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ABSTRACT
AN AIR PURIFICATION SYSTEM

The present disclosure envisages an air purification system (100). The air purification system (100) comprises housing (102). The housing (102) includes an inlet (104), an outlet (106), and a set of components (108). The set of components (108) disposed in the housing (102) and arranged sequentially between the inlet (104) and the outlet (106) in a sequential order. The set of components (108) comprises at least one filter (110), a purifier block (112) and a fan (114). The purifier block (112) includes at least one photo-catalytic oxidation (PCO) filter (112A), at least one UV-lamp (112B), at least one high efficiency particulate air (HEPA) filter (112C) and at least one multichem filter (112D). The system (100) is less expensive, can be washed and reused, has long life.

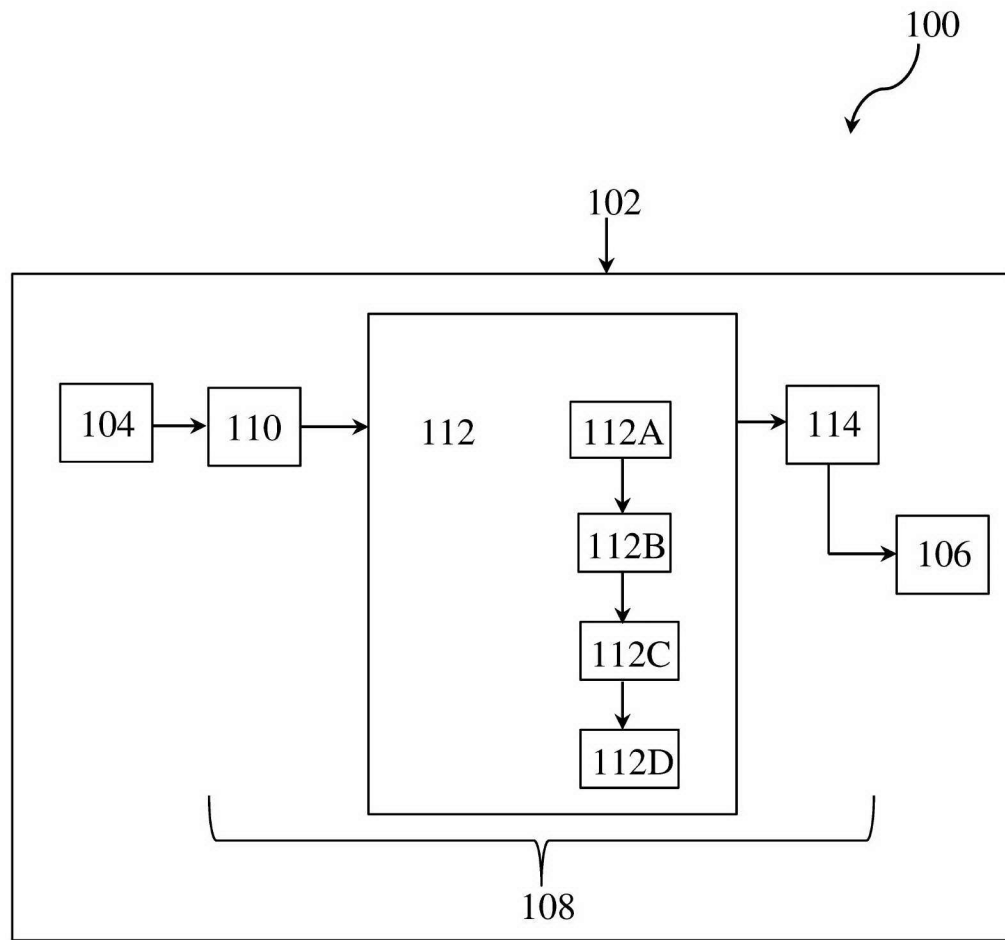


FIGURE 1

AN AIR PURIFICATION SYSTEM

FIELD

[0001] The present disclosure relates to air purification systems, particularly indoor air purification systems and filter system thereof.

