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Pollution Filter

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ABSTRACT

Air pollution has become the biggest concern for the whole world as it is increasing at a very high rate. In India, around 1.5 million died by the effects of air pollution, according to the World health organization data. Air pollution is one of the reason and factor for heart disease, stroke and obstructive pulmonary disease. India is the world's largest emitter of carbon dioxide, according to Global Carbon atlas. Last year at the United Nations climate change conference in Paris, government consider the need to curb emissions to reduce Global Warming. Air pollution problem is not going to vanish overnight. It can be reduced by day by day efforts. Air filtration techniques can be considered as an important factor for reducing air pollutants. Air filtration can reduce air pollutants and improve the air quality. This paper presents an overview of different air filtration technologies, materials and standards, current development of air filtration technologies along with their advantages and limitations, development of undergoing air filtration techniques as in large-scale air filters. A tower that can suck in air, separating pollutants by many processes. Some of the technologies like "smog free tower" in Beijing 2016 and the "City Tree" in Paris in 2017.

KEYWORDS: pollution, filtration, health. Air, technology

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INTRODUCTION:

An air pollutants is any substance in the air that can have a negative effect on humans and ecosystem. Air pollutants can be in the form of solids, liquid or gaseous form. It can be generated from many sources. Some, like transport vehicles, industrial processes cooking etc. A pollutant can be of natural or man-made. An average adult, inhales and exhales about 7 to 8 litres of air every minute. That sums about 11000 litres of air every day. The air we breathe determines the health of lungs and other parts of our body. Indeed clean air is the must requirement of human health. According to the World Health Organization, air pollution caused 7 million people deaths worldwide in 2012. Air pollutants occur both indoor and outdoor and causes a range of health problems including asthma attacks, heart disease and lung disease. Some of the major air pollutants are as follows:

- Particulate matter
- Ozone
- Carbon Monoxide
- Nitrogen Oxides
- Sulphur dioxide
- Lead

Particulate matter: It is a tiny particles of solid or liquid suspended in gas. Some particles occurs naturally from volcanos, dust storms, forest. Human activities such as burning of fossil fuels in vehicles, power plants and various industrial processes. Averaged worldwide, anthropogenic aerosols-those made by human activities- currently holds 10% of our atmosphere.

Carbon Monoxide: It is a colourless, odourless, toxic yet non-irritating gas. It is a product of combustion of fuel such as natural gas, coal etc. Vehicular exhaust contributes to the majority of carbon monoxide in the atmosphere. It creates a smog type formation in the air that has been linked to many lung diseases and disruptions to the natural environment and animals.

Nitrogen Oxides: Nitrogen are expelled from high temperature combustion and are also produced during thunderstorms by electric discharge. Nitrogen dioxide is a chemical compound with the formulas NO_2.

Sulphur Dioxides: It is a chemical compound with the formula SO_2. SO2 is expelled by volcanoes and in various industrial processes. Coal and petroleum often contain sulphur compounds, and their combustion generates SO_2. Further oxidation of SO_2, usually in the presence of a catalyst such as NO_2, forms H_2SO_4, and thus acid rain.

Ozone: (O_3) formed from NO_x and VOCs. Ozone (O_3) is a key constituent of the troposphere. It is also an important constituent of certain regions of the stratosphere commonly known as the

