

DESIGN, FABRICATION AND ANALYSIS OF FUME EXTRACTION AND FILTRATION EQUIPMENT

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ABSTRACT

Often, Human kind is permitted to inhale the emission of fumes is in the range of 2 to 3 mg/m³. However, it is the most challenging task for the human safety and environmental pollution. It induced to do the work for reducing the toxic content in the fumes released from chemical manufacturing, metal production process and metal joining process. Thus, the investigation carried out in this work to safeguard the human kind by introducing the new design of filter setup as layers. The filtration is done by using different filters, each having the tendency to absorb the toxic particles that are present in the fumes. The filters used are Silicone crystal, Alum filter and layer of cotton. This work helps the industry to reduce the particulate matter and heavy smoke produced by the fumes of metal joining process.

INTRODUCTION

The most serious issues in our world environment is pollution particularly air pollution. The air can be polluted by various aspects. Mostly air is polluted because of industry dissipates and automobiles exhausts. There are various types of fume extraction systems are installed in many industries.

The first category is referred to as tip extraction apparatus. This method is typically used in applications such as integral extraction of GMA welding fumes extensively at their source (Cornu, et al., 1993). In electronic industry, the workers are exposed to solder fumes containing colophony cause severe asthma problems (Burge, et al., 1978) and it also cause lungs cancer and occupational asthma Burge, et al., 1979). The Smaller arm extraction systems usually comprise an arm connected to a remote vacuum apparatus. In smaller arm extraction systems, it has been a very difficult task to achieve desired volume rates and adequate pressures required for adequate alteration without creating the systems excessively large and loud in early days. During metal joining process workers are affected by intrinsic asthma, extrinsic atopic asthma, or asthma with allergic bronchopulmonary aspergillosis were hankie typed for the HLA A, B, and C loci (Brostoff, et al., 1976). All patients who are workers of industries affected with red cedar asthma demonstrated bronchial hyper reactivity to methacholine to the same extent as patients with non-occupational asthma (Chan-Yeung, 1977).

The fume extraction torch with LEV integrated into the tool of GMA fume extraction system is the mainly pretty solution but its capture efficiency is often disappointing in practice of some defects of overheating (Kollman, 1973). In detergent industry, the workers not able to breathe freely due to momentous loss of pulmonary elastic recoil causing increased lung volumes and pulmonary compliance (Musk and Gandevia, 1976). In some metal manufacturing industries, the toxic chromium in the fumes are get filtered by using ultrasonic extraction system (Wang, et al., 1997).

In crushing industry, a bag type filter is used for trapping the fine particulates of toxic fumes (Youngjin, 2015). A noticeable disadvantage to the fume extraction apparatus with remote vacuum and alter arrangements is that they are not suitably adjustable in different situations another drawback to apparatus with remote vacuum and

alter arrangements is that they lean towards to be inefficient. The main dust collection and gas cleaning systems arranged in iron and steel industry are described in two parts. One part deals with the collection of fume from electric arc furnaces and another part is described several fabric filters and mechanical cleaners. The light weight fume extraction system focused mainly on ship welding (Wildenthaler and Cary, 1971). The main objective is to create good clean comfortable environment to welders. Due to this the workers work fast and they finished their task very effectively. The method of controlling the fumes comes during the industrial process, they include depending on the variety and quantity of weld fume produced (Wiehe, et al., 1974). The survey of the metal joining industry says that the manganese easily contaminated into the blood of human kind (Wangenen, 1979).

The toxins can be controlled by three different ways including dilution aeration, ambient air collection using weakening air, an air cleaning device. Source captures using an Electrostatic precipitator cartridge. These are all having the function of extracting the fumes released during welding process. Some apparatus having filters for fumes. Those all are mostly safe guard the workers but they did not prevent the environment from effects of industrial fumes. Hence it should be filter to precaution the environment from that harmful fume in our concept we filter some toxic fumes using a set of three different filters that have the tendency to absorb the harmful toxic content present in the fumes.

METHODS

A fume extraction and filter apparatus looks like square block. A motor and fan are fixed at the lower back face of the block. Fan is used to extract the fumes and draws into the apparatus. A flexible pipe with conical inlet opening (duct) in one edge. And the other edge of that pipe is fixed to the apparatus. A filter setup is placed in between the inlet and outlet of the apparatus and it can be replaced by a door like opening. There are three layers of filters for filtration purpose. The first layer contains Silicone crystal. The second layer contains cotton bed and the final layer is alum filter paper as given in the figure-1 and figure -2.