DEFINITIONS

As used in the present disclosure, the following terms are generally intended to have the meaning as set forth below, except to the extent that the context in which they are used indicates otherwise.

The term “scaffold” for the purpose of the present disclosure refers to a stationary solid structure, in part and as a whole, that is used to hold up or support another material with functional groups.

The term “PCO filters” for the purpose of the present disclosure refers to photocatalytic oxidation filters.

The term “HEPA filter” for the purpose of the present disclosure refers to high efficiency particulate arrester filters.

The term “MERV filter” for the purpose of the present disclosure refers to minimum efficiency reporting value of the filter. The term “VOCS” for the purpose of the present disclosure refers to volatile organic compounds.

The term “multichem filter” for the purpose of the present disclosure refers to filter capable of removal of one or more inorganic gaseous contaminants along with VOCS.

The term “PPI” for the purpose of the present disclosure refers to pores per inch designates the number of pores in one linear inch, used in the measurement of porosity.

The term “sponge” or “foam” or “spongiferous matrix” for the purpose of the present disclosure refers to the macroporous and microporous polymer.

BACKGROUND

[0002] Air contamination and pollution is a long-standing problem. The air pollution levels continue to rise, with the contaminants like dust, mold, allergens, pollen and bacteria being prevalent. Other major contaminants are gaseous chemical contaminants, including volatile organic compounds (VOC's), such as formaldehyde, ammonia, and other common contaminants, which are released from indoor sources like building materials, adhesives, pesticides, cleaning agents, etc. Further, carbon monoxide is released from fireplaces, gas stoves and smoking. Apart from the indoor sources, gaseous chemicals from the outdoors such as vehicular emissions, smog, etc., can affect the indoor air quality. This problem is aggravated by inadequate ventilation in the newer "tight" construction buildings.

[0003] The inhalation of such contaminated air can cause serious health risks, mostly for people suffering from dust/pollen allergies, asthma, emphysema and other respiratory illnesses. Filters have long been used to remove contaminants like particulate, mold, pollen and dust/smoke. The filters, however, are designed only to remove contaminants up to a specific size.

[0004] Many devices use activated charcoal filters and high efficiency particulate arrester (HEPA) filters to remove the air contaminants.

[0005] A plethora of indoor air purification devices that are currently available use mechanical filters in conjunction with electronic air cleaners or ion generators. The negatively charged ions have the effect of purifying the atmosphere. A typical indoor area has an increased ratio of positive ions to negative ions, due to household activities like smoking, cooking or dusting or even due to the static electricity generated by synthetic fibers, which is not conducive to preservation of negative ions. However, these devices are not able to completely remove contaminants like gaseous chemicals and bacteria/viruses.

[0006] Purification of polluted air by removing gaseous chemicals has also been accomplished through the use of adsorbents or catalysts. Effective clean-up of air requires a combination of different types of adsorbents. In many applications, ozone is used to destroy viruses, bacteria, mold spores, pathogens and also remove odors and harmful gases. Ozone itself is toxic beyond a certain threshold level. It has been proved that long exposure to ozone might influence a critical step in the development of lung cancer by increasing the frequency of early, precancerous changes in cells.

[0007] There have also been attempts to use ultra-violet or UV lamps to destroy bacteria on a variety of surfaces, including filter surfaces. It is known that UV-C light is an effective germicidal, capable of destroying microorganisms in the air. As contaminated air passes through intense UV-C light, bacteria, viruses and other organic compounds get destroyed.

