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Design of Dust Emission to Avoid Air Pollution

Mr. N. Iyappan[1], Gunal A[2], Mohamed Anees Rahman S[3], Mohan A[4], Veeramani Aravindh I[5]
Associate Professor, Department of Mechanical Engineering[1]
Students, Department of Mechanical Engineering[2,3,4,5]
Anjalai Ammal Mahaligam Engineering College, Thiruvarur, India

Abstract: *Amounts of Industries in India have been recognized a sharply increase from year to year with the increment reaching to 42 % per annum. Meanwhile Machineries produce particulate emissions in different sizes with high concentrations depending on type of vehicles, fuels, and engine capacity. Motor Particle emissions are not only to significantly contribute the atmospheric particles but also adverse to human health. In order to reduce the particle emission, it is needed a filter. This study was aimed to develop a thin filter using coconut fibre to reduce particulate emissions for Machines. The filter was made of coconut fibres that were grinded into power and mixed with glues The filter was tested by the measurements of particle concentrations coming out from the vehicle exhaust directly and the particle concentrations after passing through the filter. The efficiency of the filter was calculated by ratio of the particle concentrations before coming in the filter to the particle concentrations after passing through the filter. The results showed that the efficiency of the filter obtained more than 30%. The efficiency increases sharply when a number of the filters are arranged parallelly*

Keywords: Emission

I. INTRODUCTION

Air Quality has become a prime issue of importance for all countries around the world. Air quality depends on particulate matter and gaseous pollutants produced by a number of sources. The number of pollutants in a volume of air, named pollutant concentration, is associated with impacts on health. In terms of particulate matter not only has a serious impact on human health but also play an important role in global change. Particulate matter is a mixture containing many different components mostly emitted by machine and heavy-duty diesel vehicles (bus and truck). Especially in the rural area, the contribution of motor vehicles to particulate matter in the atmosphere is significantly high. Meanwhile motor vehicles in Indonesia grow very fast from year to year. The growth of motor vehicles raises to more than 20 presences per year. The Indonesian Statistic Agency data shows that a number of machineries was 7.981.480 unit in 2021, and they were recorded 70.714.569 in 2022 Consequently much more particulate matters release to the atmosphere annually. Particulate matters emitted from motor vehicles in different size distribution of PM (particulates with the diameter less than 10 km), PM; PM (particulates with the diameter less than 2.5 µm), and ultrafine particles PM (particulates with the diameter less than 01 µm). In order to reduce particulate matter emitted by motor vehicles is needed a filter. This study was aimed to develop a filter to reduce particulate matters especially ultrafine particles from machines. Filtration is defined as the process of separating dispersed particles from a dispersing fluid by means of porous media. The dispersing medium can be a gas or gas mixture, most frequently air. Nonwoven fabrics are widely used for filtration application. The nonwoven fabric manufacturing technology involves producing nonwoven fabric with fibre of lower diameter (finer fibre), higher the mass per unit area (GSM) for obtaining required filtration efficiency but the filtration efficiency is decreased by increasing the air permeability. The air flow rate is one of the important factors to decide the filtration performance.The surface roughness and variation in surface enhances the filtration efficiency of the filters. In Air conditioning system, mostly synthetic fibres were used. AC systems were frequently used in residential and industrial applications. Filter has to be changed yearly once for better energy consumption, synthetic filters when disposed causes landfills to our environment. Hence, Coir fibres were used to replace the synthetic fibres. In AC systems, the filters that are used has lower thickness, so needle punched nonwoven has beenneglected. By chemical bonding, pores in the filter may be clogged during curing process. Thus, Coir fibre filter is developed by adhesion bonding, using resin as binder. In various industrial sectors, maintaining high-quality air

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standards is paramount for ensuring the health and safety of workers, protecting sensitive equipment, and adhering to environmental regulations. Carbon airfilters, particularly those utilizing activated carbon, have emerged as indispensable tools for addressing air quality challenges in industrial settings. These filters effectively remove a wide range of contaminants from the air, including volatile organic compounds (VOCs), Odors, gases, and particulate matter, making them versatile solutions for diverse industrial applications. The utilization of carbon air filters in industry stems from their unique properties and benefits. Activated carbon, derived from materials such as coconut shells, coal, or wood, undergoes a process that creates a highly porous structure with a large surface area. This structure allows activated carbon to adsorb contaminants onto its surface, effectively trapping them from the air stream. Additionally, activated carbon can be engineered to target specific pollutants, making it a versatile solution for various industrial air quality challenges. In industries such as manufacturing, chemical processing, food production, and wastewater treatment, carbon air filters play a crucial role in mitigating the adverse effects of airborne contaminants.

