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Fabrication of Solar Air Purification System

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ABSTRACT

Air pollution occurs when harmful or excessive quantities of substances including gases, particles, and biological molecules are introduced into Earth's atmosphere. It may cause diseases, allergies and even death to humans; it may also cause harm to other living organisms such as animals and food crops, and may damage the natural or built environment. Both human activity and natural processes can generate air pollution. Indoor air pollution and poor urban air quality are listed as two of the world's worst toxic pollution problems in the 2008 Blacksmith Institute World's Worst Polluted Places report. Outdoor air pollution alone causes 2. 1 to 4. 21 million premature deaths annually. According to the 2014 World Health Organization report, air pollution in 2012 caused the deaths of around 7 million people worldwide, an estimate roughly echoed by the International Energy Agency. Though government is taking several measures to control air pollution it is rising rapidly due to urbanization, excessive usage of automobiles, factories, construction works. , etc. , As we cannot deny the fact that development without transport, infrastructure and factories is not possible. We have to search for alternate means of air pollution reduction. However air purification / filtration requires lot of energy to drive induced air fans it is better to use solar energy rather than going for conventional thermal energy. As a part of our project dissertation we are planning to fabricate a solar air purification system for reduction of air pollution.

Keywords : Air Pollution, Filter, Solar Panel, Atmosphere

I. 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. Although there are many types of air purifier that are available in market but none of them are sufficient enough to deliver its working efficiency in public places like bus stand, near hospitals, traffic signals etc. Many institutes are also not able to afford these because of high cost and installation cost. Government organizations have very low budget for air purifier like extra expenditure. So, it is advisable to develop such air purifier which can cost less and are

highly efficient. So, we are making solar powered air purifier, which runs on solar energy without use of filters and also works for longer duration than others. It uses component like solar panel, fan, converter, pump, etc.

II. LITERATURE REVIEW

1. National Air Quality Index

Awareness of daily levels of air pollution is important to the citizens, especially for those who suffer from illnesses caused by exposure to air pollution. Further, success of a nation to improve air quality depends on the support of its citizens who are well-informed about local and national air pollution problems and about the progress of mitigation efforts. Thus, a simple yet effective communication of air quality is important. The concept of an air quality index (AQI) that transforms weighted values of individual air pollution related parameters (e. g. SO2, CO, visibility, etc.) into a single number or set of numbers is widely used for air quality communication and decision making in many countries.

2. Identification and Characterization of Particulate Matter Concentrations at Construction Jobsites

The identification and characterization of particulate matter (PM) concentrations from construction site activities pose major challenges due to the diverse characteristics related to different aspects, such as concentration, particle size and particle composition. Moreover, the characterization of particulate matter is influenced by meteorological conditions, including temperature, humidity, rainfall and wind speed. This paper is part of a broader investigation that aims to develop a methodology for assessing the environmental impacts caused by the PM emissions that arise from construction activities. The objective of this paper is to identify and characterize the PM emissions on a construction site with different aerodynamic diameters (PM2. 5, PM10, total suspended particulates (TSP)), based on an exploratory study. Initially, a protocol was developed to standardize the construction site selection criteria, laboratory procedures, field sample collection and laboratory analysis.

3. Components

Solar Panel

Photovoltaic solar panels absorb sunlight as a source of energy to generate direct current electricity. A photovoltaic (PV) module is a packaged, connected assembly of photovoltaic solar cells available in different voltages and wattages. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. The most common application of solar energy collection outside agriculture is solar water heating systems. From a solar cell to a PV system. Photovoltaic modules use light energy (photons) from the Sun to generate electricity through the photovoltaic effect. Most modules use wafer-based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module can be either the top layer or the back layer. Cells must be protected from mechanical damage and moisture. Most modules are rigid, but semi-flexible ones based on thin-film cells are also available. The cells are connected electrically in series, one to another to a desired voltage, and then in parallel to increase amperage. The wattage of the module is the mathematical product of the voltage and the amperage of the module . A PV junction box is attached to the back of the solar panel and functions as its output interface. External connections for most photovoltaic modules use MC4 connectors to facilitate easy weatherproof connections to the rest of the system. Also, a USB power interface can be used. Module electrical connections re made in series to achieve a desired output voltage or in parallel to provide a desired current capability of the solar panel or the PV system. The conducting wires that take the

current off the modules are sized according to the ampacity and may contain silver, copper or other non-magnetic conductive transition metals. Bypass diodes may be incorporated or used externally, in case of partial module shading, to maximize the output of module sections still illuminated. Some special solar PV modules include concentrators in which light is focused by lenses or mirrors onto smaller cells. This enables the use of cells with a high cost per unit area (such as gallium arsenide) in a cost-effective way. Solar panels also use metal frames consisting of racking components, brackets, reflector shapes, and troughs to better support the panel.