[0008] Photo-catalytic Oxidation (PCO) is the current state of the art technology used for air purification for removal of various contaminants mainly molds, pollen, bacteria/micro-organisms and to some extent odors. PCO requires a combination of UV light rays with a titanium oxide (TiO_2) coated filter. The process creates hydroxyl radicals and super-oxide ions, which are highly reactive electrons. These highly reactive electrons aggressively combine with other elements in the air, such as bacteria and VOC's. Once bound together, a chemical reaction takes place between the super-charged ion and the pollutant, effectively oxidizing (or burning) the pollutant and breaking it down into harmless carbon dioxide and water molecules, thereby purifying the air. Single or multiple PCO filters coated with titanium dioxide (with and without dopant) coated on different supports, including woven/ non-woven fabric, have been used. A number of different air purification devices using the photo-catalytic oxidation technology for providing purified indoor air have been developed in the past.

[0009] The main challenge in PCO is selection of the right kind of base matrix on which TiO_2 coating is to be done and the right coating methodology to ensure uniformity and rigidity of TiO_2 particles onto the substrate. The other major

aspects one need to consider when PCO is employed in air purification devices is filter cost, filter life, ease of manufacturing and pressure drop.

[00010] PCO filters especially made from fabric when not safeguarded with tighter pre-filters may lead to dust deposition which will reduce light impedance on catalytic surface hence efficiency. Another common limitation would be life of these filters. Fabric based PCO filters generally has low life, mainly due to mechanical abrasion and catalyst site deactivation. These filters are of the use and throw type and cannot be reused. Frequent replacement of these filters calls for the high operating cost of air purification device. The discarded filters also cause their own waste disposal issues.

[00011] In the Indian patent application No. 1723/MM/2013, there is disclosed an air filter system which includes a module for destroying/killing organisms in the air using the photo-catalytic oxidation (PCO), along with other modules. Said application requires the other modules such as a primary purification unit which include a pre-filter and an MERV (minimum efficiency reporting value) filter, a secondary purification unit which includes the PCO filter with UVA light source and a tertiary purification unit which includes a HEPA and /or an activated carbon filter to be placed in a particular sequence. The PCO filter disclosed in the Indian patent application no. 1723/MUM/2013 has a fabric based element. The requirement of a sequence of filters and use of UVA light as described in 1723/MUM/2013, results in high pressure drops, high element replacement costs due to lower PCO filter life and not so efficient use of the UVA light and overall purification system.

SUMMARY

[00012] The object of the utility model is to provide an air purification system so as to overcome the drawbacks mentioned in the above background section.

[00013] To achieve the above objective, the present system provides the following technical solution:

- [00014] The air purification system comprises housing. The housing includes an inlet, an outlet, and a set of components. The inlet receives air, which is to be purified and an outlet for discharging air after purification. The set of components is disposed in the housing. The set of components is arranged sequentially between the inlet and the outlet in a sequential order. The set of components comprises at least one filter, a purifier block, and a fan.
- [00015] The at least one filter is selected from a group consisting of at least one mesh type pre-filter and at least one minimum efficiency reporting value (MERV) filter.
- [00016] The purifier block comprises at least one photo-catalytic oxidation (PCO), at least one UV-lamp, at least one high efficiency particulate air (HEPA) filter and at least one granular/multichem filter. In an embodiment, the multichem filter is selected from a group of an activated carbon; alumina or special zeolites based adsorbent Medias with chemical impregnation of KMnO_4 , H_3PO_4 , copper, silver and any combination thereof.
- [00017] The components of the purifier block are arranged in a sequential order comprising the HEPA Filter, the at least one UV-lamp, the at least one PCO filter and the multichem filter.
- [00018] In an embodiment, the components of the purifier block are arranged in a sequential order comprising the HEPA Filter, the at least one PCO filter, the at least one UV-lamp and the multichem filter.
- [00019] In an embodiment, the components of the purifier block are arranged in a sequential order comprising the multichem filter, the HEPA filter, the PCO filter and the at least one UV-lamp.
- [00020] In another embodiment, the components of the purifier block are arranged in a sequential order comprising the HEPA filter, the multichem filter, the at least one PCO filter and the at least one UV-lamp.

[00021] In an embodiment, the components of the purifier block are arranged in a sequential order comprising the multichem filter, the at least one PCO filter, the at least one UV-lamp and the HEPA filter.

