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Wheel with Pollution Filters

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Abstract

People switching from cars to bicycles is already an important step towards cleaner air, especially in big cities, where the pollution is reaching alarming levels. But what if we could take it a step further? What if your bicycle could actually help reduce pollution by purifying the air around it? What if a wheel that consists of three different filters that are capable of purifying the air from pollutants is fitted in the bicycle? Using ABS, nylon and stainless steel, it is desired that it will help reduce pollution in our cities. Concerned about environmental issues, For example, road transport is said to be responsible for 70% of nitrogen dioxide emissions and 30% of hazardous particulate matter in the air. A number of governments are reacting to this major problem by creating designated lanes for cyclists or by offering bicycles, electric or not, for city dwellers to rent. Recently, we saw how additive manufacturing has a major role to play in cycling, making it possible to build more efficient and comfortable two-wheeled vehicles, using less material and reducing logistical delays and transport. This wheel can be very useful in future as the level of pollution is increasing day by day.

Keywords: Air Pollution, Wheel, Filter, Bike Filter, Pollution Filter.

Introduction

As we know that the wheel with pollution filters has already come into existence and in the process of testing.

This wheel is beneficial to the environment. The wheel is composed of different parts that can be made with 3D printing or injection molding. It integrates two rims with ABS fins and a nylon disc, two thermoplastics that are highly resistant to shocks. To fabricate the axle, stainless steel is used. Inside the rim, the designer placed three different types of filters: the air is channeled through the inner cylindrical opening of the rim, then filtered and finally expelled through the outer fins.

Fig. 1: Wheel with Pollution Filters

The different roles of the filters: The first is a natural loofah sponge that traps large particles. It is washable, reusable and 100% biodegradable. Then there's a HEPA filter, which can also be washed, which traps pollen and some large particles such as dust. Finally, the third filter is an activated carbon filter to trap individual gas molecules. It is therefore ideal for filtering volatile organic compounds (VOCs) and even odors. According to the studies the filters will have to be changed every 250 km or so. Air filter purification traps airborne particles by size exclusion. Air is forced through a filter and particles are physically captured by the filter. Various filters exist notably including:

High-efficiency particulate arrestance (HEPA) filters remove at least 99.97% of 0.3-micrometer particles and are usually more effective at removing larger and smaller particles. HEPA purifiers, which filter all the air going into a clean room, must be arranged so that no air bypasses the HEPA filter. In dusty environments, a HEPA filter may follow an easily cleaned conventional filter (prefilter) which removes coarser impurities so that the HEPA filter needs cleaning or replacing less frequently. HEPA filters do not generate ozone or harmful byproducts in the course of operation.

Filter HVAC at MERV 14 or above are rated to remove airborne particles of 0.3 micrometers or larger. A high-efficiency MERV 14 filter has a capture rate of at least 75% for particles between 0.3 and 1.0 micrometers. Although the capture rate of a MERV filter is lower than that of a HEPA filter, a central air system can move significantly more air in the same period of time. Using a high-grade MERV filter can be more effective than using a high-powered HEPA machine at a fraction of the initial capital expenditure. Unfortunately, most furnace filters are slid in place without an airtight seal, which allows air to pass around the filters. This problem is worse for the higher-efficiency MERV filters because of the increase in air resistance. Higher-efficiency MERV filters are usually denser and increase air resistance in the central system, requiring a greater air pressure drop and consequently increasing energy costs.

For the future, these wheels are still in testing. The research says if all Santander bikes are equipped with such wheels in London (the London bike-sharing system), we could filter 79,865 m3 of air, that is 4 times the size of Trafalgar Square! This wheel is equipped with a tracking device to locate the bike and calculate the distance traveled in real time, but also to share its journeys with its community, track the amount of air filtered, etc. By this way it will create a social commitment and make city dwellers aware of pollution problems.

