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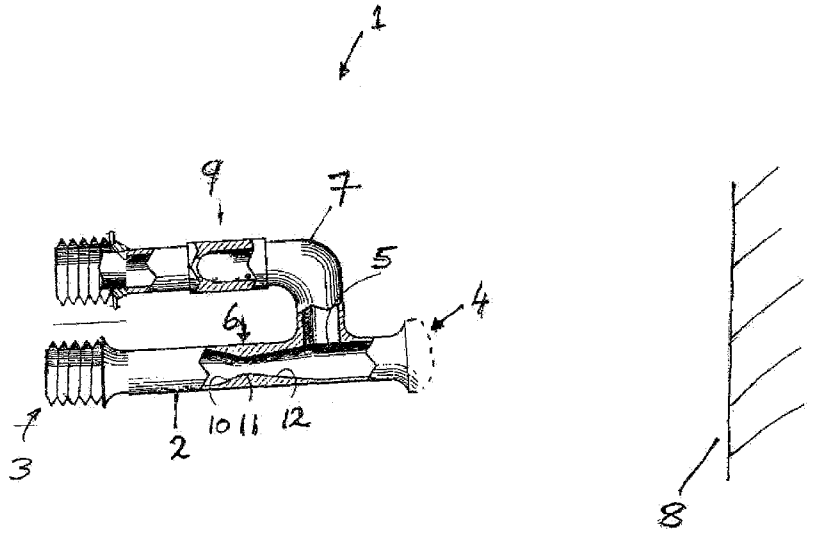
(54) **Title:** METHOD AND APPARATUS FOR CONTAINMENT AND DECONTAMINATION



(57) **Abstract:** This invention relates to a method of controlling contamination of a site by hazardous material comprising application to a surface suspected of contamination with the hazardous material of a coating of an aqueous coating composition, to provide containment of the hazardous material on the surface.

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METHOD AND APPARATUS FOR CONTAINMENT AND DECONTAMINATION

Field

This invention relates to the containment of sites, and to the containment and decontamination of sites, which have been exposed to hazardous material. In particular, this invention relates to a composition, method and apparatus which can be used by those personnel which first encounter and must manage a site of contamination.

Background

The contamination or potential for contamination of sites by hazardous material represents a serious threat to human health. The contamination may for example arise as a result of accidents in handling hazardous material or deliberate acts of contamination as a result of sabotage or terrorism.

Hazardous material includes bacteria, viruses, toxins, poisons, radioactive dust and any material that may present a biological, chemical or radiological hazard. For example hazardous material may include bio-terror agents (e.g. Plague, anthrax, botulinum toxin and ricin toxin), nosocomial agents (e.g. Tuberculosis and *Clostridium difficile*), epidemic and pandemic agents (e.g. influenza and SARS virus), the fall out from a dirty bomb and substances of interest to quarantine authorities.

When a site is suspected of being contaminated with a hazardous material, current practice involves restriction of movement of personnel and goods into and out of the area, entry by an investigation team in protective apparel, sampling using for example swabbing or other collection techniques and testing the samples for presence of suspicious material. Testing may be carried out in a mobile laboratory near the site or more commonly at a central laboratory testing facility removed from the site. Tests are normally carried out on an obvious source of risk (e.g. a powder in an envelope). Other samples may be taken e.g. from surfaces, but the significance of testing is limited by the

number of samples taken from relatively small sample areas that it is practical to take, and the fact that these are random samples (i.e. and so may miss the key contaminated areas).

In the event of a positive result, cleaning may involve fumigation for example with an antiseptic in aerosol form (frequently irritant) or with a fumigant formulation (frequently toxic) for example formalin / potassium permanganate combination. The time between suspicion of contamination and either declaration of a false alarm or fumigation is a significant risk period for first responders and the surrounding population.

It would be highly desirable to provide a safe containment means that can be used immediately after suspicion of contamination has arisen, and before fumigation. This will decrease the risk of contamination spread (e.g. through air ducts) in order to achieve "lock-down". It would also be highly desirable if in the process of applying this safe containment means, an indication could be obtained about contaminant "hotspots". This would allow subsequent sampling procedures to be well targeted rather than random, with significantly improved safety outcomes. An adequate "hotspot" analysis will enable a more directed approach to decontamination and may obviate the need for generalised fumigation of the building. This system can be used to trace-forward the contaminant spread – this is not amenable to analysis with random assay samples.

A site which has been contaminated with hazardous material will generally support that material on some or other surface – these surfaces may be reservoirs for further aerosol contamination when swabs are taken or proximal air movement occurs (redistribution). It would be highly desirable to deposit a safe, inexpensive layer that prevents redistribution over site surfaces.

For contamination with bio-terror agents, there are many agents of concern, particularly anthrax, plague and smallpox. It would be highly desirable to provide a safe, inexpensive containment material that can neutralise one or

more of these three agents. Furthermore, it would be highly desirable for these neutralised agents to be measurable in assay procedures such as microscopy, culture, or immunoassay. In other words the molecular destruction of bioterror agents is not desirable as the sequellae of this means that limited forensic analysis can be developed if it occurs.

Some biohazard agents have a high infectious dose in humans – for example the infectious dose for anthrax in humans is relatively high compared to that of ruminants. If a source of infection is controlled by, for example, stopping redistribution from the primary focus occurring, the likelihood of an infectious dose reaching a human is decreased.

In many cases, the primary concern for the emergency manager is to prevent the redistribution of biohazards from surfaces. Perpetually aerosolised materials tend to be a smaller threat because they will be diluted in the available airspace and fall below the infectious dose over time (in a reasonable number of inhalations).

There is a great need for safe, effective and convenient containment and decontamination procedures for first responders.