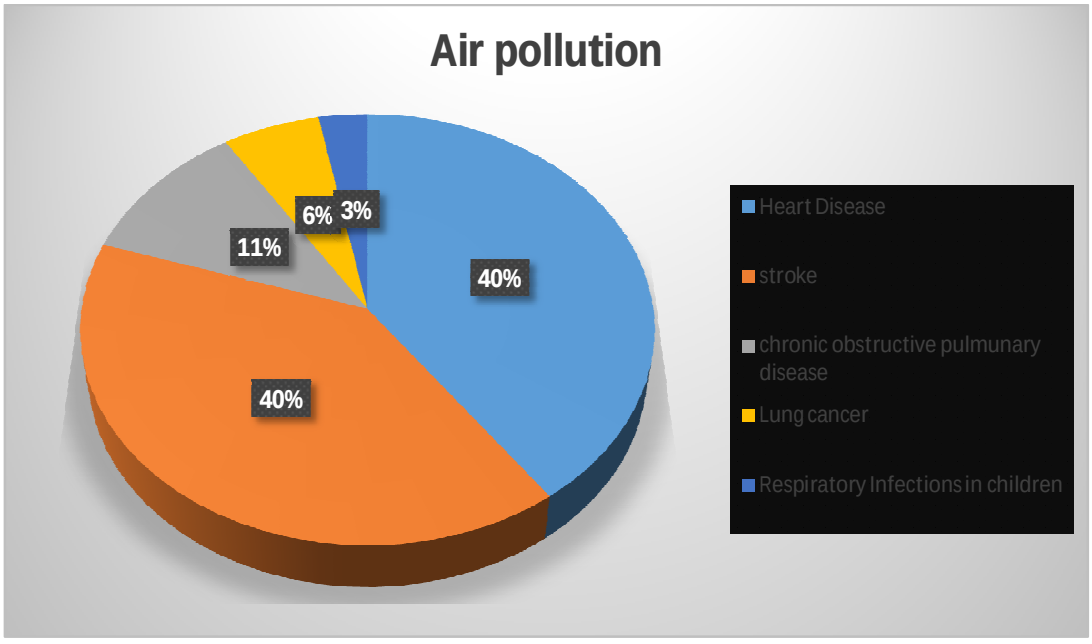
Ozone layer. Photochemical and chemical reactions involving it drive many of the chemical processes that occur in the atmosphere by day and by night.

Lead: The main source of lead pollution used to be car exhausts, but that has stopped thanks to lead- free petrol. Today lead pollution is found around lead smelters. Other sources includes metal processing and certain still using leaded fuel.

HEALTH EFFECTS OF AIR POLLUTION:

Air pollutants can affect cardiovascular health by hardening the arteries and increase the risk of heart attack and strokes, and even cause mental health conditions and degenerative brain disease such as Alzheimer's disease. The health effects caused by air pollution may include difficulty in breathing, wheezing, coughing, asthma and worsening of existing respiratory and cardiac conditions. These effects can result in increased medication use, increased doctor or emergency department visits, more hospital admissions and premature death.

Exposure to air pollution can lead to a wide range of short- and long-term effects. Temporary short-term effects include discomfort such as irritation to the nose, throat, eyes, or skin or headaches, dizziness, and nausea. Air pollution can also cause respiratory conditions such as pneumonia or bronchitis



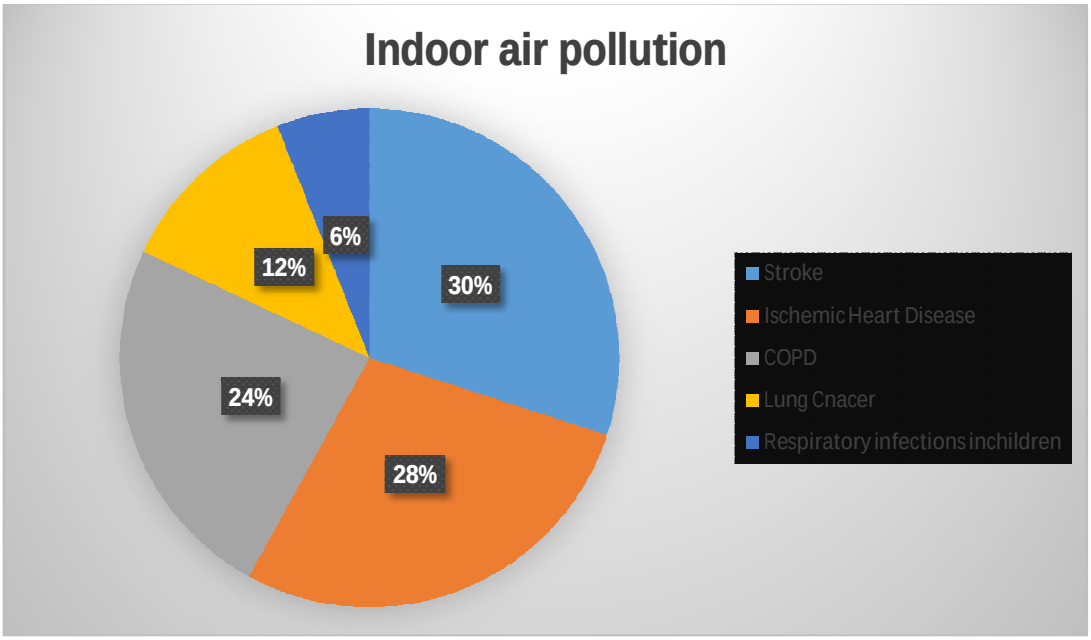
According to WHO reports, India has the highest death rate due to air pollution. India also has the most no. of deaths from asthma than any other nation. In December 2013, air pollution has estimated to kill 500,000 people in china each year. During one bad period of smog in New Delhi in late 2017, breathing outdoors was equivalent to smoking 44 cigarettes a day.

