

# AIR POLLUTION CONTROL BY USING ACTIVATED CHARCOAL

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**Abstract:** The purpose of this report is to use charcoal filter for indoor air pollution, which is growing concern, with adverse effects on human health and well-being. After a years of research and various technologies have been developed to address this issue, and surprisingly one effective approach is the use of activated charcoal filters for indoor air purification. These filters effectively trap and eliminate a wide range of indoor pollutants including VOC, formaldehyde, odours, and airborne chemicals that significantly improve the quality of indoor air without leaving any harmful chemicals. The pollutant in air to eliminate by this filter is particulate matter (2.5micrometer to 10micrometer) and gaseous. These filters can be incorporated into standalone air purifiers, offering flexibility and adaptability to various indoor environments. They are easy to install and require regular maintenance to ensure optimal performance. Periodic replacement of filters is necessary to maintain their effectiveness over time. To boost up the performance of this filter in the system other filters have been introduced, which eliminate the larger and major pollutants before expose to this filter.

**Keywords:** Air pollution, activated charcoal, pollutant, effects, techniques, etc.

## I. INTRODUCTION

Air is essential for human. Air may contain some unwanted and harmful contaminants which can affect the life and health quality of human being. Indoor air pollution has become a major concern in recent years due to its significant impact on human health and well-being. Poor indoor air quality can arise from various sources, including VOCs, chemicals, allergens, and odours, which can lead to respiratory issues, allergies, and other health problems.

The principle behind activated charcoal filtration lies in the adsorption process. When air passes through the filter, pollutants and gases present in the air come into contact with the activated charcoal surface. The pollutants adhere to the charcoal through van der Waals forces, chemical bonding, or other interactions, effectively trapping them within the filter.

The need to purify indoor air is by the concern of issuing of breathing problem to the sensitive people whom are attacked by some respiratory related disease. To address this issue, activated charcoal filter have been developed, among which have gained recognition as an effective solution for indoor air purification. Activated carbon filter have higher capacity of adsorbing contaminants which make it possible to use as filter for air purify. The filter for effective working has been incorporated in a standalone unit or system. Most preferably this purifier ventilation unit is effective in area where air contamination is more such as factories and people who need a high purified air such as in hospitals. This model is easy to install and maintain anywhere.

Do not apply in the area where the condensation is too low so that the adsorption will be happen by the capillary condensation with in the micro pores of adsorbent. With the change in time supply of gas concentration, humidity, temperature and airflow rate to the filter can decrease the adsorption capacity of the adsorbent.

Model; The model used in this study is made of elemental models representing the activated carbon filter placed in the air cleaning device, and the simulated room in which it is operating. These models were implemented in the generator exhaust to simulate the behaviour of the activated-carbon filter for several pollutants commonly found in the Indoor air that generated from kitchen and other sources.

The results are mainly trying to find the capacity of the air cleaning device to improve the indoor air quality as a function of the pollutant modelled and also to compare its performance after a long period of time with its first operating hours or day.

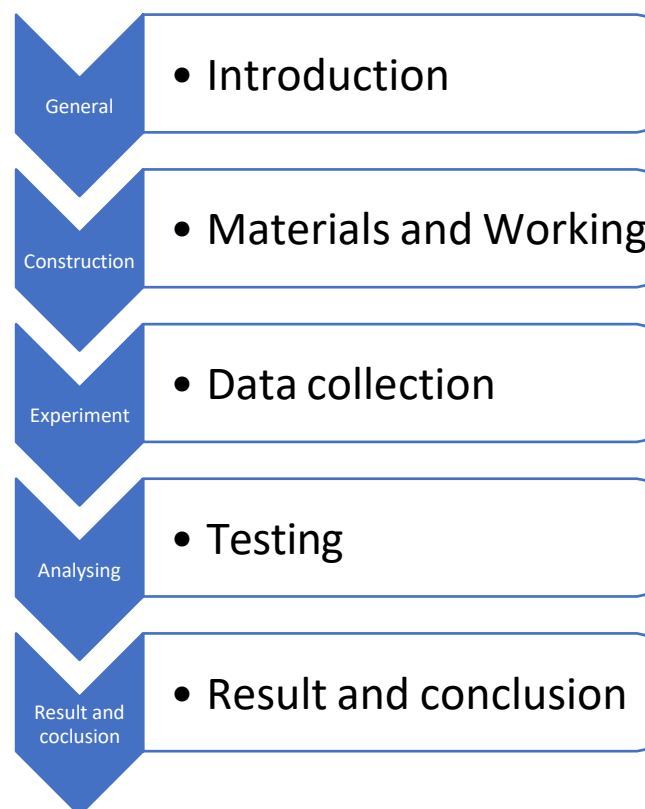
## II. AIM

1. Aim of project is to removal of VOCs: Activated charcoal has a highly porous structure, which provides a large surface area for adsorption which helping to improve indoor air quality and reduce their potential health effects.
2. Removal of Odours: Activated charcoal is known for its ability to absorb and eliminate odours. It can capture and trap odour-causing molecules.
3. Reduction of Harmful Gases: Activated charcoal filters can also help reduce the concentration of harmful gases in the air.
4. Filtering Particulate Matter: While the primary function of activated charcoal filters is adsorption, they can also capture some particulate matter suspended in the air.
5. Improving Indoor Air Quality: By addressing various sources of air pollution activated charcoal filters contribute to improving overall indoor air quality.