II. METHODOLOGY

Assessment of Air Quality Requirements:

Conduct an assessmicknesssent of the industrial facility to identify specific air quality requirements, including the types and concentrations of contaminants present, regulatory standards, and operational needs.

Identification of Contaminants:

Identify the types of contaminants present in the air, such as volatile organic compounds (VOCs), odors, gases, particulate matter, or specific chemicals emitted from industrial processes.

Selection of Carbon Air Filters:

Choose the appropriate carbon air filters based on the identified contaminants and air quality requirements. Consider factors such as the type and quality of activated carbon, filtration efficiency, flow rate, and compatibility with existing HVAC systems or air handling equipment.

System Design and Integration:

Design the layout and configuration of the carbon air filtration system, considering factors such as airflow patterns, filtration media placement, ductwork design, and integration with existing infrastructure.

Ensure proper sizing of filters and equipment to meet the air quality demands of the facility while optimizing energy efficiency and operational costs.

III. LITRATURE REVIEW

S. No:	Name of the Author	Title	outcome
1.	S. Ravindran, Dept. of Mech. Engg., Bharath Inst. of Sci. and Tech., Bharat University, Selaiyur, Chennai - 600 073, India	Stone Crushers and Dust Problem.	• Open call for the development of a dust extraction system to Indian environmental conditions. • The proposed system should be economical and capable of in-situ performance testing.
2.	Mr. A. C. Dubal , Assistant Professor SYMBIOSIS SKILL & OPEN UNIVERSITY PUNE.PhD Scholar M.E.Civil (Structure),M.B.A,LMISTE	The Utilization Of Crushed Stone Dust As A Replacement Of Sand In Cement Concrete	• Explores the potential of replacing sand with stone dust in concrete mixes. • It emphasizes the importance of understanding the impact of fine aggregate on strength and workability before replacement. • The study suggests that stone dust can fully replace sand with appropriate mix adjustments.

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3.	Dr. Qiang (Chong) Zhang, P.Eng, Professor University of Manitoba	Design analysis of Dust collection system	• The importance of effective dust control in manufacturing industries to meet emissions regulations and sustain operations. • It discusses the complexities of designing dust collection systems, highlighting key engineering decisions and components involved. • It concludes by stressing the need to consider customization and upgrades within an overall air quality control strategy.
4.	Central Pollution Control Board Ministry of Environment, Forest and Climate Change Parivesh Bhawan	Environmental Guidelines for Stone Crushing Units	• The catch in this article lies in the detailed environmental guidelines provided for stone crushing units to mitigate fugitive dust emissions. • While the guidelines outline numerous measures to control pollution, including water sprinkling, enclosure of crushers, installation of dust extraction systems, and proper covering of conveyor belts, the effectiveness of implementation depends heavily on compliance and enforcement by regulatory authorities.

IV. MATERIAL SELECTION

Material selection is a step in the process of designing any physical object. In the context of product design, the main goal of material selection is to minimize cost while meeting product performance goals. Systematic selection of the best material for a given application begins with properties and costs of candidate materials.

DUST COLLECTOR BODY

STAINLESS STEEL

Stainless steel, also known as inox, corrosion-resistant steel (CRES) and rustless steel, is an alloy of iron that is resistant to rusting and corrosion. It contains at least 10.5% chromium and usually nickel, as well as 0.2 to 2.11% carbon. Stainless steel's resistance to corrosion results from the chromium, which forms a passive film that can protect the material and self-heal in the presence of oxygen. The alloy's properties, such as luster and resistance to corrosion, are useful in many applications. Stainless steel can be rolled into sheets, plates, bars, wire, and tubing.