Thomsen J in US patent application 20040047776 describes a mobile air decontamination method and device which combines features in respirators, industrial and hospital grade air filtration with the ability to provide air testing to guide the connection of the device with other treatment modules or existing high vacuum or other equipment. These air decontamination units may be used to decontaminate the air after industrial, medical and bio-terror contaminations. Devices such as these can be used to remove contaminants from air, but are not efficient when the bio-hazardous agent is located on a surface, with possible redistribution.

Lehman W in US patent 6960244 describes a system and method for removing contaminants from the air in a mail sorting room. The system

includes a vacuum unit and a filter, both of which may be located within this room. The vacuum unit creates a downwardly directed laminar flow of air which expels airborne particulates from the room. The mail sorting room preferably has a modular construction with removable walls, a ceiling and a floor. Devices such as these can be used to remove contaminants from air, but are not efficient when the bio-hazardous material is located on a surface with possible redistribution.

Strohmeyer et al in US patent 6941794 describe systems and methods for the detection of residues of chemical or biological warfare agents which may be present in letters and other 'Flats' of mail. Rollers are used to expel air from the flats of mail and a detection system is used to measure the chemical or biological agents in the expelled air. This system is adequate for detecting some bio-hazardous agents within letters, but is not adequate for detecting such agents in a contaminated site, nor does the system facilitate the containment of bio-hazardous agents.

Flanigan, V. in US patent application 20050260138 describes a smoke or vapour generating system that disperses an airborne biocidal oil such as methyl soyate to decontaminate an area or object. The airborne methyl soyate is claimed to have broad spectrum efficacy against viruses, bacteria and fungi. Flanigan describes the following prior art methods for decontaminating large spaces such as office buildings, hospital rooms, surgical suites and cargo vessels including trucks, ships and planes. The surfaces may be cleaned with chlorine based solvents, glutaraldehyde, formaldehyde, commercial disinfectants, alcohol based products or fumigation with chlorine dioxide, ethylene oxide and other toxic gases. Problems include the toxicity of reagents, intransigent residues, and exacerbation of redistribution (for example when disinfectant is propelled by a pressurised propellant) and the eliciting of a powerful allergic reaction. Flanigan claims that methylated vegetable oils which are delivered through a smoke generator enable the safe decontamination of large areas. A problem with Flanigan's invention is that thick residues of bio-

hazardous materials may be incompletely neutralised, and there is no mitigation of redistribution.

Summary

In one aspect the invention provides a method of controlling contamination of a site by hazardous material comprising application to a surface suspected of contamination with the hazardous material of a coating of an aqueous coating composition, to provide containment of the hazardous material on the surface.

The aqueous coating composition is preferably a structured or structure forming aqueous system. The preferred examples of structured and structure forming materials include foams, gels and materials which form a coherent layer or skin over time.

In a further aspect the invention provides a composition for decontamination of an area at least suspected of being contaminated by a hazardous material by application of a coating of the composition to at least part of one surface in the area, the composition comprising an aqueous mixture of a water absorbent polymer and at least one agent of a system for neutralising the hazardous material and/or signalling the presence of the hazardous material. The water absorbent polymer may be water soluble as in the case of a linear polymer or water swellable as in the case of a cross linked polymer.

In a further embodiment the invention provides a method of controlling contamination of a site by hazardous material comprising application to a surface suspected of contamination with the hazardous material of a coating of an aqueous coating composition wherein the aqueous coating composition is formed by application to the surface of an aqueous stream into which a swellable material, preferably dissolved or dispersed in a liquid, is mixed with the stream, preferably by virtue of a venturi created in a duct or conduit provided with a source of the swellable material. The swellable material is preferable added to the water stream immediately prior to application the surface such as in the delivery conduit.

Detailed Description

The invention utilises an aqueous coating composition to contain and preferably neutralise the hazardous material on or adjacent surfaces to which the composition is applied.

Where used herein the term hazardous material includes materials which present a hazard (generally a serious hazard) to animal health particularly human health.

The hazardous material may present a hazard from potential infection or contraction of disease or by causing other harm such as through radiation or poisoning or vapour generation which may be harmful to health.

Specific examples of hazardous materials include:

- biohazards by which is meant infectious agents such as bacteria, fungus, viruses and toxins generated by these agents;
- chemical agents including poisons and carcinogens; and

radioactive material such as radioactive dust.

Hazardous material may include bio-terror agents (e.g. Plague, anthrax, botulinum toxin, ricin toxin), nosocomial agents (e.g. Tuberculosis, *Clostridium difficile*), epidemic and pandemic agents (e.g. influenza, SARS virus), and the fall out from a dirty bomb and substances of interest to quarantine authorities.

The composition and method of the invention preferably utilise at least one agent of a signalling system for signalling the presence of one or more hazardous materials. The signalling system may contain one or more agents. Where the signalling system contains a number of agents those agents may coact to develop a signal dependant on the presence of the hazardous material. One agent of a multi agent system may for example be present in the aqueous coating composition and may be adapted to react with the hazard or material and/or with materials associated with the presence of the hazardous material.

A further agent may be applied to or incorporated into the coating (which contains another agent of a multi-agent signalling system) after the coating has been applied to the hazardous material and the further agent may develop a signal (for example it may develop a visual signal such as colour) in response to reaction of the first agent with the hazardous material.

The term "signalling system" is thus used herein to refer to both a single signalling agent which acts alone to develop a signal and a plurality of agents added contemporaneously or at different times to develop a signal in response to the presence of one or more hazardous materials. The term signalling agent on the other hand refers to an agent which may rely on interaction with other agents to complete the development of a detectable signal in the presence of the hazardous material.

Throughout the description and the claims of this specification the word "comprise" and variations of the word, such as "comprising" and "comprises" is not intended to exclude other additives, components, integers or steps.

The aqueous coating composition preferably has a yield stress or develops a yield stress *in situ* following application to the surface. *In situ* development of a yield stress may occur as a result of evaporation or reaction. Preferably the yield stress is at least 15 Pa, more preferably at least 40 Pa.