## III. OBJECTIVE

- To evaluate the effectiveness and efficiency of activated charcoal filters for indoor air purification.
- To assess the capability of activated charcoal filters in capturing and removing various indoor pollutants, including VOCs, odours, and airborne chemicals.
- To investigate the impact of activated charcoal filters on improving indoor air quality and its potential benefits for human health and well-being.
- To provide insights into the feasibility and usability of incorporating activated charcoal filters into existing units, thereby enabling a more efficient and effective filtration system.
- To provide concrete evidence on the effectiveness of these filters in various settings, including residential, commercial, and institutional environments.

## IV. METHODOLOGY



**Introduction:** Indoor air pollution has become a major concern in recent years to address this problem we use charcoal filters to remove the pollutants from indoor air.

**Materials:**

1. 3D-Printer: Using 3D printing technology in air purification models is the ability to create intricate and customized designs.
2. Liquid Resin: . The photoinitiator is a chemical compound that reacts to the UV light and initiates the curing process, transforming the liquid resin into a solid object.
3. Activated charcoal: Due to its exceptional adsorption properties it is used as a filter media in this project to remove microscopic pollutants from air.
4. Arduino: small computer that is programmed to perform specific tasks by receiving and processing input from sensors and other components.
5. BLDC motors: Unlike traditional brushed motors that use brushes and a commutator to control the flow of current, BLDC motors employ electronic commutation for operation.

**Working:**

An air purifier that uses activated charcoal, also known as activated carbon, use to remove certain contaminants from the air.

**Activated Charcoal:** Activated charcoal is a highly porous form of carbon that has been treated to have a large surface area. This treatment creates tiny pores and increases the charcoal's ability to adsorb various gases, chemicals, and volatile organic compounds (VOCs).

**Air Circulation:** The air purifier draws in the surrounding air using a fan or other means, pulling it into the device.

**Filter System:** The air passes through a filter system containing activated charcoal. This filter is usually made up of multiple layers to enhance the filtration process.

**Adsorption Process:** As the air flows through the activated charcoal filter, contaminants present in the air come into contact with pre-filter first, which eliminate the large particle of PM10 and then air will pass through HEPA filter which is more denser filter that will remove the particle of size range from PM2.5 and above. After passing through these two filter the air will pass to activated charcoal's surface. The contaminants are attracted to the surface of the activated charcoal and get trapped within its pores due to a process called adsorption. Charcoal filter, which will remove much smaller particle and odours from air that makes the air pure and harmless to breath.

**V. DATA COLLECTION**

After every 6 min data have collected for 1 hours to see the absorption efficiency

Time	PM2.5 & PM10(microgram/m <sup>3</sup> )
10:45 AM	= 15
10:46 AM	= 18
10:47 AM	= 22
10:48 AM	= 27
10:49 AM	= 30
10:50 AM	= 32
10:51 AM	= 28
10:52 AM	= 25
10:53 AM	= 21
10:54 AM	= 18

RESULT:

Pollution emitted by generator:

Capacity of DC(KVA)	Average fuel consumption(lt/hr)	PM2.5(gm/sec)	PM 10(gm/sec)	CO (gm/sec)
250	35	0.031	0.017	0.139

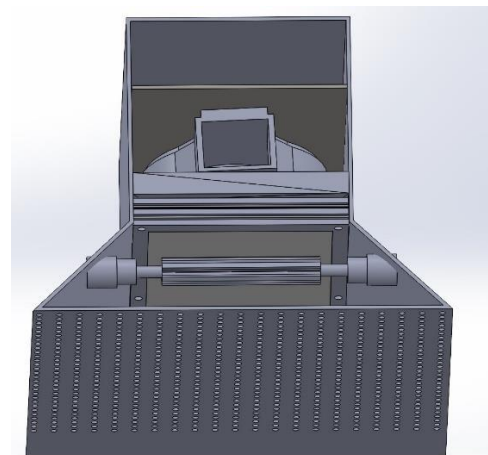
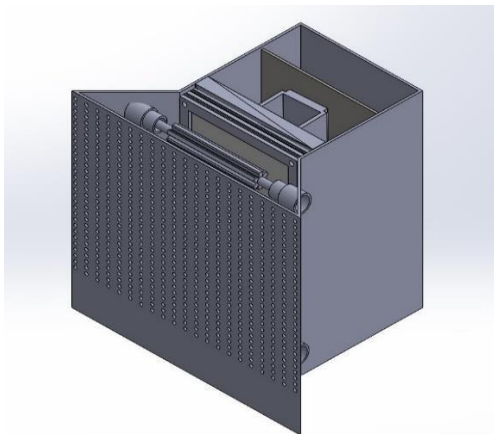
Airflow for generator – 100 CFM Volume unit - 100 cubic ft / min Velocity unit – 245.77 ft/ min Efficiency of filter paper:

