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Study on MRR, TWR in AISI 316 by Solar Powered and Centrifugal Air Filtration System

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Abstract:

To ensure ongoing sustainability, achieve emission goals, and manage dust, the majority of the manufacturing sector must overcome substantial obstacles. Either preventing dust emissions or removing dust once it has entered the atmosphere is viable options for reducing dust emissions. Although the idea behind a dust collection system appears straightforward, if the design specifics aren't carefully considered, a lot can go wrong. The effective use of available space, the length of duct runs, the simplicity of reintroducing collected dust to the process, the required electrical requirements, and the choice of the best filter and control equipment are just a few of the engineering decisions that go into dust control systems. Determining the issue, choosing the right tools for the job, and creating the ideal dust collecting system for an operation are all crucial technical decisions. A well-designed dust collection system must take into account both the dust's characteristics as a possible pollutant and the characteristics of the dust capturing system. An exhaust hood, ductwork, dust collector, and air mover/fan are four essential parts of a dust collection system. By carefully choosing and sizing exhaust hoods, ducts, dust collectors, and air blowers or fans, this project aids in understanding as a design guide that provides information that will help to achieve maximum performance and energy efficiency in commercial dust collection systems. The advantages of a well designed dust collection system are solar powered. A well-designed dust collection system has many advantages that lead to a dust-free workplace that boosts productivity, complies with emission requirements, and boosts employee or people's morale in the sector. The design analysis and best selection of a dust collection system are also demonstrated in this model for various manufacturing industries that are experiencing dust emissions but are unable to control them. These systems can also assist in controlling odor, moisture, and other unfavorable environmental conditions.

Keywords: Cyclone separator, dc blower, Centrifugal impeller etc.

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I. INTRODUCTION

A dust collecting system removes particle contaminants from the air in manufacturing facilities, workshops, and industrial complexes. The device cleans the air by passing it through a succession of sealed filters. Once the air has been cleaned, it is either vented outdoors or recirculated after meeting the required emission limits.

As environmental concerns have developed, dust collection devices have become essential for companies that generate huge amounts of dust particles and ambient gases. Manufacturers of dust collecting systems must follow tight government rules and ensure their customers that their systems are efficient and meet EPA, NFPA, and MSHA regulations. A dust collecting system is intended to remove particulates from air generated during an operation. This brief explanation is an

oversimplification of the imagination necessary to design and manufacture a method of catching dangerous pollutants. A dust collection system consists of a blower, a dust filter, a cleaning system, a receptacle, ductwork, and a method for collecting particulate matter. Dust collectors include fabric filter bag houses, inertial separators (also known as mechanical cyclones), cartridge collectors, wet scrubbers, and electrostatic precipitators. Bag house dust collectors are the most often used since they are 99% efficient.

The sorts of pollutants eliminated vary depending on the industry. Dust collector manufacturers design and develop equipment to specifically meet the needs of each environment condition. The ductwork design may appear straightforward, but it must be carefully addressed to guarantee that the system operates properly. The pipe size is determined by the tool size, air needs, required pipe length, the number of machines being serviced, and the types of particles extracted. The ductwork size varies throughout the system, and it gathers air brought in by fans and collectors.

Several aspects must be considered when installing a fan or blower in a dust collection system, despite its simple design. The first of these elements is the amount of air that must be moved. This is measured in cubic feet per minute (CFM). The next factor to examine is the static pressure across the system. Temperature, airborne chemicals, and moisture content are all factors to consider. The blower or fan is an essential component of a dust collection system since it is the mechanism that draws polluted air into the ductwork away from the workplace and transports it to the filtering and cleaning systems. The two main types of blowers are centrifugal and axial. The dust filter is the air-cleaning component of the dust collection system. There isn't a single standard dust collection filter. In essence, the blower draws air from its location into the filter, which eliminates particles from the air. The air-to-cloth ratio refers to the amount of air that flows through one square foot of the filter.

II. LITERATURE REVIEW

1.Di Zhang, Zuyun Chen and Fangquan Zhong, "Experimental Study on Dust Removal Performance of Electrostatic Water Film Cyclone Dust Collector"

Due to their limitations, conventional electric and water film dust removal methods struggle to handle fine dust. This study presented information on and examined the electrostatic water film cyclone dust collector (EWFCDC). By using the variable control approach, the impacts of inlet flow speed, water film flow rate, and corona pole form on dust removal performance were investigated. At EWFCDC, an orthogonal test was carried out to improve the test design and operating parameters based on the single-factor experiment. The pressure loss in the cyclone cylinder, when there is no water film and no corona pole, is a quadratic function of the inlet flow speed, and it is 2418.10 Pa at a 21.25 m/s inlet flow speed. The effectiveness of dust removal may be increased by increasing the water film flow rate. The effectiveness of dust removal is greatly influenced by the type of corona pole used, and cage needling thread is the optimal type. The electrostatic water film cyclone's multimechanism coupling significantly increases the effectiveness of dust removal.