In one embodiment of the method of the invention the aqueous coating composition is applied to a surface to provide a coating that is at least 50 microns thick, more preferably 200 microns thick, even more preferably at least 500 microns thick. The maximum thickness is not narrowly critical and will depend on the extent to which the composition is self supporting on the relevant surface. Typically the thickness is less than 5 cm and preferably less than 2cm.

It is preferred that the coating provides a substantially continuous covering of the contaminated portion of the surface to which it is applied.

The coating material may be applied to the contaminated surface by physical contact for example with a roller or brush, or in the form of a jet, mist, fog or spray. Preferably if a spray is used, that spray is developed using an airless spray applicator. Preferably the spray is applied at low pressure, more preferably through a wand having multiple orifices for ejection of the coating material.

Preferably the aqueous coating retains substantial quantities of water for at least one hour after application to the surface, preferably at least 30% water under ambient conditions (approx. 20°C).

Preferably the ratio of the diffusion co-efficient of a water soluble globular protein with a molecular weight in the range 50 to 150 kilodaltons in the coating material (immediately after surface application) to the diffusion co-efficient of the same protein in water is 0.05 or greater, preferably 0.1 or greater. Such a diffusion coefficient has the advantage of allowing the preferred signalling and neutralising agents of the invention to more efficiently operate. The diffusion coefficient may also be selected in this range to inhibit migration of biological hazardous material or other hazardous materials which are in the form of particles of size significantly larger and/or less soluble than the signalling and/or neutralising agent.

In a preferred embodiment the invention is used to contain a biological material which is hazardous. In this embodiment the aqueous coating material preferably comprises at least one member of a signalling reagent system which signals the presence of a biological material. For example the signalling reagent system may signal the presence of protein. Preferred examples of signalling reagents and components thereof may include at least one selected from the group consisting of Coomassie Blue, pyrogallol red, fluorescamine, O-pthaldialdehyde, bicinchoninic acid, copper ions and other reagents described in US patent 5981287 (Sinclair et al) and US patent 6,958,242 the contents of which are herein incorporated by reference.

In a preferred embodiment of the invention the signalling reagent system comprises antibody or antibody fragments. This may be used as an alternative or in addition to the previously mentioned agents. Polyclonal antibodies are preferred and more preferably the polyclonal antibody is derived from eggs or ruminants such as dairy cows. In the most preferred example of this embodiment of the invention the polyclonal antibody is derived from mammalian colostrum.

The signalling agent used in the composition in the aqueous coating may comprise one or more components which constitute all or part of the signalling system. For example the aqueous coating composition may contain only a reagent which is reactive with one or more hazardous materials and which is treated after application of the coating to the hazardous material to develop the reacted reagent and provide a visual or other identifiable signal. The process of developing the signal may involve removing excess reagent by flushing and or the addition of further developing reagents.

In a further embodiment the signalling reagent system alternatively or in addition to other signalling agents comprise bio-polymeric liposomes which exhibit a detectable change, particularly a colour change, in response to contact with a hazardous agent. Examples of liposomes suitable for use in this embodiment of the invention are described in US patent application 20050153386, the contents of which are herein incorporated by reference.

In yet another embodiment of the invention the aqueous coating comprises (optionally in addition to one or more of the signalling systems) at least one agent for at least partially neutralising the activity of the hazardous material. Examples of such agents include antidotes, neutralising antibodies, neutralising antibody fragments and chelating agents.

The neutralising antibody or antibody fragment preferably comprises a neutralising antibody against at least one biohazard such as those selected

from the group consisting of anthrax, plague and smallpox. A recoverable chelating agent may be used for metallic hazardous agents. The recoverable chelating agent for metallic hazardous agents may comprise an acid or base functional group for down-stream recovery on an ion exchange resin. Preferably the neutralising agent allows the neutralised hazardous materials to be readily collected and/or concentrated in a down-stream process. Preferred chelating agents include polyaminocarboxylate moieties, for example polyamino carboxylate moieties attached to a resin or gel.

Preferably the neutralised hazardous material remains in a form measurable in at least one standard assay procedure such as microscopy, culture or immunoassay.

The amount of signalling system and/or neutralising system present in the composition of the invention will depend upon factors such as the method of detection to be used, the potency of the hazardous material and the amount of hazardous material. Some signalling systems and neutralising agents are operable in amounts of only nanograms per litre. The amounts of each of the signalling system and neutralising system will generally be no more than 20% by weight and preferably each no more than 5 % by weight of the aqueous composition.

The aqueous coating may and preferably will comprise a polymer, protein or other macromolecule capable of absorbing and swelling in significant quantities of water for example as described in US patents 4978460 and 5190110, the contents of which are herein incorporated by reference.

In one embodiment the composition comprises an aqueous phase having dispersed therein gel particles swollen by hydration having a diameter of for example from 0.1 to 3 mm and comprising individual moderately cross-linked water-insoluble polar macromolecules of acrylic acid and/or acrylamide derivatives. The gel particles may be present in an amount of from say from 0.001 to 50 % and preferably from 0.01 to 5.0% by weight, calculated as dry substance and based on the aqueous phase. The preferred water additive has the characteristics of a highly water-absorbent polymer (super absorbent

polymer) that is easily mixed with the water supply and, when combined with water, results in a water-additive mixture with sufficiently high viscosity that the mixture readily adheres to vertical and horizontal surfaces. The additive may have a very short swell time to absorb the water.

A water swellable additive may be chosen to allow it to be mixed with a stream of aqueous precursor liquid such as water and the mixture applied onto the surface. In one embodiment the additive is caused to mix with a water stream by a venturi produced by the stream on a source of the additive, for example in a duct or conduit converging with the stream. The invention thus further provides a system for providing rapid containment of a hazardous material on a surface the system comprising means for providing a water stream, a source of particulate swellable material and means for causing the swellable material to be added to the water stream particularly a venturi producing suction at an inlet of swellable material.