Fan selected – BLDC Fan

An exhaust BLDC (Brushless DC) fan commonly used for ventilization and air extraction purpose in various application including in industrial,commercial and residential setting.

Filter selection

Filter selected – Coconut Fibre

The coconut fibre acts as a most effective filtering medium to treat domestic waste water our research team to studied a wide range of synthetic and organic material The result where clear coconut husk fragments offer the most reliable performances over

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time and because they are 100% natural in renewable and compostable they make our eco system the most sustaianable solution available.

CAD MODEL OF DUST COLLECTOR

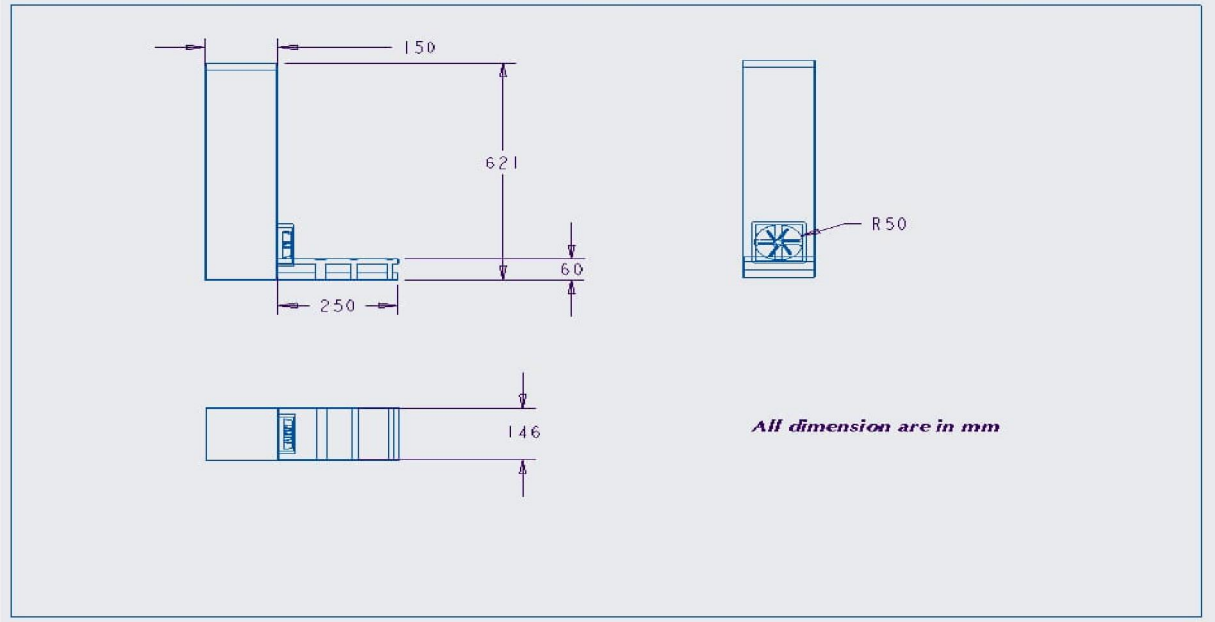

FIG 1.1 2D DIAGRAM

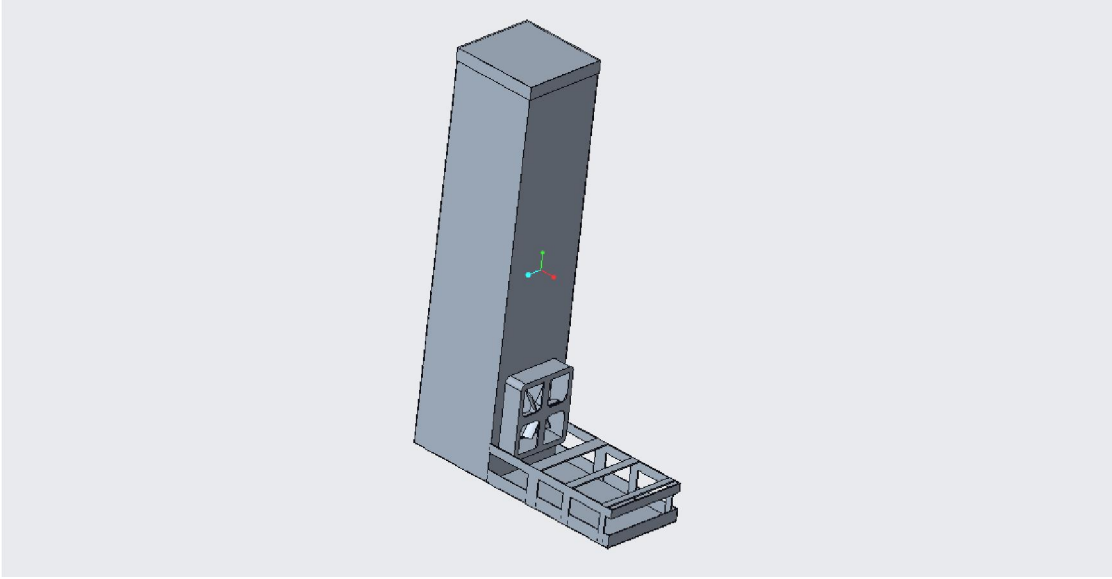

FIGURE 1.2 3D DIAGRAM

V. PROCESS INVOLVED IN FABRICATION

5.1 OXY-FUEL WELDING

Also known as oxyacetylene welding or oxy welding, uses fuel gases and oxygen to weld and cut metals.

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5.2 GAS METAL ARC WELDING

Commonly termed MIG (metal, inert gas), uses a wire feeding gun that feeds wire at an adjustable speed and flows an argon-based shielding gas or a mix of argon and carbon dioxide (CO2) over the weld puddle to protect it from atmospheric contamination.

5.3 SHIELDED METAL ARC WELDING

Also known as manual metal arc welding (MMA or MMAW), flux shielded arc weld in or informally as stick welding, is a manual arc welding process that uses a consumable electrode covered with a flux to lay the weld. An electric current, in the form of either alternating current or direct current from a welding power supply, is used to form an electric arc between the electrode and the metals to be joined.

The work piece and the electrode melts forming a pool of molten metal (weld pool) that cools to form a joint. As the weld is laid, the flux coating of the electrode disintegrates, giving off vapors that serve as a shielding gas and providing a layer of slag, both of which protect the weld area from atmospheric contamination.