2. D.K.Mohankumar and C.Sooriyakanth " Design and Fabrication of Solar Powered Dust Collector for Industrial Applications"

The object of study is a solar-powered dust collector. It is a more advanced version of portable commercial dust collectors. It operates on the basis of a manual shaking mechanism. A few articles and books have been written about the investigation and research of this type of dust collectors the goal of this project is to explain the efficiency and energy changes of a solarpowered dust collector. Pollution is greatly reduced and the environment is aided by the use of renewable energy such as solar energy

3. A.I. Khan & M. Y. Bhuiyan, -"Analysis of Design and Purchase Decision of Central Dust Collection System"

The central dust collecting system for Bangladeshi furniture industries is better addressed

in this study, along with consumer knowledge of the issue for purchasing decisions. Furniture industries that strive for high-quality goods, appropriate safety, operations, and maintenance include dust collecting systems as an essential component. Furniture businesses must prioritise an effective woodworking dust collecting system to maintain their operations. The main cause of issues with dust collection systems is shoddy ductwork and hood configurations. A thorough study of all the aspects involved is required in order to make an informed decision about the purchase of a dust collector. This paper presents an improved central dust collection system for woodworking that takes proper dust suction system regulation into account. The enhanced central dust collecting system for woodworking shown in this study incorporates proper control of dust suction systems, moisture, air speed, duct and hood design, installation, and other factors.

4.Nanaware Tukaram Sunil1 , Hole Vivek Baban," Review Paper on Solar Dust Collector"

It is quite difficult to find cooperative people in today's competitive society. Many people gave it their entire support in our initiative. Any project is not a solo endeavour. It represents the labour of many minds, hands, and hearts. The same concept that produces power from a normal battery's chemical reaction also produces electricity from solar panels. The silicon's semiconductive characteristic is essential to the operation of solar panels. The way electrical appliances function has been transformed by the special chemical known as silicon. The solar panels on this property are utilised to produce electricity. We must comprehend how silicon functions at the atomic level in order to comprehend how solar panels function.

III. MATERIALS AND PARAMETERS

✓ *The major components in this project experimental setup are as follows,*

1. *12V-Solar Panel with stand*
2. *Acessories*
3. *Battery*
4. *Fan*
5. *Automizer*
6. *Pump*
7. *Pipe connector*
8. *DC Blower*

- 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.

Fig.1. Solar Powered & Centrifugal Air Filteration Machine Setup

When the sun shines onto a solar panel, energy from the sunlight is absorbed by the PV cells in the

panel. This energy creates electrical charges that move in response to an internal electrical field in the cell, causing electricity to flow. A photovoltaic (PV) cell, commonly called a solar cell, is a non-mechanical device that converts sunlight directly into electricity. Some PV cells can convert artificial light into electricity. Sunlight is composed of photons, or particles of solar energy.

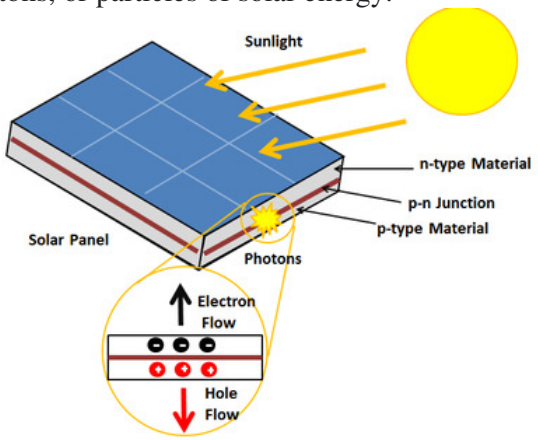

Fig.2 Photovoltaic (PV) cell

1. **Solar PV** installations require support structures, commonly referred to as racking or mounting, to secure the panels to the ground or building roof. For ground mounted structures racking may be mounted onto foundations that are driven (I beams, channels or posts), or screwed (helical piles and earth screws)

2.DC Blower

A DC blower is a type of fan used in network servers and telecommunications systems with high impedance from back pressure. These types of fans contain a circular impeller within an enclosed cage, which is often referred to as a "squirrel cage".

Blowers increase the pressure of the absorbed gas by a series of vortex motions formed by the centrifugal movement of the impeller. When the impeller is rotating, the channels in the impeller push the air forward by the centrifugal movement and a helical movement occurs.

An air blower uses a rotating impeller/rotor to create a vacuum. This vacuum causes air to rush into the blower. The air enters the centre of the impeller and is divided by the rotating blades. Centrifugal force increases the speed of the air and volume of the air stream within the housing.

Blowers work by way of an increase in pressure of either air or gas through the centrifugal movement of a rotor. The blower takes in air/gas via an inlet valve, which causes the impellers (or rotors) to rotate, which creates a centrifugal force which propels the air or gas.