Brief description of the Drawing

Figure 1 is a partial cut away side view of a coating system of the invention

Referring to Figure 1 the composition of the invention may be delivered from a applicator (1) comprising a delivery tube (2) comprising an input end (3) for the stream of aqueous precursor such as water and an outlet nozzle (4). An input (5) to the tube (2) is provided for allowing the swellable material to be sucked from input conduit (7) to the tube (2) via the input(s). The swellable material may be in fluid form such as a particulate material or suspension or solution typically in an inert liquid. A flow restriction (6) for providing a venturi suction in the input (5) for injecting the swellable material to the aqueous stream is provided in tube (2) adjacent or upstream of the input (5). The swellable material is typically delivered to the input (5) by a conduit (7) or duct. The coating composition may be applied directly from the output end (4) to the contaminated surface (8). In embodiments wherein the swellable material is in solution it may be preferred to include a non-return valve (9) in the inlet conduit

(7) for the swellable material. The flow restriction (6) is preferably a venturi having a convergent section (10) a throat (11) and a divergent section (12).

The upstream end of the tube (2) and swellable material input conduit (7) may be provided with fastening means (13, 14) such as a threaded portion or clip lock to allow connection of applicator.

Further examples of suitable mixing and spraying dev ices are known in the art which may be used for comparing the relatively small proportion of water swellable material with relatively large volumes of water.

GB 1 503 810 (the contents of which are herein incorporated by reference) describes a mixing apparatus with reference to a drawing. Such a device could be used in the present invention in which a water swellable material is retained in reservoir (8) which is vented to the surrounding atmosphere (see vent 9). The venturi (2) is connected at one of its ends to a spray nozzle and at its other end to a conduit for connection to a water supply. The device has two activators one for controlling the water flow and one for controlling dispensing of liquid from the reservoir as a result of the suction from the conduit extending into the liquid within the reservoir from the venturi.

The water swellable material may be in the form of particles, a particulate dispersion in an inert solvent, as a solution in an inert solvent or as an concentrated emulsion particularly an inverted (water-in-oil) emulsion. In a preferred embodiment the water swellable material is in a carrier which is insoluble or at least insufficiently soluble to dissolve in the aqueous phase in the mixing proportions used. In this instance the composition components may be selected to provide an emulsion on combination of the components. For example the aqueous and/or water swellable phase may be in the form of a water-in-oil emulsion where the water phase contains the water swellable material. It may comprise one or more surfactants adapted to a water-in-oil and phase emulsion on contact with the water stream.

The invention may utilise a water-swellable additive comprised of a cross-linked, partially cross-linked or linear water-swellable polymer or other macromolecule in a water-in-oil emulsion that is produced by an inverse phase polymerization reaction. For example the polymer may be a co-polymer of acrylamide and acrylic acid derivatives such as a terpolymer of a salt of acrylate, acrylamide, and a salt of 2-acrylamido-2-methylpropanesulfonic acid (AMPS). The particles resulting from this polymerization may be less than about one micron in size.

The particles may be dispersed in an oil emulsion wherein the polymer particles are contained within discrete aqueous “droplets" within the oil. With the help of an emulsifier, the water "droplets" are dispersed relatively evenly throughout the water/oil emulsion. This allows the additive to be introduced to the water supply in a liquid form, such that it may be easily educted with equipment of the type which is commonly used in fire fighting. The nature of such an additive may be such that it is a thickener for the water, and combines this thickening property with a very high water absorption capacity. Thus, the water-additive mixture that is sprayed may have a relatively high viscosity so as to adhere readily to both vertical and horizontal surfaces. This adherence allows the water-additive mixture to prevent the hazardous material from becoming airborne and to contain the material on the surface and/or within the applied coating.

Accordingly in a particularly preferred embodiment of the invention the aqueous coating is formed by contacting an inverse hydrogel emulsion with water for example by eduction of the inverse hydrogel emulsion into a stream of water for example using a hose eductor. Suitable inverse hydrogel emulsions include emulsions disclosed in US patents 5989446 and 6245252, the contents of which are herein incorporated by reference.

The aqueous coating may comprises at least one water soluble polymer or oligomer or other macromolecule, e.g. polyalkylene glycol, polyacrylic acid, polyacrylamide, copolymers comprising acrylic acid monomer or acrylamide

monomer or vinyl pyrrolidone monomer, or polyvinylpyrrolidone, or carbohydrates or carboxymethylcellulose or proteins which may include gelatinous moieties such as gelatin. The water soluble polymer may be used to adjust the rheology of the aqueous composition to optimise its adhesion to surfaces, particularly vertical surfaces and/or the extent of migration of one or more components such as the signalling system components, neutralising components or adsorbed bio-hazardous material.

The aqueous adherent coating may be of a type which can be re-hydrated. Rehydration may take place to allow further treatment or analysis of the hazardous material. The process of rehydration can be used to carry out chemical changes such as oxidation or reduction of the hazardous material or in the process of carrying out detection or developing signalling systems. It may be advantageous in some circumstances to re-hydrate coated hot-spot areas using strongly oxidising or strongly reducing aqueous liquor, for example to treat biological materials.

The identification of the hazardous material is in many cases important to ensure it is properly neutralised or otherwise dealt with in a safe manner. This may require repeated analysis or the use of a variety of signalling systems over a period of many hours or even days after initial containment using the aqueous coating. Rehydration (or the ability to dilute the coating following application) may also be important to facilitate development of some signalling systems. For example some signalling systems require that the composition be flushed with liquor to remove excess reagents and/or to promote visualisation of the signal.

Where the coating is to be rehydrated using an oxidising liquor the oxidation potential is preferably equal to or greater than 0.5% potassium permanganate aqueous solution, preferably equal to or greater than 1.5% potassium permanganate solution and more preferably equal to or greater than 4% potassium permanganate solution.