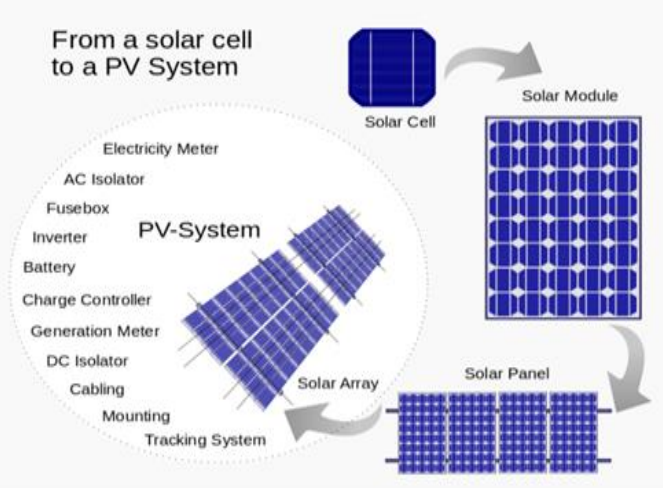

Fig : 1. From Solar Cell to a PV Cell

III. AIR FILTER

A particulate air filter is a device composed of fibrous or porous materials which removes solid particulates such as dust, pollen, mold, and bacteria from the air. Filters containing an adsorbent or catalyst such as charcoal (carbon) may also remove odours and gaseous pollutants such as volatile organic compounds or ozone. Air filters are used in applications where air quality is important, notably in building ventilation systems and in engines. Some buildings, as well as aircraft and other human-made environments (e. g. , satellites and space shuttles) use foam, pleated paper, or spun fiberglass filter elements. Another method, air ionizers, use fibers or elements with a static electric charge, which attract dust particles. The air intakes of internal combustion engines and air compressors tend to use either paper, foam, or cotton filters. Oil bath filters have fallen out of favor. The technology of air intake filters of gas turbines has improved significantly in recent years, due to improvements in the aerodynamics and fluid dynamics of the air-compressor part of the gas turbines.

INTERNAL COMBUSTION ENGINE AIR FILTERS

The combustion air filter prevents abrasive particulate matter from entering the engine's cylinders, where it would cause mechanical wear and oil contamination. Most fuel injected vehicles use a pleated paper filter element in the form of a flat panel. This filter is usually placed inside a plastic box connected to the throttle body with duct work. Older vehicles that use carburetors or throttle body fuel injection typically use a cylindrical air filter, usually between 100 millimetres (4 in) and 400 millimetres (16 in) in diameter. This is positioned above or beside the carburetor or throttle body, usually in a metal or plastic container which may incorporate ducting to provide cool and/or warm inlet air, and secured with a metal or plastic lid. The overall unit (filter and housing together) is called the air cleaner.

Fig : . 2. Air Filter

FAN

Due to the low pressure, high volume air flows they create, most fans used are of the axial flow type; centrifugal and crossflow fans type. Two important functional specifications are the airflow that can be moved, typically stated in cubic feet per minute (CFM), and static pressure. Given in decibels, the sound volume figure can be also very important for home and office computers; larger fans are generally quieter for the same CFM.

Dimensions

The dimensions and mounting holes must suit the equipment that uses the fan. Square-framed fans are usually used, but round frames are also used, often so that a larger fan than the mounting holes would otherwise allow can be used (e. g. , a 140 mm fan with holes for the corners of a 120 mm square fan). The width of square fans and the diameter of round ones are usually stated in millimeters.

Typically, square 120 mm and 140 mm fans are used where cooling requirements are demanding, as for computers used to play games, and for quieter operation at lower speeds. Larger fans are usually used for cooling case, CPUs with large heatsink and ATX power supply. Square 80 mm and 92 mm fans are used in less demanding applications, or where larger fans would not be compatible. Smaller fans are usually used for cooling CPUs with small heatsink, SFX power supply, graphics cards, northbridges, etc.

Fan sizes and corresponding screw hole spacing :
40mm fan size - 32mm between screw holes.
50mm fan size - 40mm between screw holes.
60mm fan size - 50mm between screw holes.
70mm fan size - 60mm between screw holes.
80mm fan size - 71. 5mm between screw holes.
92mm fan size - 82. 5mm between screw holes.
120mm fan size - 105mm between screw holes.
140mm fan size - 124. 5mm between screw holes.
200mm fan size - 154mm between screw holes.
220mm fan size - 170mm between screw holes.