INDOOR AIR POLLUTION:

A lack of ventilation indoors concentrates air pollution where people often spend the majority of their time. Radon (Rn) gas, a carcinogen, is exuded from the Earth in certain locations and trapped inside houses. Building materials including carpeting and plywood emit formaldehyde gas. Paint and solvents give off volatile organic compounds as they dry. Exposure to indoor air pollution has been attached to the development of everything from infections to asthma to lung cancer. It can also cause less serious side effects such as headaches, nasal congestion, fatigue, dry eyes. Air pollution particles can be in form of solid, liquid or gases. Excess indoor particles can build up indoors due to inadequate ventilation, high temperature and humidity levels. Ventilation can be challenging, because indoor pollutants levels can increase if not enough outdoor air in brought in to dilute indoor air, but can also be increased by outdoor pollutants travelling indoor and getting trapped.

Indoor air pollution comes from:

- Cooking, Heating
- Smoking
- Building Materials
- Furniture and furnishings
- Using products like paints, vanishes, cleaning products
- Pollution entering through cracks and leaks in building
- Natural Radon gas entering from basement of building



AIR FILTRATION TECHNOLOGIES:

Air filtration which can separate the air pollutants from the air. Large scale filtration has entered the public imagination in recent years. A “Smog Free Tower” popped up in Beijing in 2016 and the “City Tree” in Paris in 2017. But the technology has yet to take off at scale.

Anand Daryani, an Indian boy is pushing forward with an Industrial-scale filter to rid skies of pollutants and carcinogens that plagues modern cities. He is working towards a cylindrical long tower that sucks the air inside, separating air pollutants in five phase process. He says his method adopts and shrinks techniques used by the energy sector and gas emitting industries.

“There are two things that we need to separate: One is dust and other heavy solid particles in the air, and second is microscopic carbon particles which are actually causing lung cancer.

Major constituents of air pollution are from the vehicle exhaust which contributes the most in the air pollution. An Air filter attached to the exhaust which can separate all the harmful air from the exhaust gases and releasing clean gas in the atmosphere.

As in 2016, an Indian start-up Graviky labs developed a carbon filter which can attached to the vehicle exhaust and separate the carbon particles from the exhaust gas which can be used as an ink afterwards.

They developed Air-Ink from carbon soots. At the MIT media labs, they invented a device that captures air pollution. They turned this pollution into safe, high quality ink for art. By using 30ml of AIR-INK, you can negate 45 minutes’ worth of pollution. AIR-INK is made up out of air pollution particulate matter- namely the unburned carbon soot you see coming out of exhaust pipe of vehicles, chimneys and more.

The device used for removal of carbon soot is called KAALINK. KAALINK is retrofitted to the exhaust pip of cars, generators and more. AIR-INK is currently available as 2mm, 15mm, 30mm and 50mm markers, and a 150 ml screen printing ink set.

ALTERNATIVE TECHNOLOGIES:

In 2015, Stanford engineers developed an air filter that could ease the breathing for people in polluted cities.