The coating is preferably readily removable from the surface. Further the coating will typically entrap the hazardous material to substantially remove the danger of reactivation of the hazardous material and/or the material being re-exposed. The coating is preferably removed using a vacuum. The removal process may simply involve application of a vacuum or other steps such as, rehydration, aerial scouring or other cleaning or decontamination steps according to the specific hazard and/or circumstances.

In a preferred embodiment the aqueous coating has a gel structure, and is removed from a surface by collapsing said gel structure using gel structure-collapsing agents. Examples of gel structure-collapsing agents include aqueous ionic liquids (e.g. 2% saline solution), hydrophilic colloids, ionic and non-ionic surface active agents and colloidal sulphur. The aqueous composition may alternatively,or in addition be provided with a slip reduction component. An example of a preferred slip reduction component is finely divided water dispersible particulate mineral which most preferably is hydrophobic silica.

The invention will now be described with reference to the following examples. It is to be understood that the examples are provided by way of illustration of the invention and that they are in no way limiting to the scope of the invention.

Example 1 – Gel stopping local air spread

Biohazard: Bacillus stearothermophilus (as a model for B. anthracis). From International Culture collection as provided by RMIT Microbiology Department. The bacteria are freeze dried and milled to a powder.
Carrier powder: Fumed silicon dioxide, primary particle size 5 nm, secondary particle size 8 microns, density 100g per litre, surface area (including internal surface area) 450m^2 per gram (BET method), Sipernat 50S (purchased from Degussa).

A biohazard powder having a strong tendency for redistribution in mild air currents was formulated by adding 2 g of finely divided freeze dried B. stearothermophilus to 50g of Sipernat 50S, followed by mixing (ball milling for 20 minutes with small ceramic balls).

Characteristics of hydrogel: Thermogel (1 gallon container, Part number TG200L1) was purchased from Thermo Technologies LLC, 400 East Broadway Suite 50, Bismark ND 58501. This gel (provided as an inverse hydrogel emulsion) was educted at 2% level into a stream of water (Approximately 12 litres per minute) passing through a nozzle (Part Number TG15V1) (Fog pattern tip). The above gel comprises a terpolymer of acrylate salt, acrylamide, and salt of 2-acrylamido-2-methylpropanesulfonic acid.

0.2 grams of the biohazard powder was split on a shelf, and the shelf was spray coated with hydrogel formulation to a thickness of 1 – 0.5 mm. In a controlled experiment 0.2 grams of powder was spilt on a shelf and tested without spray coating.

The presence and amount of particulate matter in the air space above the biohazard powder was measured using a Versatrap Sampling Cassette at 20 litres per minute air sampling rate (manufactured by SKC Pennsylvania 15330 USA).

Compared with the control (no hydrogel coating) the concentration of spores when hydrogel coating was used was reduced by a factor of more than 95%.

Example 2: Detection of Protein Materials in the environment

A tank was prepared containing bicinchoninic acid (BCA) protein assay reagent dissolved in water. Liquor from the tank was pumped through a nozzle as described in example 1 and inverse hydrogel emulsion was educted at 2% level in the liquor as in example 1.

Glass microscope slides were prepared with protein solution (milk whey protein) dried on them to yield 25 mg of protein (simulated biohazard) powder on each slide. The slides were spray coated with BCA/hydrogel formulation to a thickness of 1 – 0.3 mm. Separate control slides with no protein were also sprayed.

The BCA/hydrogel coating developed a purple colour within 10 minutes where it was in contact with the protein powder, whereas the hydrogel coating of control slides did not.

Example 3: Neutralisation of bio-hazardous agent

The model biohazard material in this example was a capsular spore material derived from Sterne Strain Bacillus anthracis vaccine (procured from Fort Dodge Vaccines, Sydney, Australia). This material has the same surface antigen profile as pathogenic B. anthracis.

The aqueous coating was as in Example 1, except that the stream of water (into which the hydrogel was educted) contained 0.1% affinity purified bovine antibodies taken from the colostrum of cattle vaccinated with Sterne strain B. anthracis vaccine. The vaccination protocol was a single dose of vaccine given subcutaneously 2 months before calving. Colostrum collection and processing methodology was as described in WO 2004/078209 (Compositions for the treatment and prevention of bacterial infections) the contents of which are incorporated by reference.

The dilute vaccine was dried onto a glass microscope slide within a petri dish. The dry dish was then sprayed with the above aqueous adherent coating to a depth of 0.5 mm using the application system described in Example 1. The gel was removed, dispersed in 50 fold excess of water, incubated at pH 5 for 30 minutes at room temperature and examined under a microscope. The sample showed clumping of the bacterial spores consistent with neutralisation.

Example 4: Neutralisation of bio-hazardous agent (enterotoxigenic E. coli)

The model biohazard material in this example was vegetative bacteria E. coli O78 from the culture collection of University of Melbourne Department of Microbiology. This bacteria is a pathogen that causes diarrhoea in humans.

The polyclonal antibody against E. coli O78 was derived from the colostrum of vaccinated dairy cows (as described in PCT application number AU2004/000277) and was dissolved in water at 2.2mg per ml.

Sufficient (approximately 5%) hydroxyethylcellulose to form a viscous adherent gel was added to the above liquor. After storage at room for 1 hour, the gel was diluted by a factor of 1:400, 1: 800, 1:1600 with phosphate buffered saline.

The antibody viability in the gel was tested by running an ELISA using the following reagents. A) E. coli O78 bacterial antigen fixed to the substrate, B) test material added, wash x3 with PBS, C) add anti bovine HRP conjugate, wash x3, D) add colour reagent (tetra-methylbenzidine). Read with spectrophotometer and compare with control antibody preparation with no added gel

Results:

Antibody dilution	% compared to control
1:400	104
1:800	98
1:1600	100

The above experiment was repeated using a gel forming polyacrylamide supplied by RCA International of Melbourne, Australia.

At an antibody dilution of one is to 400, greater than 93% of the control spectrophotometric reading was obtained.