Techniques used for wheel with pollution filters

Emission filter wheels can have two side attachments like car hubcaps and filters inside that trap pollution particles. The hubcaps have a cavity in the center and fins around the perimeter. As the wheel spins, it sucks air through the central cavity, filters it, then pushes [filtered air] through the fins. The faster it spins, the more air enters and is filtered. But that doesn't take a speed machine - I tested the prototype on a fan with incense and it even ran on low speed. This project does not require additional energy to operate as it uses the kinetic energy of moving vehicles. Compared to other outdoor air purification devices, it captures polluted air directly at the source, resulting in increased efficiency and impact. The device consists of three parts: a triple wheel and two circles which contain the circular and washable air filters. As the bike wheel spins, it recreates a centrifugal fan that draws polluted air into centerth Taurus, passes it through a set of filters, and expels cleaner air into the environment.

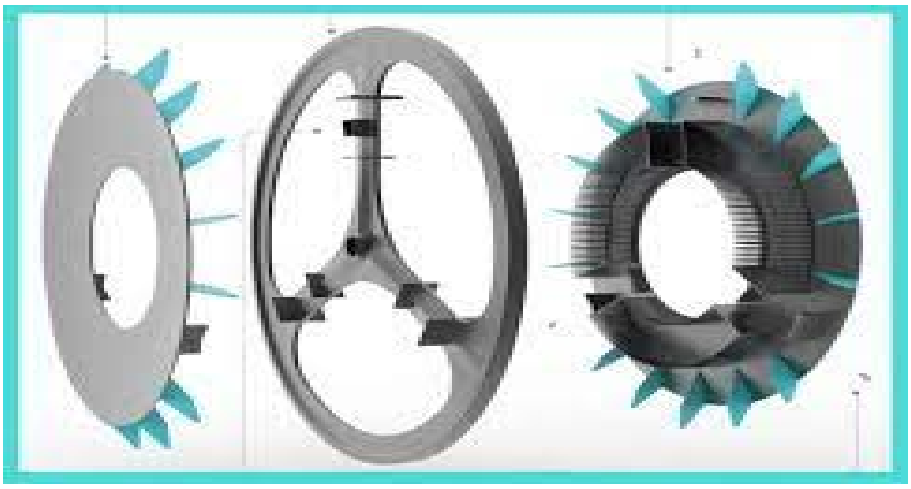

Fig. 2: A Bike Filter That Filters Air While You Cycle

Air Purification Technologies

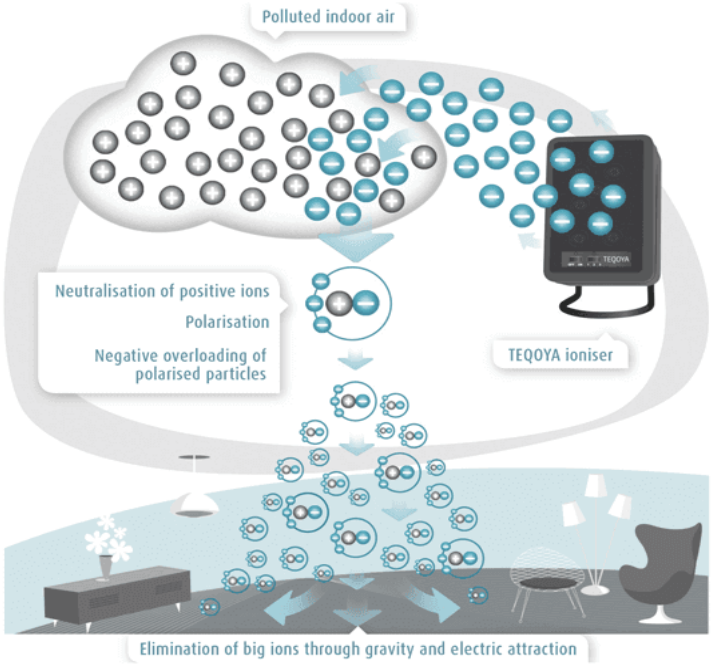

Fig 3: Elimination Of Big Ions Through Gravity And Electric Attraction

Air pollution is a growing environmental concern. Industrial development, deforestation and urbanization have caused air quality across the globe to plummet to dangerous levels. Polluted air affects human and other life forms, and alters the fragile balance of the ecosystem. It induces global warming, ozone depletion, acid rain and extinction of species.