5.4 CUTTING OPERATIONS

In this project it is used to cut the raw material such as Plates, rod. This is done by arc cutting machine.

VI. CONCLUSION

In conclusion, coconut fiber-based air filters emerge as a sustainable and efficient solution for addressing air filtration requirements across diverse industrial settings. Leveraging activated carbon derived from coconut shells, these filters offer a multitude of advantages. Their exceptional adsorption properties enable the effective capture of a wide spectrum of airborne contaminants, ranging from volatile organic compounds (VOCs) to odors, gases, and particulate matter. Beyond their filtration efficacy, the utilization of coconut fiber aligns with environmental sustainability objectives, harnessing a renewable and biodegradable resource. This eco-conscious approach not only reduces reliance on fossil fuel-derived materials but also promotes a circular economy ethos. Moreover, coconut-based filters prove to be cost-effective, boasting relatively low raw material expenses and extended service lifespans. Their versatility allows for customization to specific industrial needs, whether integrated into existing HVAC systems or deployed as standalone units. By ensuring compliance with stringent environmental regulations, coconut fiber-based air filters contribute to maintaining healthy indoor environments for workers, mitigating respiratory risks, and upholding occupational health standards. Furthermore, ongoing research and development efforts continually enhance these filters' performance and efficiency, driving innovation in air quality management practices within industry. In essence, coconut fiber-based air filters represent a dependable, sustainable, and economically viable solution for elevating indoor air quality and fostering safer, healthier workplaces across a spectrum of industrial sectors.

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