Stanford’s Yi Cui and his student’s converts a material commonly used in surgical gloves into a low cost, highly efficient air filter. Yi Cui is a professor of material science and engineering at Stanford.

He and his students first searched for the polymers that would have a strong attraction to the main components of smog, particularly particle matters that are smaller than 2.5 microns, known as

PM2.5. These pose the greatest risk to the human body and the organs of the body. It turned out to be Polyacrylonitrile (PAN), a material commonly used to make surgical gloves.

Using a technique called electrospinning, they converts the liquid PAN into spider web like fibres that are just thousandth the diameter of a human hair. They performed the field test in Beijing. The final product allows about 70% transparency and yet collects 99% of the particles. It can collect 10 times its own weight. The first two immediate applications would probably be the simple passive systems such as personal masks, hospital filtration system.

Just like HEPA filters, Outdoor air pollution is a major contributor to indoor air pollution—but high-efficiency particulate air (HEPA) filters used in the home significantly reduce fine-particulate matter in the air compared with non-HEPA air filters, according to the researchers. HEPA filters can reduce fine particulate matter by 55 percent and particulate pollution coming inside could be reduced by 23 percent.

These harmful (usually odourless) gases need to be adsorbed as they come through the filter and before they re-enter the room. The only thing that will effectively do that is an **activated carbon filter** placed directly behind the Hepa filter. The type and size of the carbon is directly related to just how much of the pollution is adsorbed. Expert air purifiers can contain around a kilo or more of genuine activated carbon.

Air filtration Technology	**Uses**	**Efficiency**
Electrostatic air filter	Permanent	81-93%
Cold Plasma air filtration	Fungal spores and airborne bacteria	85-98%
Trombe Wall system	Breathing wall panels	99.4%
Bio Filtration technique	Ventilated building	90%

CONCLUSION:

A sustainable and healthy environment have received much attention in past years. By aiming to reduce the indoor air pollutants and pollution outside have halted the deterioration of indoor air quality. Currently, a large variety of air filtration technologies are available to remove the indoor air pollutants but still they are not that effective. Traditional filters have lot of advantages, such as high removal efficiency, low initial cost and simple shape. However, they also characterized by the high pressure, high maintenance cost and to overcome this, they needed to be coated by chemicals, polymers.

Single filtration technology can be ineffective when it comes to the multiple type of pollutants. Bio filtration technology is considered as "most easily adopted to mechanically ventilated building and pit fans of naturally ventilated buildings.

Air filtration efficiency largely depends on the pressure drop. High pressure indicates additional energy consumption and increased operating cost. According to the recent studies, most research focusses on the air filtration efficiency improvements, pressure drop reduction, cost savings etc.

Additionally, the indoor air quality monitoring needs more attention and the air pollution levels of monitored spaces should be available to the public. Since indoor air quality is most influenced by human activities, it is suggested that people wear pollution sensors. The data collected this way could be useful to facilities managers and local authorities who therefore could gain a more precise knowledge on the extent and distribution of indoor air pollution. Furthermore, there is an emerging need for developing energy rating systems and simulation methods for air filters. Additionally, the indoor air quality monitoring needs more attention and the air pollution levels of monitored spaces should be available to the public. Since indoor air quality is most influenced by human activities, it is suggested that people wear pollution sensors. The data collected this way could be useful to facilities managers and local authorities who therefore could gain a more precise knowledge on the extent and distribution of indoor air pollution. Furthermore, there is an emerging need for developing energy rating systems and simulation methods for air filters. Additionally, the indoor air quality monitoring needs more attention and the air pollution levels of monitored spaces should be available to the public. Since indoor air quality is most influenced by human activities, it is suggested that people wear pollution sensors. The data collected this way could be useful to facilities managers and local authorities who therefore could gain a more precise knowledge on the extent and distribution of indoor air pollution. Furthermore, there is an emerging need for developing energy rating systems and simulation methods for air filters.

This paper gives the brief of future technologies and development in order to achieve healthy and sustainable environment.

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