Blowers operate at moderate pressure, with an air pressure ratio of 1:1.1 to 1:1.2, and fans move large volumes of air with little to no change in air pressure. Blowers direct air in a specific direction, while fans circulate air throughout a defined space.

Applications of High Air Flow DC Blower Fans

- ✓ Network Servers.
- ✓ Telecommunication Systems.
- ✓ Medical Systems.
- ✓ Automotive Applications.

IV. RESULT AND DISCUSSION

1. OBJECTIVES OF THE INVENTION

- ❖ To design and develop a cyclone dust collector systems using bifacial solar PV and maintain the air quality in the environment.
- ❖ To utilize the PV and wind energy conversion systems effectively using the controllers
- ❖ To increase electric power generation and promote the use of green energy
- ❖ To compare the PV characteristics and performance of Bifacial solar PV panels over Monocrystalline solar panels to operate the impellers effectively.
- ❖ To measure the air polluted spots and preserve the air quality.

2. SUMMARY OF THE INVENTION

- ❖ To design and develop cyclone dust collector systems using Locating solar PV panels on both sides of the cyclone dust collector
- ❖ Introducing bifacial solar panels to extract more solar power for better operations
- ❖ This system can operate in various thermal and climatic conditions.

- ❖ Can be implemented in air-polluted areas.
- ❖ To utilize renewable energy resources properly

3. DETAILED DESCRIPTION OF THE INVENTION

Cyclone Dust collector are Mechanical Separator using inertia effect &Centrifugal force to separate large dusts and useful particles in industrial applications. A cyclone dust collector is air pollution control equipment used to remove large dust particles from industrial process exhausts. Cyclone Separator is also same and uses centrifugal forces to collect useful particles in product recovery. Both are one and same, only application differs. The efficiency of Cyclone collectors is high with higher particle size and are normally used as primary collectors in multistage filtration application. In some applications, a properly designed high efficient Cyclone Separator with added filter bags or filter cartridges fitted at exhausts serves as main collectors. Cyclone dust collectors are the most oldest and most widely used and reliable dust collection equipment used across various industries. It has many advantages like low initial costs, Low maintenance costs, less wearable parts, can work at high temperature applications. Since the performance of cyclone separator depends directly on particle size and weight (Centrifugal forces), a properly sized and designed cyclones, inlet ducting, rotary air locks, and filtering bag and cartridge arrangement at exit will boosts its performance and efficiency in collecting micron sized dust particles. To properly design a safe and efficient cyclone dust collectors, we consider input factors like dust loading, particle size distribution, input gas temperature and pressure, corrosive, abrasive, explosive and sticky nature of dusts, plugging and electro staticnature of dusts, moisture content etc.

This project will be more suitable for the common man as it has many more advantages. The solar energy (nonconventional energy) is vastly available, so it is easy to charge the battery and is also pollution free. But the initial investments in the solar- powered dust collector will be high, and it will be easy to fabricate and install the setup. At present, in order to curtail global warming and ozone depletion, the government of India is offering subsidies for solar equipment. Because of the rapid industrialization, the amount of dust particles in our surroundings is very high, causing environmental and material impacts. Moreover, this setup is well suited for industrial sites, construction areas, etc. This setup may be incorporated into the cell phone towers for cost reduction and multiple purposes such as catalytic convertor etc. This system was designed, fabricated successfully, and tested. It works satisfactorily and collects the dust. We hope that this will remain the most versatile and interchangeable one even in the future.

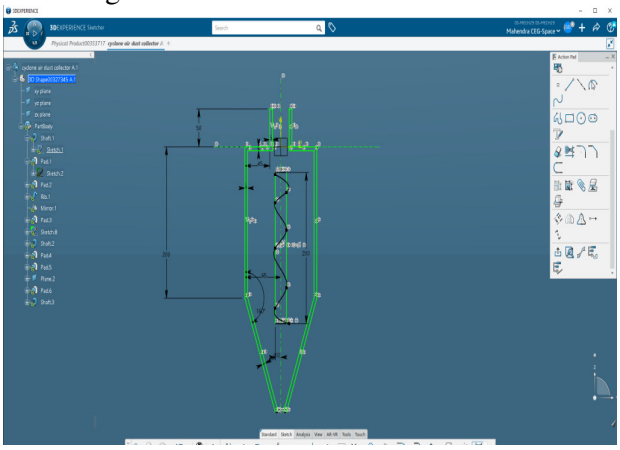

Fig.3 Cyclone effect

Cyclone separators are generally able to remove somewhere between 50-99% of all particulate matter in flue gas. How well the cyclone separators are actually able to remove this matter depends largely on particle size. If there is a large amount of lighter particulate matter, less of these particles are able to be separated out. Because of this, cyclone separators work best on flue gases that contain large amounts of big particulate matter.

V.CONCLUSION

i**n** our invention, impellers are introduced inside the cyclone dust collector system to increase the airflow efficiency and the filtration level. a portable system is introduced to run without electricity, using solar energy to remove dust particles and preserve a safe environment.

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