[00022] The at least one photo-catalytic oxidation (PCO) filter includes at least one scaffold. The scaffold comprises an alumina zirconia matrix which is coated with TiO_2 . In an embodiment, the alumina zirconia matrix has pore size in the range of 0.1 mm to 3 mm and pore density in the range of 20 PPI to 60 PPI. The alumina zirconia matrix has alumina content in the range of 80 to 99.5%.

[00023] In another embodiment, the alumina zirconia matrix is a coated matrix obtained by dipping the alumina zirconia matrix in a coating composition comprising a TiO_2 precursor sol, a binder and a solvent mix, and having viscosity in the range of 10-5000 centipoise (cps), at a predetermined speed and at a controlled temperature for a predetermined hold time followed by drying and cooling at room temperature to obtain a dipped matrix. The obtained dipped matrix is calcined in a furnace with a calcining temperature controlled in a range of 450°C to 700°C followed by cooling to obtain the coated matrix. The alumina zirconia matrix is cleaned prior to the dipping in an ultra-sonication bath with at least one cleaning agent comprising at least one diluted organic solvent.

[00024] As compared to the prior art, the utility model has the following advantages: the air purification system requires less production costs; the system simplifies making of the PCO filter; air purification system has long life; the filters can be washed and reused.

BRIEF DEESCRIPTION OF DRAWING

[00025] Figure 1 illustrates a block diagram of the air filter and purification system, in accordance with an embodiment of the present disclosure.

[00026] In the figure: 100: system; 102: housing; 104: inlet; 106: outlet; 108: a set of components; 110: at least one filter; 112: a purifier block; 112A: at least one photo-catalytic oxidation (PCO) filter; 112B: at least one UV-lamp; 112C: at least one high efficiency particulate air (HEPA) filter; 112D: at least one multichem filter; 114: a fan.

DETAILED DESCRIPTION

[00027] The present disclosure envisages an air purification system. With reference to Figure 1, the air purification system 100 comprises a housing 102 which includes an inlet 104, an outlet 106, and a set of components 108. The inlet 104 receives air, which is to be purified and an outlet for discharging air after purification. The set of components 108 is disposed in the housing 102. The set of components 108 is arranged sequentially between the inlet 104 and the outlet 106 in a sequential order. The set of components 108 comprises at least one filter 110, a purifier block 112, and a fan 114.

[00028] The at least one filter 110 is selected from a group consisting of at least one mesh type pre-filter and at least one minimum efficiency reporting value (MERV) filter.

[00029] The purifier block 112 comprises at least one photo-catalytic oxidation (PCO) filter 112A, at least one UV-lamp 112B, at least one high efficiency particulate air (HEPA) filter 112C and at least one granular/multichem filter 112D. In an embodiment, the multichem filter 112D is selected from a group of an activated carbon; alumina or special zeolites based adsorbent Medias with chemical impregnation of KMnO_4 , H_3PO_4 , copper, silver and any combination thereof.

[00030] In an embodiment, the components of the purifier block 112 are arranged in a sequential order including at least one HEPA Filter 112C, the at least one PCO filter 112A, the at least one UV-lamp 112B and the at least one multichem filter 112D, and any combination thereof.

[00031] The at least one photo-catalytic oxidation (PCO) filter 112A includes at least one scaffold. The scaffold comprises an alumina zirconia matrix which is coated with TiO_2 . In an embodiment, the alumina zirconia matrix has pore size in the range of 0.1 mm to 3 mm and pore density in the range of 20 PPI to 60 PPI. The alumina zirconia matrix has alumina content in the range of 80 to 99.5%.