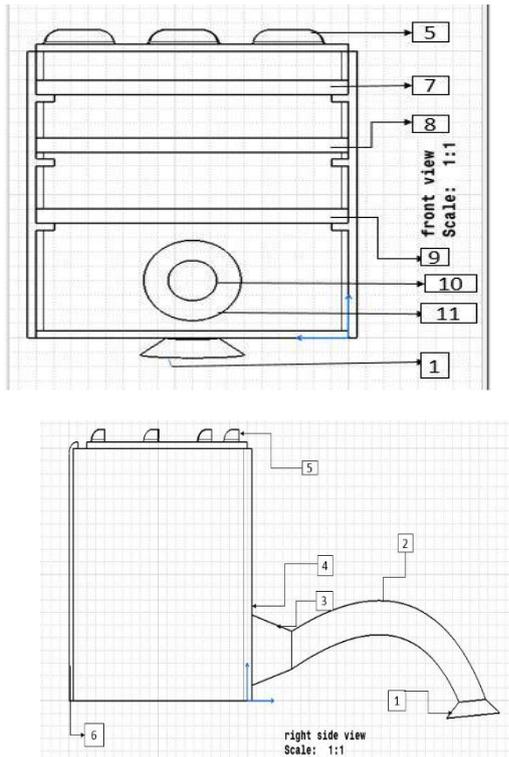


Figure-1: Design of Fume Extraction and Filtration Equipment

Parts

- 1. Inlet duct ventilation
- 2. Inlet tube
- 3. Inlet fan cover
- 4. Regulator for fan
- 5. Outlet of apparatus
- 7. First filter arrangement (Alum Filter)
- 8. Second filter arrangement (Cotton Bed)
- 9. Third filter arrangement (Silicone Crystal)
- 10. Dc motor
- 11. Fan



Figure-2: Fume Extraction and Filtration Equipment

MATERIALS

Silicone crystal: It appears as blue in color. It has the capability to absorb moisture content in the atmosphere and used to absorb the dust particles present in the atmosphere. The use of silicone crystal is in chemical manufacturing laboratories, used in transformer for supply fresh air into the oil tank to prevent the formation of corrosion of the tank of transformer and filter for HEFA.

The weld fume comes during welding is to be extract and draws into the housing by the fan placed at the bottom face of the block. The fume first passes through silicone crystal layer, after which it passes through the

cotton layer. Then the air travels across the alum filter paper before exhausting to the atmosphere. The filters used are having the capability to absorb the toxic particles present in the weld fume, making it purified before it reaches the atmosphere. The fan which is used for suction purpose is run by DC motor. If the filter exceeds its limit, it should be replaced by a door like opening in the front of the equipment.

Alum Filter: Aluminum Hydroxide gel is a hydrated aluminum oxide having the varying amounts of simple bicarbonate and Aluminum carbonate. It contains of aluminum oxide, glycerin and sorbitol. It is dry gel and white in colour, amorphous and tasteless powder. The third and final filter layer of the apparatus is Alum filter paper. The normal filter paper is taken that have the size of 0.2µm. The filter paper is made by coating with alum gel and it is spread over the filter paper like a thin layer. Due to this coating of alum gel, the fine content of fumes is deposited on the filter paper.

RESULTS AND DISCUSSION

The fumes that come during welding process are more harmful. It can be extracted and filtered by present invention. Before the filtration process the weight of the cotton are less when compared with the weight of the cotton layer after the filtration process. Before the filtration process weight of Alum filter paper are less when compared with the weight of Alum filter paper after the filtration process. Moreover, the silicone gel turns pink color after the filtration process. analysis of filtration is shown in the Table – 1 and 2.