1. Pre-filter = 40-60%
2. HEPA filter = 96%
3. Charcoal filter = 98%

By using PM sensor:

CADR = 177.19 cubic meter/ hours ACH rating = 2.56

**Design of model**



**ADVANTAGES:**

1. **Chemical and Odor Removal:** Activated charcoal is highly effective at adsorbing volatile organic compounds (VOCs), gases, and odors. It captures and traps these substances within its porous structure, eliminating unpleasant smells from cooking, pets, smoke, and other sources.
2. **Filtering Volatile Organic Compounds (VOCs):** VOCs are potentially harmful chemicals emitted by various sources such as paints, cleaning products, adhesives, and furniture. Activated charcoal can effectively trap and reduce the concentration of VOCs in the air.
3. **Removal of Formaldehyde and Benzene:** Formaldehyde and benzene are common indoor air pollutants found in furniture, carpets, paints, and other household products. Activated charcoal can adsorb these chemicals effectively and helps to reduce the health risks.
4. **Allergen Reduction:** While activated charcoal primarily targets gases and odors. The pre- filter and HEPA filter capture particulate matter like dust, pollen, pet dander, and mold spores, while the activated charcoal filter helps eliminate associated odors and gases.
5. **Long Lifespan:** Activated charcoal filters have a relatively long lifespan compared to other types of filters. They can typically last several months before requiring replacement, depending on the specific model and usage.

## DISADVANTAGES

1. **Limited Particle Filtration:** Activated charcoal primarily targets gases, odors, and volatile organic compounds (VOCs), but it has limited effectiveness in capturing and removing particulate matter like dust, pollen, and pet dander.
2. **Regular Maintenance Required:** Air purifiers with activated charcoal filters often require regular maintenance to ensure optimal performance. This may involve periodic cleaning or replacement of the filter.
3. **Ineffectiveness for Certain Contaminants:** While activated charcoal is efficient at removing many gases and odours, it may not be the ideal choice for removing formaldehyde or certain volatile chemicals with high molecular weights
4. **Potential Release of Captured Contaminants:** If the activated charcoal filter is not properly maintained, there is a risk of the captured contaminants being released back into the air.
5. **Limited Coverage Area:** Depending on the size and capacity of the air purifier, an activated charcoal filter may have limited coverage for larger rooms or open floor plans.

## VI. FUTURE SCOPE

With the advancement of smart home technology, air purifiers using activated charcoal can be integrated into smart home systems. This integration allows for remote monitoring and control of air quality, filter replacement reminders, and even adaptive filtration based on real-time air quality data. Smart features can enhance convenience and enable more efficient operation of air purifiers. The future of air purifiers utilizing activated charcoal presents exciting prospects for enhancing efficiency, intelligence, and sustainability in addressing indoor air quality concerns, thereby creating healthier living environments.

## VII. CONCLUSION

The air purifier that utilizes activated charcoal as a filtration medium offers significant advantages in terms of performance and effectiveness. By leveraging the exceptional adsorption efficiency of activated charcoal, the purifier effectively captures and eliminates a wide range of contaminants, such as VOCs, odors, and harmful gases. This leads to a noticeable improvement in indoor air quality, creating a more pleasant and healthier environment. However, it's important to acknowledge that air purifiers relying solely on activated charcoal filtration may have limitations when it comes to addressing particulate matter like dust, pollen, and pet dander.

For a more comprehensive air purification solution, it is advisable to consider combining activated charcoal with other filtration technologies, such as HEPA filters, which excel at capturing particles. To maintain optimal performance, regular maintenance and timely replacement of the activated charcoal filter are critical. As the activated charcoal becomes saturated with adsorbed impurities over time, its effectiveness diminishes.

To keep a longer function of purifier maintenance and replacement schedule is essential to ensure continuous and efficient purification. Which concludes that an air purifier employing activated charcoal as a filtration medium proves to be highly beneficial for indoor spaces, effectively eliminating contaminants and enhancing air quality. The estimated emissions from the diesel generator, with significant use of charcoal filter reduce pollutant of total PM<sub>2.5</sub> and PM<sub>10</sub> ranging from 27 to 21%.

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