[00032] In an embodiment, the alumina zirconia matrix is a coated matrix obtained by dipping the alumina zirconia matrix in a coating composition comprising a TiO_2 precursor sol, a binder and a solvent mix, and having viscosity in the range of 10-5000 centipoise (cps), at a predetermined speed and at a controlled temperature for a predetermined hold time followed by drying and cooling at room temperature to obtain a dipped matrix. The obtained dipped matrix is calcined in a furnace with a calcining temperature controlled in a range of 450°C to 700°C followed by cooling to obtain the coated matrix. The alumina zirconia matrix is cleaned prior to the dipping in an ultra-sonication bath with at least one cleaning agent comprising at least one diluted organic solvent.

[00033] In an embodiment, the PCO filter 112A and other filter elements (112B to 112D) are disposed in a relation to enable the irradiation of UV light onto two or more filters, preferably UV light on PCO filter 112A with HEPA filter 112C and/or the multichem filter 112D. In an embodiment, the at least one UV-lamp 112B is configured to emit UV-light. The UV light emitting from the UV lamp 112B passes through porous structure of the PCO filter 112A to impinge light on HEPA filter 112C and/or multichem filter 112D. Effective use of germicidal UV-light emitting from the UV-lamp 112B is such that it prevents the growth of micro-organisms on filtration surfaces. Any kind

of exposure to the UV light is safeguarded by use of mechanical shielding means. The fan 114 is disposed proximal to the outlet 106. The fan 114 sucks the air and induces a draft for directing the purified air outside the housing 102. The fan 114 is disposed proximal to the outlet 106. The fan 114 sucks the air through the inlet 104, thereby purifying the sucked air. The fan 114 induces a draft for directing the purified air outside the housing 102.

Claims:

1. An air purification system (100), said system (100) comprising:
 - a housing (102) having:
 - an inlet (104) for receiving air to be purified;
 - an outlet (106) for discharging air after purification; and
 - a set of components (108) disposed in said housing (102), said set of components arranged sequentially between said inlet (104) and said outlet (106) in a sequential order, comprising:
 - (a) at least one filter (110) selected from a group consisting of at least one mesh type pre-filter and at least one minimum efficiency reporting value (MERV) filter,
 - (b) a purifier block (112) comprising:
 - (i) at least one photo-catalytic oxidation (PCO) filter (112A) comprising at least one scaffold, said scaffold comprising an alumina zirconia matrix, coated with TiO_2 ,
 - (ii) at least one UV-lamp (112B) to emit UV-light,
 - (iii) at least one high efficiency particulate air (HEPA) filter (112C), and
 - (iv) at least one granular/ multichem filter (112D), and
 - (c) a fan (114) disposed proximal to said outlet for inducing a draft for directing purified air outside said housing and sucking in air to be purified through said inlet.
2. The air purification system (100) as claimed in claim 1, wherein said alumina zirconia matrix has a pore size in a range of 0.1 mm to 3 mm and a pore density in a range of 20 PPI to 60 PPI, said alumina zirconia matrix comprises an alumina content in a range of 80 to 99.5%.
3. The air purification system (100) as claimed in claim 1, wherein the components of said purifier block (112) are arranged in a sequential order comprising said HEPA Filter (112C), said at least one UV-lamp (112B), said at least one PCO filter (112A) and said multichem filter (112D); or

wherein the components of said purifier block (112) are arranged in a sequential order comprising said HEPA Filter (112C), said at least one PCO filter (112A), said at least one UV-lamp (112B) and said multichem filter (112D); or

wherein the components of said purifier block (112) are arranged in a sequential order comprising said multichem filter (112D), said HEPA filter (112C), said PCO filter (112A) and said at least one UV-lamp (112B); or

wherein the components of said purifier block (112) are arranged in a sequential order comprising said HEPA filter (112C), said multichem filter (112D), said at least one PCO filter (112A) and said at least one UV-lamp (112B); or

wherein the components of said purifier block (112) are arranged in a sequential order comprising said multichem filter (112D), said at least one PCO filter (112A), said at least one UV-lamp (112B) and said HEPA filter (112C).