Example 5: Modulation of slip properties in hydrogel, and destruction of gel structure

7 hydrogels were developed as follows. Thermogel (2g) was mixed into 100g of water and a gel was formed. The following agents were mixed into the gel:

Hydrogel 1: amorphous silica (colloidal 13%)
Hydrogel 2: sodium chloride (solution 2%)
Hydrogel 3: sodium tripolyphosphate (solution 2%)
Hydrogel 4: cornflour (24% suspension)
Hydrogel 5: polyethylene wax (13% solids)
Hydrogel 6: colloidal sulphur (25% suspension)
Hydrogel 7: hydrophobic silica (40% suspension).

Only hydrogel 7 exhibited significantly reduced slipperiness while retaining robust gel character.

The other hydrogels collapsed in whole or part as a result of the presence of additives. In particular efficient gel destruction was achieved in hydrogel 2 – this provides a basis for hydrogel removal strategies.

The above experiment was repeated using a gel forming polyacrylamide supplied by RCA International of Melbourne, Australia. Again only hydrogel 7 exhibited significantly reduced slipperiness while retaining robust gel character.

CLAIMS

1. A method of controlling contamination of a site by hazardous material comprising application to a surface suspected of contamination with the hazardous material of a coating of an aqueous coating composition, to provide containment of the hazardous material on the surface.

2. A method according to claim 1 wherein the aqueous composition is a structured or structure forming aqueous composition.

3. A method according to claim 2 wherein the structured or structure forming composition provides a coating structure selected from the group consisting of a foam, a gel and a coating which forms a coherent layer or skin.

4. A method according to any one of the previous claims wherein the aqueous composition has a yield stress or develops a yield stress *in situ* in the coating.

5. A method according to any one of the previous claims wherein the aqueous composition has a sufficiently high viscosity so that the mixture readily adheres to vertical and horizontal surfaces.

6. A method according to claim 4 wherein *in situ* development of a yield stress occurs during or after application of a coating.

7. A method according to claim 4 wherein the resulting yield stress is at least 15 Pa.

8. A method according to any one of the previous claims wherein the aqueous composition is applied to a surface to provide a coating that is at least 200 microns thick.

9. A method according to claim 8 wherein the coating thickness is in the range of from 200 microns to no more than 5 cm.

10. A method according to anyone of the previous claims wherein the aqueous composition is applied as a spray using an airless spray applicator.

11. A method according to claim 10 wherein the spray is applied at low pressure through a wand having multiple orifices for ejection of the coating material.

12. A method according to any one of the previous claims wherein the aqueous composition retains at least 30% water under ambient conditions (approx. 20°C) for a period of at least one hour.

13. A method according to and one of the previous claims wherein the ratio of the diffusion co-efficient of a water soluble globular protein with a molecular weight in the range 50 to 150 kilodaltons in the aqueous composition (immediately after surface application) to the diffusion co-efficient of the same protein in water is at least 0.05 .

14. A method according to and one of the previous claims wherein the ratio of the diffusion co-efficient of a water soluble globular protein with a molecular weight in the range 50 to 150 kilodaltons in the aqueous composition (immediately after surface application) to the diffusion co-efficient of the same protein in water is at least 0.1.

15. A method according to any one of the previous claims wherein the aqueous coating material comprises at least one signalling agent for signalling the presence of one or more hazardous materials on contact therewith.

16. A method according to claim 15 wherein the signalling agent is adapted to provide a system which signals the presence of protein.

17. A method according to claim 15 wherein the signalling agent includes at least one component selected from the group consisting of Coomassie Blue, pyrogallol red, fluorescamine, O-pthaldialdehyde, bicinchoninic acid and copper ions.

18. A method according to claim 15 wherein the signalling agent comprises a polyclonal antibody or fragment thereof.

19. A method according to claim 15 wherein the signalling reagent comprises colostrum or a polyclonal antibody derived therefrom.

20. A method according to claim 15 wherein the signalling agent comprises one or more bio-polymeric liposomes which exhibit a detectable change in response to contact with a hazardous agent.

21. A method according to any one of the previous claims wherein the aqueous coating comprises at least one agent for at least partially reducing or neutralising the hazardous activity of the hazardous material.

22. A method according to any one of the previous claims wherein the biohazard comprises at least one agent selected from the group consisting of bio-terror agents, nosocomial agents, epidemic and pandemic agents, and the composition comprises at least one neutralising antibody or antibody fragment against at least one thereof.

23. A method according to any one of the previous claims wherein the hazardous material is selected from the group consisting of anthrax, plague and smallpox and the composition comprises at least one neutralising antibody or antibody fragment against at least one thereof.

24. A method according to any one of the previous claims wherein the hazardous material comprises a metal and the composition comprises at one chelating agent for neutralising and/or as a signalling agent.

25. A method according to anyone of the previous claims wherein the aqueous composition comprises a strongly water swellable polymer preferably of high molecular weight.

26. A method according to claim 25 wherein the aqueous composition comprises at least one polymer selected from the group consisting of polyalkylene glycol, polyacrylic acid, polyacrylamide, copolymers comprising acrylic acid monomer or acrylamide monomer or vinyl pyrrolidone monomer, or polyvinylpyrrolidone, or carbohydrates, or carboxymethylcellulose or proteins.

27. A method according to claim 25 wherein the aqueous composition comprises polymer gel particles present in an amount of from 0.001 to 50 % by weight, calculated as dry substance and based on the aqueous phase.

28. A method according to any one of the previous claims wherein the aqueous adherent coating composition is formed by contacting an inverse hydrogel emulsion with water.

29. A method according to any one of the previous claims wherein the coating is allowed to dry and is rehydrated using an oxidising liquor the oxidation potential of which is equal to or greater than 0.5% potassium permanganate aqueous solution.

30. A method according to any one of the previous claims wherein the coating is removed under vacuum.

31. A method according to any one of the previous claims wherein the aqueous coating composition is formed by application to the surface of an aqueous stream into which a swellable material is mixed with the stream.

