therapy of immunosuppressed patients, or in industrial clean rooms used for manufacturing electronic and semiconductor equipment.

The material of the invention has multiple uses in fermentation applications and cell culture, where it may be used to remove microorganisms from aqueous fluids, such as fermentation broths or process fluids, allowing these fluids to be used more efficiently and recycled, e.g., without cross-contamination of microbial strains. In addition, because the material is so efficient at removing microorganisms and at retaining them once removed, it may be used as an immobilization medium for enzymatic and other processing requiring the use of microorganisms. A seeding solution containing the desired microorganisms is first forced through the material of the invention, and then substrate solutions, e.g., containing proteins or other materials serving as enzymatic substrates, are passed through the seeded material. As these substrate solutions pass through the material, the substrates dissolved or suspended therein come into contact with the immobilized microorganisms, and more importantly, with the enzymes produced by those microorganisms, that may then catalyze reaction of the substrate molecules. The reaction products may then be eluted from the material by washing with another aqueous solution.

The material of the invention has numerous other industrial uses, e.g., treating water used in cooling systems. Cooling water often passes through towers, ponds, or other process equipment where contaminants may come into contact with the fluid.

Similarly, breathable air is often recycled in transportation systems, either to reduce costs (as with commercial airliners) or because a limited supply is available (as with submarines and spacecraft). Efficient removal of contaminants permits this air to be recycled more safely. In addition, the material of the invention may be used to increase indoor air quality in homes, buildings, enclosed areas, and protective shelters, in conjunction with the air circulation and conditioning systems already in use therein. The composite material of the invention may also be used to purify other types of gases, such as anesthetic gases used in surgery or dentistry (e.g., nitrous oxide), gases used in the carbonated beverage industry (e.g., carbon dioxide), gases used to purge process equipment (e.g., nitrogen, carbon dioxide, argon), and/or to remove particles from surfaces, etc.

The composite materials of the invention may be used to generate catalytic devices based upon chemicals such as metals, metal oxides, and biochemical agents such as enzymes. These devices may be used to treat or remediate emission gases such as those generated by the chemical, mining, power, and manufacturing industries as well as those generated from consumer products such as those powered with combustion engines. They may be used to generate gases for specific applications such as oxygen for respiration.

In each of these applications, the method of using the material of the invention is relatively simple and should be apparent to those of skill in the filtration art. The fluid to be treated is simply conducted to one side of the composite material of the invention, typically disposed in some form of housing, and forced through the material as the result of a pressure drop across the composite purification material, or conducted across the surface. Treated fluid is then conducted away from the "exit" side of the material and further processed or used.

The invention having been thus described by reference to certain of its specific embodiments, it will be apparent to those of skill in the art that many variations and modifications of these embodiments may be made within the spirit of the invention, that are intended to come within the scope of the appended claims and equivalents thereto.

What is claimed is:

1. An assembly comprising: (i) a reservoir and (ii) a composite material comprising

a fluid expandable material; and

an agent that modifies the properties of said expandable material,

wherein said composite material is in contact with the reservoir containing a first chemical or biological agent, and a composite material is disposed between the reservoir and a fluid in need of treatment, and

wherein the composite material regulates contact between said fluid and said first chemical or biological agent, serving as a conduit for said fluid to pass through said composite material into the reservoir or for said first chemical or biological agent to pass from the reservoir through said composite material into said fluid.

2. The assembly of claim **1**, further containing material that does not expand in the presence of fluid.

3. The assembly of claim **2**, wherein the non-expanding material is insoluble in the fluid and is selected from synthetic polymers, naturally occurring ion exchange materials, naturally occurring polymers, minerals, activated carbons, and metals.

4. The assembly of claim **2**, wherein the non-expanding material is soluble in the fluid and is selected from synthetic polymers, naturally occurring ion exchange materials, naturally occurring polymers, minerals, activated carbons, and metals.

5. The assembly of claim **2**, wherein the non-expandable material is in the form of a particle, fiber, block, sheet, web, or combinations thereof.

6. The assembly of claim **2**, wherein the non-expanding material can absorb fluid.

7. The assembly of claim **2**, wherein the non-expanding material is surface modified.

8. The assembly of claim **1**, wherein the composite material is in a form where the presence of the first chemical or biological agent alters the properties of the expandable material.

9. The assembly of claim **1**, wherein the composite material is in a form where the release or reaction of the first chemical or biological agent alters the properties of the expandable material.

10. The assembly of claim **1**, wherein the composite material is in a form that removes a second chemical or biological agent from the fluid.

11. The assembly of claim **1**, wherein the composite material is in a form that both removes a second chemical or biological agent from the fluid and releases the first chemical or biological agent into the fluid.

12. The assembly of claim **1**, wherein the expandable material is obtained from synthetic or naturally occurring organic molecules, or a combination thereof.

13. The assembly of claim **1**, wherein the expandable material is obtained from synthetic or naturally occurring inorganic molecules, or a combination thereof.

14. The assembly of claim **1**, wherein the composite material contains a combination of expandable material obtained from synthetic or naturally occurring inorganic and organic molecules.

15. The assembly of claim **1**, wherein the composite material contains an expandable material which is surface modified.