A recent report published by the World Health Organization (WHO) stated that every year, an estimated 7 million die due to air pollution-related causes. In India alone, in 2016, around 1.5 million people perished due to the effects of air pollution.

Another 2016 report by the WHO revealed that 14 of the 15 most polluted cities in the world based on PM 2.5 concentration were in India, with Kanpur taking the lead, followed by Faridabad, Varanasi, Gaya, Patna and New Delhi, in that order.

In such a scenario with deadly levels of air pollution choking our cities, it is absolutely essential to ensure the air in our homes is at least clean and respirable. This is where air purifiers enter the picture. Air purifiers help remove impurities and harmful pathogens from indoor air. They play a critical role in eliminating pollutants like fine particulate matter, aerosols, bacteria, fungal spores, viruses, pet hair and dander, pollen and volatile organic compounds (VOC).

Air purifiers use advanced technology to remove pollutants from the air. Some of the leading techniques include HEPA filters, activated carbon filters, ultra-violet radiation, ionization and ozone generators. Most modern air purifiers use a combination of two technologies. This is mainly because a single mechanism cannot remove all the impurities present in the air. It often takes two techniques to fully rid the air of contaminants.

HEPA, which stands for High Efficiency Particulate Air, is the most widely used technology in air purification. It is highly effective in eliminating harmful microbes and particulate matter.

Activated carbon, another method used to clean the air, is good at removing VOCs and bad odors.

UV light purifiers incinerate and destroy microorganisms floating in the air. They make air pass through a lamp or rod emitting UV-C radiation which burns bacteria and mold spores.

Ionization is used to generate negatively charged gas ions which attract the air-borne particles and prevents them from entering our bodies through respiration. Ionization does not kill the germs but rather takes them out of the air by making the particle-gas ion structure stick to walls, ceiling and floors from where they can be removed through vacuuming.

Purifiers that use ozone are meant for commercial use only. Ozone is used in repair and restoration of buildings destroyed by flood and fire. While HEPA, activated carbon, UV light and ionizers can be used in homes and offices, ozone generators are only suited for industrial use and in certain cases, hospitals.

HEPA Technology

HEPA is also known by other names like High Efficiency Particulate Arresting and High Efficiency Particulate Absorber. It is the most advanced technology used in air purification. It is the current industry standard for air purification. Most brands today use HEPA technology in their premium air purifiers.

According to the United States National Institute for Occupational Safety and Health, a filter can qualify as a HEPA filter if it is able to remove 99.97% air pollutants of diameter 0.3 micrometer or larger. To put this in perspective, we would like to inform you that a human hair typically measures about 50 to 150 micrometer in diameter. So a HEPA filter eliminates impurities approximately 50 to 150 times smaller than a human hair.

HEPA filters comprise of a mat of randomly arranged fiberglass fibers with diameters between 0.5 and 2.0 micrometer. When air is passed through this mat, the microscopic particles present in the air stick to the fibers by virtue to three important mechanisms: interception, impaction and diffusion.

Interception removes particles when they come within one radius of a fiber and stick to it. The air stream makes pollutants come very close to the fibers and this makes them adhere to the fibers.

Under impaction, larger particles get stuck in the filter when they fail to avoid the fibers. They are unable to follow the curving zig-zag paths of the air stream and ultimately get embedded in the filter mesh. Impaction increases as the distance between the fibers decreases.

The third mechanism i.e. diffusion removes the smallest particles when air velocity is low. It makes the pollutants collide with gas molecules which slows down the pollutants and pushes them into the mat of filter fibers. They are eventually removed from the air by either interception or impaction.

Interception and impaction eliminate pollutants with a diameter of 0.4 micrometer and larger while diffusion filter out impurities of diameter 0.1 micrometer and smaller.