32. A method according to claim 31 wherein the swellable material is in the form of an emulsion suspension or solution.

33. A method according to claim 31 wherein swellable material is mixed with the stream by virtue of a venturi created in a duct or conduit provided with a liquid source of the swellable material.

34. A method according to any one of the previous claims wherein the aqueous coating composition comprises a non-slip agent.

35. A method according to any one of the previous claims wherein the aqueous coating composition forms a gel on the surface and is removed by a process comprising contacting the coating with a gel structure-collapsing agent.

36. A composition for decontamination of an area at least suspected of presenting a hazard by application of a coating of the composition to at least one surface in the area, the composition comprising an aqueous mixture of a water absorbent polymer and an agent selected from signalling agents and neutralising agents for the hazardous material.

37. A composition according to claim 36 having a yield stress or which develops a yield stress on application to the surface.

38. A composition according to claim 36 which yield stress of at least 15 Pa on formation of a coating.

39. A composition according to claim 36 wherein the ratio of the diffusion co-efficient of a water soluble globular protein with a molecular weight in the range 50 to 150 k in the coating material (immediately after surface application) to the diffusion co-efficient of the same protein in water is at least 0.05.

40. A composition according to claim 36 comprising at least one signalling agent or reagent system which is adapted to provide a signals in the presence of a biological material.

41. A composition according to claim 40 wherein the signalling agent or reagent system signals the presence of protein.

42. A composition according to claim 40 wherein the signalling agent comprises at least one selected from the group consisting of Coomassie Blue, pyrogallol red, fluorescamine, O-pthaldialdehyde, bicinchoninic acid and copper ions.

43. A composition according to claim 36 wherein the agent selected from signalling agents and neutralising agents comprises an antibody or antibody fragment.

44. A composition according to claim 36 wherein the agent selected from signalling agents and neutralising agents comprises at least one polyclonal antibody derived from eggs or ruminants such as dairy cows.

45. A composition according to claim 40 wherein the agent comprises a polyclonal antibody derived from mammalian colostrum.

46. A composition according to claim 36 comprising a signalling agent which comprises one or more bio-polymeric liposomes which exhibit a detectable change in response to contact with a hazardous agent.

47. A composition according to claim 36 comprising at least one agent for at least partially reducing or neutralising the hazardous activity of the hazard.

48. A composition according to any one of claims 36 to 47 wherein the biohazard comprises at least one agent selected from the group consisting of bio-terror agents, nosocomial agents, epidemic and pandemic agents, and the

composition comprises at least one antibody or antibody fragment directed against at least one thereof.

49. A composition according to claim 36 comprising the neutralising agent wherein the neutralising agent comprises at least one antibody or antibody fragment directed against at least one biohazard selected from the group consisting of anthrax, plague and smallpox.

50. A composition according to claim 36 wherein the water absorbent polymer comprises at least one selected from the group consisting of polyacrylic acid, polyacrylamide, polyvinylpyrrolidone, carbohydrates carboxymethylcellulose, proteins and copolymers comprising two or more monomers selected from the group consisting of acrylic acid monomer, acrylamide monomer, vinyl pyrrolidone monomer, alkyl acrylate monomers.

51. A composition according to any one of claims 36 to 50 wherein the water absorbent polymer is present in an amount of from say from 0.001 to 50 % by weight, calculated as dry substance and based on the aqueous phase.

52. A composition according to claim 36 wherein the hazardous material comprises a metal and the composition comprises at one chelating agent as a neutralising and/or signalling agent.

53. A composition according to any one of claims 36 to 52 wherein the water absorbent polymer is present in an amount to provide a sufficiently high viscosity that the mixture readily adheres to vertical and horizontal surfaces.

54. A composition according to any one of claims 36 to 53 wherein the aqueous coating composition is formed by providing an aqueous stream into which a swellable material is mixed.

55. A composition according to claim 36 wherein swellable material is mixed with the stream by virtue of a venturi created in a duct or conduit provided with a liquid source of the swellable material.

56. A composition according to any one of claims 36 to 55 wherein the aqueous coating composition comprises a non-slip agent.

57. A composition according to any one of the previous claims wherein the aqueous coating composition forms a gel on the surface and is removed by a process comprising contacting the coating with a gel structure-collapsing agent.