Silicone Crystal before welding observations

Weight = 1 kg; Appearance of color = Blue

Table-1: Analysis of weight of Silicone crystal before and after welding

S. No.	No. Of welding electrode	Time	Weight of silicone crystal after welding	Appearance of colour after welding
1	30	1 hrs	1.036 kg	Partially pink with blue
2	60	2 hrs	1.113 kg	pink
3	90	3 hrs	1.213 kg	pink
4	120	4 hrs	1.337 kg	Partially pink with white

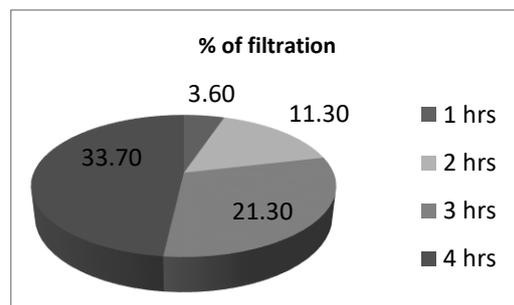


Figure-3: Efficiency of Silicone crystal filtration

Silicone crystal after welding Observations: The fumes that draws into the housing is made to pass through the silicone crystal first. The observations inferred that the harmful effects of toxic fumes are absorbed by the crystal. Before welding the weight of silicone crystal is 1 kg but after the completion of 1 hour

of welding process using 30 electrodes, the weight of silicone crystal is increased as 1.036 kg. Hence it is concluded that about 0.337 kg of toxic content present in the welding fumes are get trapped (i.e) 33% of fumes are trapped by silicone crystal for 4 hours' period as shown in figure - 3. The silicone crystal is in the colour of blue before welding process. After the welding process the silicone gel turns into pink in colour. The weight of the silicone crystal keep on increasing if the fumes are produced continuously and its appearance is become fair pink. If the silicone crystal reached this state it shows it attains its limit. After this state the silicone crystal should be replaced or reused with suitable treatment of heating the crystals in the range of 150°C - 200°C.

Alum filter paper before welding Observation: Weight = 2.78 g; Appearance of color = white

Before the process of welding the filter, paper is having the weightage of 2.78 g and it appears in the colour of white. But the colour of the filter paper changes to light brown after the welding process for 1 hour by 30 welding electrodes. The weight of the paper increases from 2.78 g to 2.81 g. Thus, the Alum filter paper traps the very minute size of toxic content present in the welding fumes.

Table – 2: Analysis of weight of Alum Filter before and after welding

S.No.	No. Of welding electrode	Time	Weight of alum filter paper
1	30	1 hrs	2.81 g
2	60	2 hrs	2.84 g
3	90	3 hrs	2.87 g
4	120	4 hrs	2.91 g

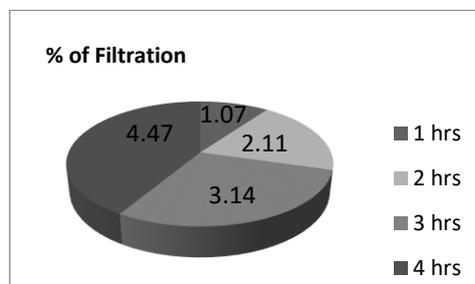


Figure- 4: Efficiency of Alum Filter

Alum filter paper after welding Observation: The weight of the Alum filter paper keep on increasing if the fumes are produced continuously and its appearance is become lite brown shade. If the Alum filter paper reached this state that it reaches its limit. After this state the Alum filter paper should be replaced. This analysis figure out the affinity and effectiveness of the Alum filters around 4.4% filtration of fumes, that are used in our fume extraction and filter apparatus on the basic of its weightage of filter component before and after welding process shown in the figure - 4. Due to this analysis, we predict that the number of fumes that are getting to be trapped by the filters and forecast the number of fumes came out from the welding process is reduced

CONCLUSION

The toxic fumes produced during above mentioned chemical manufacturing, metal fabrication, primary

metal production, petroleum processing, metal joining process are harmful to environment and human life. This invention is flexible and adjustable to the place where it is used and it has many applications. Most probably it is used to extract and to filter the fume to produce the best by providing cheap. It also having the features of reducing the toxic content present in the fumes through the filters used to safeguard the human life as well as environment. Finally, we conclude that for 4 hours' experimentation the silicone crystal observes around 33% and Alum filter observes 4.4% of particulates and gases from the fumes which combined about 37 % of fumes trapped. Due to this work the workers are turn aside from the pneumonia, metal fume fever, occupational asthma, irritation of throat, temporary reduced lung function, eye irritation, skin ulceration which all are caused by toxic fumes comes out during above chemical manufacturing, metal fabrication, primary metal production, petroleum processing, metal joining process.

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