4. The air purification system (100) as claimed in claim 3, wherein said multichem filter (112D) is selected from a group comprising activated carbon, alumina or special zeolites based adsorbent medias with chemical impregnation of KMnO_4 , H_3PO_4 , copper, silver and any combination thereof.
5. The air purification system (100) as claimed in claim 1, wherein said alumina zirconia matrix is a coated matrix obtained by dipping said alumina zirconia matrix in a coating composition comprising a TiO_2 precursor sol, a binder and a solvent mix, and having viscosity in a range of 10-5000 cps, at a predetermined speed and at a controlled temperature for a predetermined hold time followed by drying and cooling at room temperature to obtain a dipped matrix, and calcining said dipped matrix in a furnace with a calcining temperature controlled in a range of 450°C to 700°C followed by cooling to obtain said coated matrix, wherein said alumina zirconia matrix is cleaned prior to said dipping in an ultra-sonication bath with at least one cleaning agent comprising at least one diluted organic solvent.

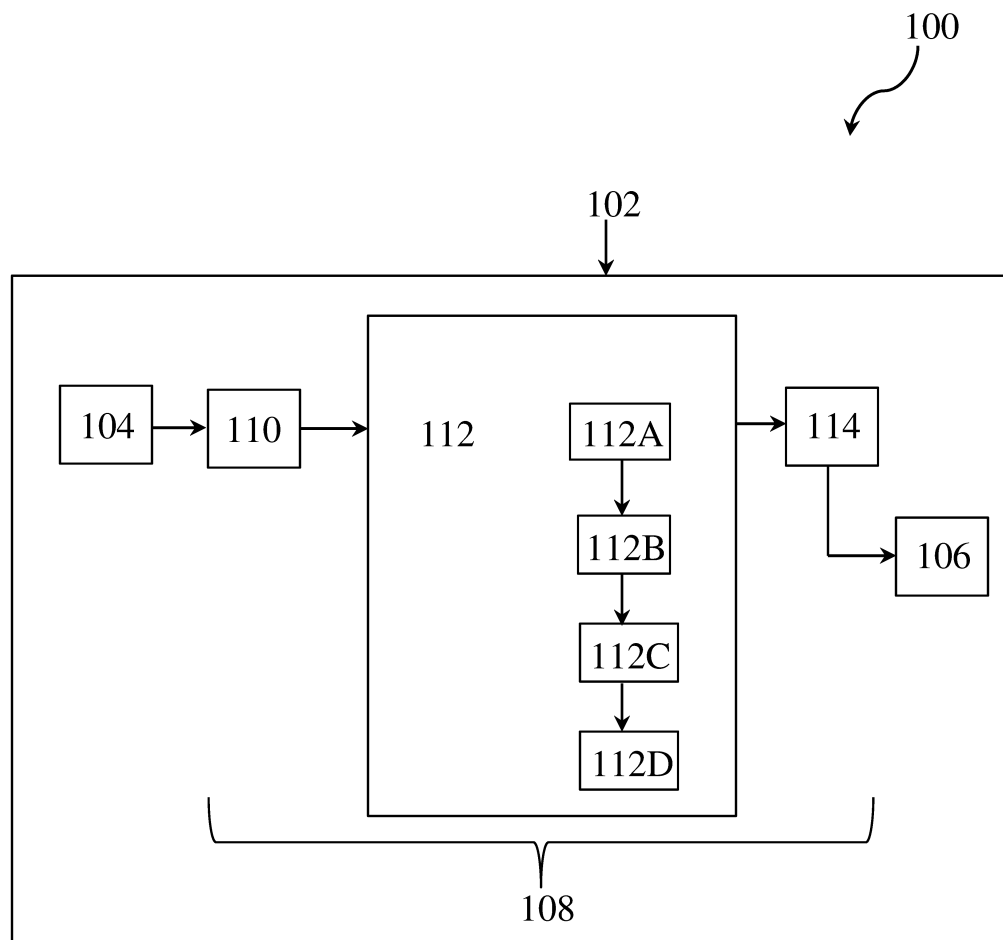


FIGURE 1