HEPA filters were originally developed for use in nuclear power plants to remove radioactive particles from the air. Today they are widely used in industrial facilities where dust, smoke and harmful pathogens are released as part of the manufacturing process. They are used in aircrafts, pharmaceutical plants, hospitals, IC fabrication units and automobile manufacturing plants.

HEPA filters remove PM 2.5 and PM 10 particulate matter, pollen, fungal spores, dust mites, tobacco smoke and pet hair and dander from the air. HEPA filtration is recommended for people with allergies and asthma. It can be used in homes and offices to keep the indoor air clean and free of germs. Please note HEPA filters cannot remove odors and VOCs.

In total, there are three filters that the inventor installs in the wheel:

- Glass wool, capable of preventing the largest particulates and rain from reaching finer filters.
- A HEPA filter that helps remove particulate matter (<PM1) small enough to pass through the throat and nose and enter the lungs.
- An activated carbon filter can trap noxious gases and CO_2.

The filters can be cleaned and reused; even the captured pollutants can be reused for third party products such as construction materials. The materials proposed by Tapping have been specially chosen to add the minimum extra weight to the whole bike. Rolloe's parts are easy to assemble or disassemble and recycle at the end of their lifecycle. The final product will be built from recycled plastic materials via injection molding.

Working

Polluted air travels through the interior cylindrical opening, gets pushed through the set of filters using centrifugal force and is expelled out through the exterior perimeter. The filters can trap noxious gases and particulate matter (PM10-2.5; Ozone, O3; NO2; and CO2). The filter system uses a loofah sponge, a washable HEPA and activated carbon. The filters are reusable, and captured pollutants are reused for third party products such as construction materials.

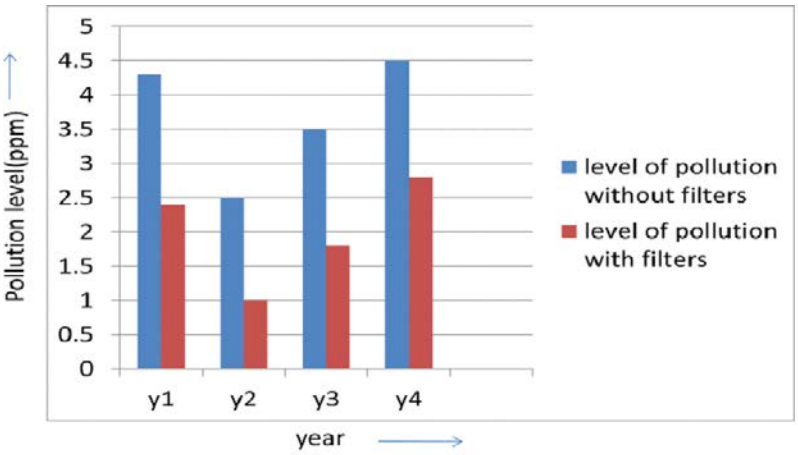

Fig. 4: Comparison of Pollution Levels With and Without Filters

The above graph is comparison between of pollution levels before and after using pollution filters. when we compare level of pollution for a year, the level of pollution is very less when we use pollution filters wheel with any perticular vehicle and whereas it is very high when we not use the filters.

Applications

Roll off emissions — the wheel can take the busiest, most polluted roadways, and with zero energy, except for the pedal power from the cyclist, it aims to tackle one of the most pressing problems of the modern urban age: pollution.

Dubbed the Smog Free bicycle, the invention works by sucking the polluted air into a contraption located on the front of the bike, cleaning it through a filtration system, then releasing the fresh air—all while the rider is pedaling through the streets.

Future scope:

- This wheel can be implemented with modern vehicles.
- It can be used to reduce high levels of pollution on an individual basis.
- Reduce disease caused by the air pollution.
- It can be used for the reduction of global warming.

Conclusion

This project that is based on the technique of air pollution filters is very useful for the upcoming era. Nowadays the level of pollution is increasing day by day and to reduce this level, this project can be estimated with many vehicles. This project tends to reduce-

- Disease due to air pollution. Control of air pollution.
- Clean the air .
- Reduce harmful pollutants present in air.

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