizziness and dry cracked skin. The aim of this work is to design and fabricate a portable fume extractor that is suitable for use in welding workshops and external welding sites.

### II. OBJECTIVES

- [1] To avoid inhalation of the fumes.
- [2] To control the eye, throat irritation and headaches.
- [3] To reduce the cause of dermatological problems.

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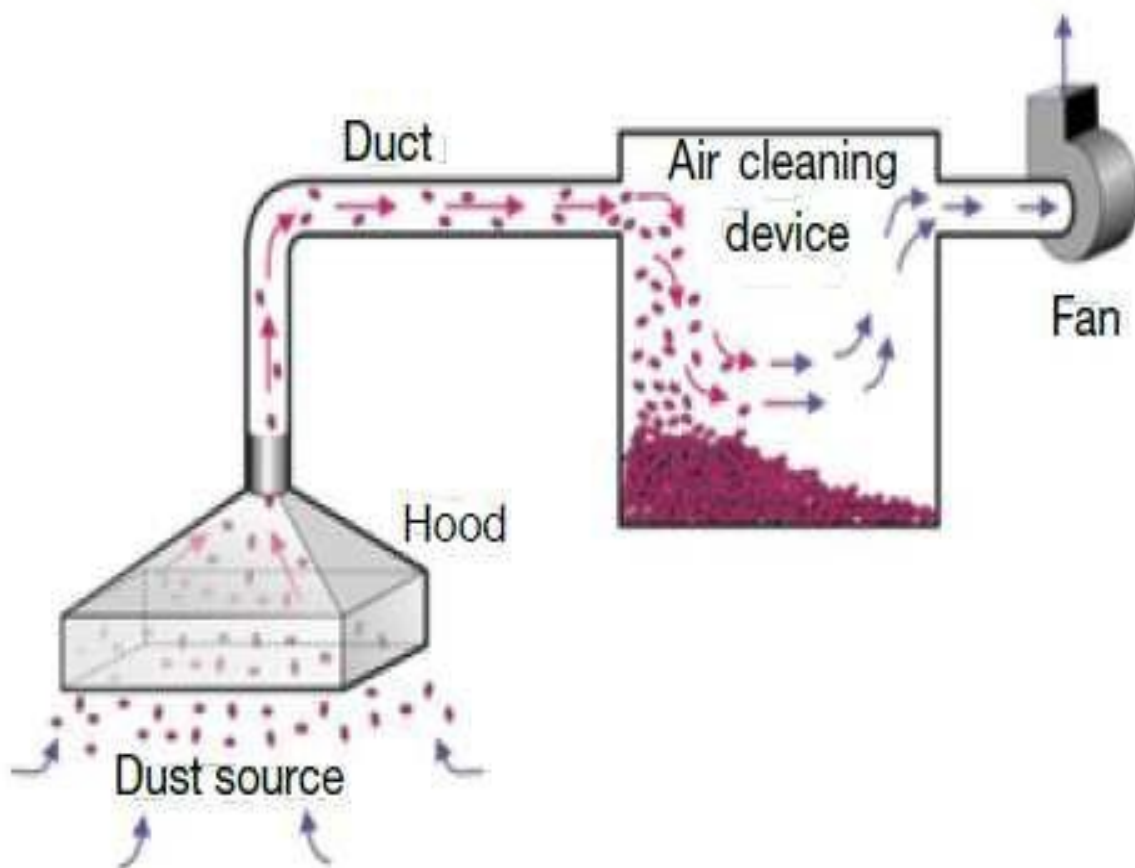
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### III. WORKING PRINCIPLE

The fume extractor is a machine that uses an electric motor to power an axial blower. The electric motor provides power for the rotation of the impeller inside the axial blower which leads to suction of fume from a welding process. This fume goes through the capture hood into the machine and an air filter purifies the fume laden air by extracting the welding particles from the fume, and then releases a clean air back to the atmosphere. The fume extractor works on the principle of high volume air, travelling at low velocity.



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### IV. MATERIALS USED

SI.NO	MATERIALS	QUANTITY
1	Axial blower	1
2	Duct	1
3	Frame	1
4	Wheels	4
5	Motor	1
6	Filter	1

### V. DESIGN CALCULATION

#### Calculation of Flow Rate:

Circular Area (A) =  $\pi(d)^2/4$

Flow Rate =  $v \times A$

Where,

A=Area

d =Diameter of Duct

v=Velocity

#### Air Change Rate:

$n = 60q / V$

Where,

n =area change rate per hour

q =air flow through the box (CFM)

V =volume of the box (Cubic Feet)

#### Ventilation Calculations:

Ventilation rate (m<sup>3</sup>/h) = Air Change Rate (/h) x Room Volume (m<sup>3</sup>)

Ventilation rate (m<sup>3</sup>/s) = Ventilation rate (m<sup>3</sup>/h) / 3600

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## VI. ADVANTAGES

- [1] Easily portable.
- [2] Low cost.
- [3] Simple in construction.
- [4] It contributes to a healthy, safe and working environment.
- [5] Less absenteeism at work.
- [6] Motivated and energetic workforce.

## VII. APPLICATIONS

A fume extractor is a system utilizing a fan to pull fumes and particulate into a filtration system cleaning the air of harmful chemicals and particulates. Industrial processes create fumes or particles such welding, sanding, grinding, spraying, powder filling and chemical applications.

## VIII. CONCLUSION

The principal of design and fabrication of welding fumes extraction system has taken a role model of vacuum cleaner. The construction and testing of the machine has been achieved. The design was done in accordance with standard design specifications and appropriate tests carried out indicated a high level of performance in the extraction of welding fumes. The machine is safe and easy to operate and does not require any special technical training on how to operate it. The machine components were coated with aluminium silver spray to make them corrosion resistant. The machine will find extensive use in both local workshops and industries which are involved in welding, soldering, and brazing processes.

## REFERENCES

1. Foy M. Development of a test method for low-volume high velocity extraction systems for hand soldering. MSc thesis, University of Aberdeen, 1997.
2. Kollman, K.G., "Solving the problem of GMAW fume extraction", Welding Journal, August 1973.
3. Wiehe, A.E., Cary, H., and Wildenthaler, L., "Application of a smoke extracting system for continuous electrode welding", Welding Journal, June 1974.
4. Robinson H, Ingham DB. Numerical modelling of the flow patterns induced by a push-pull ventilation system. Ann Occup Hyg 1996.
5. Wright, R.R., "Fume removal for semi-automatic welding",—International Conference on Exploiting Welding in Production Technology, The Welding Institute, London, April 1975.
6. Mansour A. B. and Mohammad K. G. (2010) Total Fume and Metal Contaminations during Welding in Selected Factories in Jeddah, Saudi Arabia. International Journal of Environmental Research and Public Health, Vol. 7, No 7, pp 2978-2987.
7. Witt P.J., Solnord C.B., Mitonni L.J., Finn S. and Pluta J., Optimizing the Design of Fume Extraction Hoods Using a Combination of Engineering and CFD Modeling. Applied Mathematical Modeling, Vol. 30, pp. 1167-1179, 2006.
8. Lehnert M., Pesch B., Lontz A., Pelzer J., Kendzia B., Gawrych K., Heinze E. and VanGeler R. . Exposure to inhalable, respirable, and ultrafine particles in welding fumes. Annals of Occupational Hygiene Vol. 56 (5), pp: 557 - 567. 2012.
9. Francis B. Factors Affecting the Capture Efficiency of a Fume Extraction Torch for Gas Metal Arc Welding. Annals of Occupational Hygiene, Vol. 60, No. 6, pp: 761 – 770, 2016.
10. Caster, H.R. Gas Metal Arc Welding Fume Generation Using Pulse Current Welding. Welding Journal Vol. 74, No. 2, pp. 59 – 68. 1995
11. Shan-jun M.O., Zhao Z., Liang D. and Zhi-jian H. Engineering Simulation of Smoke Extraction Design in Atrium Fires of Student Union, Procedia Engineering Vol. 11, pp: 325-334. 2011.
12. Sizing mechanical ventilation systems by IDES EDU-IEE/09/631/SI2.558225 28.10.2011.