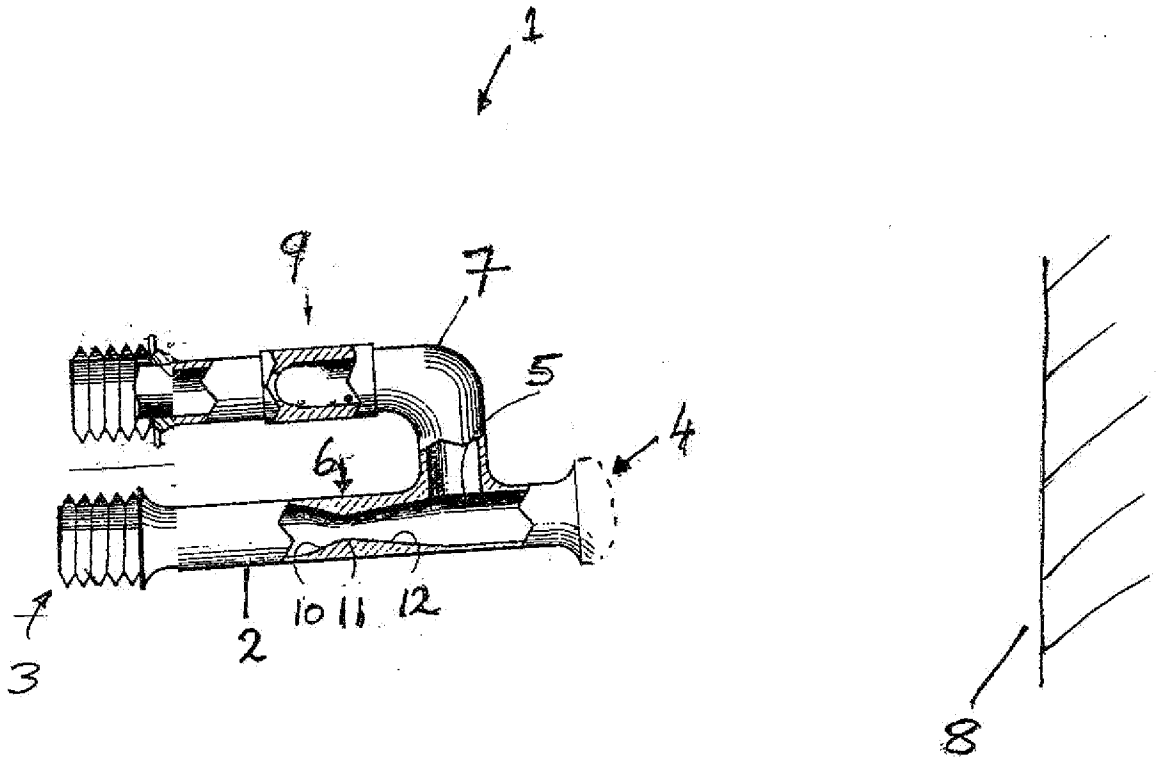

FIGURE 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2007/000252

A. CLASSIFICATION OF SUBJECT MATTER (Int. Cl.)

C09K 3/00 (2006.01) ***A62D 3/00*** (2007.01) ***C09K 3/30*** (2006.01)
A61L 2/16 (2006.01) ***C09D 5/00*** (2006.01) ***C09K 3/32*** (2006.01)
A61L 2/232 (2006.01) ***C09D 5/14*** (2006.01) ***G01N 33/00*** (2006.01)
A61L 2/235 (2006.01) ***C09K 3/22*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DATABASES: DWPI, JAPIO; KEYWORDS: A61L 2/16, 2/232, 2/235; A62D 3/00; A61K 3/00; hazard+, harmful+, decontamin+, neutralis+, neutraliz+, disinfect+, immobilis+, immobiliz+, foam+, gel+, absorb+, swell+, polymer+, signalling/complexing/chelating agent, ligand+; and others

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Derwent Abstract Accession No. 2005-048489/05, Class A96 B06 D22 E36 WO 2004/108170 A1 (STERIS INC) 16 December 2004 Abstract	1-9, 12-14, 21, 25-27, 36-39, 47, 50-51, 53
X	Derwent Abstract Accession No. 2000-664751/64, Class A96 B03 E19 K02 WO 2000/048684 A1 (CANADA MIN NAT DEFENCE) 24 August 1999 Abstract	1-8, 12-14, 25-27, 36-39, 47, 51, 53
P, X	Derwent Abstract Accession No. 2006-668809/69, Class A97 K07 (A14 A17 A25) US 2006-217584 A1 (NUNEZ L) 28 September 2006 Abstract	1-9, 12-14, 25-27, 36-39, 47, 50-51, 53

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 April 2007	17 APR 2007
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **DAVID GRIFFITHS** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : (02) 6283 2628

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2007/000252

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X.	Derwent Abstract No. 2002-329429/36, Class A97 D15 E19 H03 Jo1 K01 (A11 K07) WO 2002/009819 A2 (ANSUL INC) 07 February 2002 Abstract	1-9, 12-14, 25-27, 36-39, 47, 50-51, 53
X	Derwent Abstract Accession No. 2003-895177/82, Class D15 E36 US 6,569,353 B1 (LYNNTECH INC) 27 May 2003 Abstract	1-6, 10, 12, 21
P, X	Derwent Abstract Accession No. 2006-392570/40, Class C03 D22 E16 K07 WO 2006/054923 A1 (IVANOVA E. B.) 26 May 2006 Abstract	1-9, 12
X	Derwent Abstract Accession No. 2006-001114/01, Class P35 DE 10,002,455 A1 (KARNA-BIOCHEMIE GMBH) 08 September 2005 Abstract	1-9, 12
X	Derwent Abstract Accession No. 93-151611/19, Class K07 US 5,205,864 A (WESTINGHOUSE ELECTRIC CORP) 27 April 1993 Abstract	1-9, 12
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Y	Derwent Abstract Accession No. 2000-578225/54, Class A89 B04 D16 J04 (A17 A92) US 6,051,388 A (TOXIN ALERT INC) 18 April 2000 Abstract	15-23, 40-49
Y	Derwent Abstract Accession No. 2004-329515/30, Class A89 B04 D16 (B05) WO 2004/025268 A2 (UNIV CARNEGIE MELLON) 25 March 2004 Abstract	15-23, 40-49

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2007/000252

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	2004108170	AU	2004245034	CA	2525751	CN	1798581
		EP	1628689	KR	2006002353	US	7071152
		US	2006105930	US	2007037723		
WO	0048684	AU	25302/00	CA	2300698	EP	1154820
		IL	144978	US	6525237		
US	2006217584	US	7166758				
WO	0209819	AU	80739/01	CA	2417394	EP	1305086
		MX	PA03000862	NZ	523843	US	6599872
		US	2002072481				
US	6569353	US	2004009095				
WO	2006054923	RU	2004133478				
DE	10002455	EP	1161356	WO	0153121		
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		CA	2406308	CA	2406309	CN	1331799
		EP	1141700	EP	1290445	EP	1364210
		MX	PA02010203	MX	PA02010204	US	6376204
		US	6379908	US	6692973	US	6696264
		US	6841392	US	6867052	US	2002009811
		US	2002045200	US	2003211635	WO	0037934
		WO	0179840	WO	0179850	WO	02084251
		WO	03016858	WO	03036294		
WO	2004025268	AU	2003278832	US	2006019408		

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX