International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 06 | June - 2023 SJIF Rating: 8.176 ISSN: 2582-3930

Solar Power Outdoor Air Purifier with Air Quality Monitor

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Abstract - Air pollution has become a serious problem these modern days. Air pollution is present outside in the environment and has become difficult to provide safety inside the house. This polluted air can cause many serious health problems in cities. If someone is suffering from breathing problems like Asthma or Sinus or suffering from any lung problem then air-purifier acts as a surviving tool. Air purifier reduces the chances of health issues caused by indoor pollutants, which directly trigger neurological problems, respiratory infection or symptoms in asthma suffering. Hence, the fabrication of solar powered air purifier with air quality made using a HEPA filter, Activated Carbon Filter, Solar Panel, and some miscellaneous components that can become a low-cost but efficient alternative for surviving in such difficult times. This is regarding planning and making out an air setup system with quality check of the air at any place. It uses an extra high power energy resource for checking the efficiency of the system which reduces pollution in and outside. The air consists of many suspended particulates to be extracted. This is done in the basis of per area particulate method even in the key particulate contributing area such as urban areas and industrial areas. It deals with a nonconventional procedure and purposes to achieve absolute best air filtration results exploitation eco-accommodating and efficient method. It chips away at the major guideline of grip of the suspended particles inside the air with the fluid and settles down on account of being heavier than air and gets isolated from the air to improve quality of air.

***Key Words*:** Solar panel, Air purifier, Quality monitor

INTRODUCTION: As we know that air pollution level in cities is very high. Most of pollution comes as by-product from vehicle and construction of buildings; these are in form of particulate matter which is like methane, carbon dioxide, dust particulate etc. These create a lot of health problems like respiratory illness, decreased lung functions, development of diseases like asthma etc. Larger dust particles are major particulate among these and if its air quality value are down to minimum then air has very improved quality in which all type of living things can breathe easily. This project is about designing and fabricating an air purifier system which is powered by solar energy. The best way of controlling pollution is by using air purifiers but regular indoor air purifiers are small low power devices that don't possess enough purifying capability needed for outdoor spaces. Along with this there is also an issue of power supply in outdoor machines. So here we design a heavy-duty outdoor air purifier that is made for outdoor purification along and powered by solar panels so it is energy independent.

Fig -1: **Air Purifier**

LITERATURE SURVEY

Design and Fabrication of Solar Powered Air Purifier

Authors: - MANASH DEY (2018)

Now we have seen that how efficient is SOLAR POWERED AIR PURIFIER than other type of device available in market. It also very economical and do not have to replace any component quickly. It reduces particulate level to satisfactory position where a person

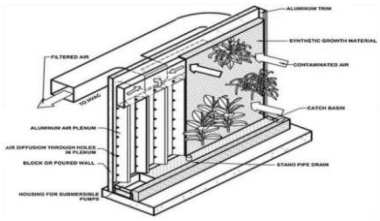
does not need to worry about pollution related problems. Apure and clean air is right of a human being and all other living creatures on this earth and this project is a small effort from our side to give the all their right. Also in future, modifications can be made to improve working efficiency without effecting setup.

Research Development in Sustainable and Healthy Building Ventilation.

Filtration technology is currently the integral part of air purification techniques that focus on particulate matters. The most common example is the fibrous filter Air filters can be divided into four types according to the particle filtration efficiency: pre filter, medium filter, high efficiency particulate air (HEPA) filter and ultra-low particulate air (ULPA) filter. The filtration efficiency of ULPA filter is over 99.999% with a particle diameter of 0.12–0.17-µm. Similarly, HEPA material has a strong ability for trapping particles as it can remove 99.97% of particulate matter, smog and bacteria that have a size over 0.3 µm, whereas the efficiency of medium filter is only 60–90%.

Bio filtration technique - biologically degrades air contaminants by taking advantage of the process of microbiotic oxidation. The process is as follows: when polluted air flows through a biofilter, the pollutants are degraded by bacteria and fungi that are immobilized in the biofilm on the surface of the packed bed. Consequently, a large area is typically required for the filtration of large airflows, which is one of the main disadvantages of this technique. The industry has been commonly applying biofilters for many years, as earlier research proved its effectiveness in odor control for a wide range of volatile organic compounds (VOCs) such as sulfur compounds and amines (Joseph, Marc, & Todd, 1999). Other common uses of biofiltration include purification of surface runoff and waste water processing.

Fig-3:Indoor bio filtration system



WORKING:

There is a chamber in which air is sucked in by the fan, while the air is entering it passed through strainer. Simultaneously water is pumped from reservoir to the atomizer, which converts water into small water droplets and these droplets are suspended into the chamber along with air. These water droplets have adhesive property due to which the particulate matter and dust particles get absorbed on them. This way air is cleaned and is flown out from chamber by exhaust fan. The water with dust and particulate matter is collected in evaporation tank, where water under goes natural evaporation process, leaving behind the dust and particulate matter these are periodically cleaned and water is used again in air cleaning process.

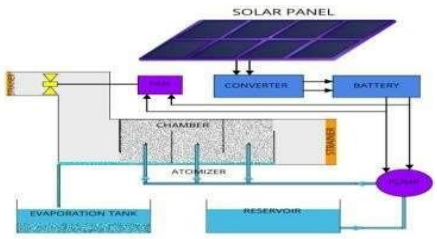


Fig-2: Block diagram for Solar Power System

EXPERIMENTAL READINGS

APPARATUS USED	PARTICULATE MATTER	MAXIMUM VALUE	MINIMUM VAL
AMBIENT ENVIRONMENT	PM2.5	71	55
	PM10	95	73
FAN	PM2.5	83	62
	PM10	111	83
FAN + PUMP	PM2.5	195	170
	PM10	260	226
FAN + INCENSE STICK	PM2.5	167	118
	PM10	222	157
FAN + PUMP + INCENSE STICK	PM2.5	257	205
	PM10	343	273

Table-1: Experiment results

Calculation based on PM2.5 reading

The deviated results of the above table is due to the measuring device limitation of detecting fine droplets as particulate matter and therefore the contribution due to water droplets must be eliminated, which can be done by

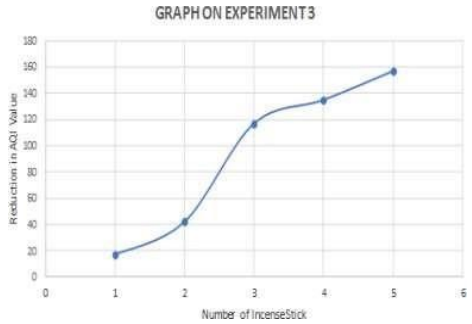
- Moisture content = (AQI of fan + pump + incense stick) – (AQI of fan + pump) = 222 117 = 105
- Amount of purification = AQI of incense stick – Moisture content = 999-105 = 894
- Purification percentage = [(reduction of AQI/AQI of incense stick) *100] = 89.4%

APPARATUS USED	PARTICULATE MATTER	MAXIMUM VA
AMBIENT ENVIRONMENT	PM2.5	75
	PM10	100
FAN	PM2.5	77
	PM10	103
FAN + PUMP	PM2.5	130
	PM10	173
FAN + INCENSE STICK	PM2.5	147
	PM10	196
FAN + PUMP+ INCENSE STICK	PM2.5	200
	PM10	267

Table-2: Experiment results

Calculation based on PM2.5 reading

- Moisture content = (AQI of fan + pump + incense stick) – (AQI of fan + pump) =180 - 118 = 62
- Amount of purification = AQI of incense stick – Moisture content = 999 - 62 = 937
- Purification percentage = (reduction of AQI/AQI of incense stick) *100 = 93.79%



Graph-1: Air QualityIndex Vs No. of incense stick

From this graph, we can conclude that the air purification system is able to maintain good to moderate pollution level even when the number of incense sticks is increased i.e. even when pollution level is increased.

OBJECTIVES:

- The goal of air purifier removes particles, gases, and other pollutants from indoor air, making the air cleaner to breathe.
- Energy consumption.
- Better air leads to better productivity in the workplace.
- Our project will bring: o Cleaner air o Improved quality of life

PROBABLE OUTCOMES:

- Heavy Duty Purifiers
- Automatic Operation
- Fast Purification
- Easy to Clean Removable Filters

COMPONETS USED:

Solar Panel

Fig-4: Solar Panel

There is an installation of a 100-watt solar panel. solar panel was selected as the main supply energy for the system. When radiation of sunlight reaches the panel, the particles of the sunlight or called photon then converted into electrical energy. The process takes place is called photovoltaic effect. As the photon strikes on solar cell, it will trigger electron in the solar cell and cause it moving freely or in excite state. This situation will produce an electric current.

Electrical Converter

Fig-5: Electrical converter

There is a 500-watt ability gadget put in gadget that is utilized to change over DC voltage of sunlight-based battery power supply into AC voltage that is utilized charge the battery inside the framework. It might be a design made by blasting the iron point bar. It introduces the confusion and furthermore the spouts. It is regularly extricated from and embedded into the chamber.

Battery

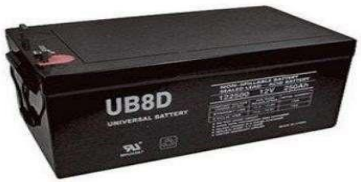


Fig-6: Battery

A battery with a high capacity and a low power rating is installed which delivers a low amount of electricity (enough to run a fan) for a long time.

Suction Fan

Fig-7: Suction fan

This fan has two implications that are to suck polluted air from the inlet environment into the flow away the clean air into the outlet environment.

S sensor

Fig-8: Sensor

An MQ135 air quality sensor is one type of MQ gas sensor used to detect, measure, and monitor a wide range of gases present in air like ammonia, alcohol, benzene, smoke, carbon dioxide, etc. It operates at a 5V supply with 150mA consumption. Preheating of 20 seconds is required before the operation, to obtain the accurate output.

WORKING:

Solar air purifier consists of a heavy-duty suction fan that pulls air from the bottom of the purifier through a layer of HEPA and Carbon filters for elimination of PM 10 PM 2.5 pollutants as well as gases. The purifier uses 2-layer purification, the first one being HEPA layer and second and active carbon filter. The combination of these 2 filters leads to dual filtration using a centrifugal air force to suck large amount of air and purify it of dust particles. Now this suction fan is used to suck out air using high power centrifugal force and blowing out fresh air from the top. The system also includes an air quality sensor and display to display the current air quality. We now use a solar panel for the power supply. The panel is used to supply electricity to battery which in turn powers to run the suction fan. The machine is mounted with 4 castor wheels and a handle for easy movement. This makes the air purifier portable so it can be easily moved to school play areas, parks, residential areas, public places for efficient and instant pollution control.

Fig-9: Project working model

CONCLUSION

By completing this project we have achieved a clear knowledge of comfort cooling system for human by usin non-conventional energy. This project would be full fill in both domestic & industrial backgrounds.
We also know about non-conventional energy sources & utilization. It reduces particulate level of satisfactory position where a person doesn't need to worry about pollution related problems.

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