Rotational speed

The speed of rotation (specified in revolutions per minute, RPM) together with the static pressure determine the airflow for a given fan. Where noise is an issue, larger, slower-turning fans are quieter than smaller, faster fans that can move the same airflow. Fan noise has been found to be roughly proportional to the fifth power of fan speed; halving the speed reduces the noise by about 15 dB. Axial fans may rotate at speeds of up to around 23,000 rpm for smaller sizes. Fans may be controlled by sensors and circuits that reduce their speed when temperature is not high, leading to quieter operation, longer life, and lower power consumption than fixed-speed fans. Fan lifetimes are usually quoted under the assumption of running at maximum speed and at a fixed ambient temperature.

Air pressure and flow

A fan with high static pressure is more effective at forcing air through restricted spaces, such as the gaps between a radiator or heatsink; static pressure is more important than airflow in CFM when choosing a fan for use with a heatsink. The relative importance of static pressure depends on the degree to which the airflow is restricted by geometry; static pressure becomes more important as the spacing between heatsink fins decreases. Static pressure is usually stated in either mm Hg or mm H2O.

4. Fabrication of Structure

Supporting Columns

Fabrication of structure is started by taking mild steel angle of 1 inch width and 3mm thickness is taken

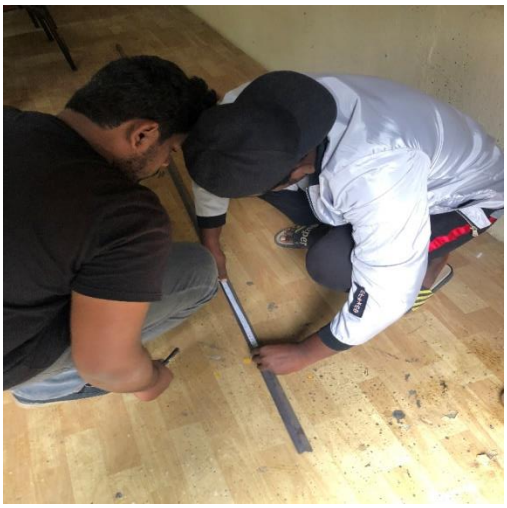

Fig. 4. Marking For Supporting Rod

Marking is performed for the length of 300mm as the pillars of the structure.

Fig. 5. Cutting of Supporting Rods

Cutting is performed using 4 inch grinding wheel as per the above marking.

Fig : 6. Grinding of Supporting Rod

Grinding is performed to achieve good surface finish using grinding wheel.

Solar Panel Holder

Mild steel angle 1 inch face width and 3mm thickness is taken.

Fig : 7. Welding of Solar Panel Holder

Marking is performed according to the holes provided on solar panel for fitting

Fig : 8. Drilling of holes

Holes are drilled using drilling machine.

Fig : 9. Solar Panel Holder

The plates are fixed to the solar panel using nuts and bolts.

Filteration setup

The main air filtering setup is made by fixing the sucktion fan to the filter . firstly the fan is fixed to a plate which has a hole of diameter which is almost equal to the fan's inner diameter.

Fig : 10. Suction Fan Fixed to the Plate

Then it is fixed using nuts and bolts to the four holes provided on the fan.

Fig : 11. Arrangement of Fan

Then this setup is fixed to the one open end of the filter and is tightly packed using seal.

Fig : 12. Seal packing of setup

The other end of the filter is fixed to the plate using a bolt to the center. Then it is fixed to the mild steel angle in 3 sides Therefore the filtration setup is ready. Welding process.

As the welding process begins by welding the support columns to the supporting base. After that it is given strength by adding small support bars near the joints in inclined position.

Fig : 13. Welding Of Supporting Columns

Next the solar panel supports are welded at an inclined position at an angle of 120 to get maximum output and it is performed carefully so that the panel doesn't get damaged. It is also given strength by adding small supports near the joints at inclined position. After that the filtration setup is welded to the columns at a height of 400mm with the help of angle clamps.

Fig : 14. Welding of Filteration Setup

DESIGN

Fig : 15. Design of Setup

IV. WORKING

The solar air purifier works on electricity which is produced by solar panel using solar energy from sun. it helps to run the suction fan which sucks the polluted air from environment which is to be purified through the filter which filters the air from dust particles and harmful bacteria. . Then the air gets purified and it escapes through the fan to environment. It is specially designed for outdoor use and is an endless process. There are different types of filters of different particulate size used according to the air pollution index.

Fig : 16. Final Setup

V. CONCLUSION

Now we have seen that how efficient is solar power air purifier done other type of device available in the market. It is also 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. A pure 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 all their rights Also in future modification can be made to improve the working efficiency without effecting setup.

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