"Disinsection device"

Technical Field

[1] The present disclosure relates to the field of disinsection, particularly to a disinsection device for disinsection of an interior space, for example a Unit Load Device (ULD) for use in an aircraft.

Background

[2] The transmission of diseases through insects is a significant problem in the field of aircraft biosecurity. Mosquitoes and other insects carrying dangerous diseases often become stowaways on transports including in aircraft ULDs, leading to the spread of diseases and posing major risks to human health. Many diseases are transmitted across both domestic and international borders from such insect vectors. It is therefore important to neutralise insects such as mosquitoes that may find their way into ULDs to limit or eliminate the spread of disease.

[3] Unit Load Devices (ULDs) are frequently used in cargo holds of aircraft as storage for a variety of items. They are typically loaded with cargo before being sealed and stowed on aircraft. Prior to sealing a ULD for transport, it is easy for insects and other vectors of human diseases to enter a ULD and to become sealed within it. For example, the insect may enter the ULD at the time of packing the cargo or it may have been present in the ULD beforehand. Either way, if it is present in the ULD at the time it is sealed, it will be present in the ULD at the transport destination. When an aircraft or other cargo transport arrives at its destination, the ULDs are unsealed, which can lead to the unintentional release of the insects into the new environment. It is difficult and time consuming to prevent insects from becoming stowaways on aircraft and other transports. To address the problem, the interiors of ULDs are often treated by a process of disinsection.

[4] Disinsection is the procedure of neutralising insects for the control of insect vectors of human diseases commonly found in ULDs, cargo containers, or other enclosed storage

spaces. Disinsection often uses insecticide or other chemicals to exterminate disease-carrying vermin from these spaces. It is a tested and effective method of controlling the spread of disease through insects. It is commonplace that all incoming aircraft be treated with disinsection of some form to prevent biohazards and security risks.

[5] Common methods used for disinsection, particularly for the disinsection of aircraft, involve the use of aerosol sprays. These aerosol sprays are often labour intensive, requiring the user to spray over the majority of, or every surface of the target area of disinsection. It is easy to pass over an area and leave gaps where insects can survive, which leads to a reduction in the effectiveness of the aerosol spray.

[6] Disinsection devices such as residual disinsection devices often include batteries and/or other electrical components which can pose a hazard when travelling on aircraft and are unsuitable for use in an aircraft cargo hold. Other types of residual disinsection devices pollute the surrounding air with smoke and are therefore unfit for confined spaces such as in ULDs for aircraft disinsection.

[7] Embodiments of the device of the present disclosure aim to overcome or at least mitigate one or more problems of known disinsection methods and devices for use in interior spaces such as ULDs.

[8] Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the present disclosure as it existed before the priority date of each of the appended claims.

Summary

[9] Disclosed herein is a disinsection device for disinsection of an interior space such as an aircraft unit load device, comprising:

a reservoir comprising an active ingredient;

a sachet comprising a mixture configured to facilitate heat activation of the active ingredient upon exposure of the sachet to air; and

a receptacle in which the sachet is disposed, wherein:

the receptacle is initially in a first configuration in which the receptacle forms a substantially airtight compartment around the sachet to prevent activation of the active ingredient, and is transitionable to a second configuration to expose the sachet to air to cause activation of the active ingredient.

[10] In the second configuration, exposure of the sachet to air may cause an exothermic reaction of the mixture and thereby vaporisation of the active ingredient.

[11] The vaporisation of the active ingredient may be initiated by a heat reaction of the mixture with the surrounding air.

[12] The reservoir may comprise an active-impregnated sticker.

[13] The active ingredient may comprise an insecticide.

[14] The active ingredient may comprise one or more of metofluthrin, allethrin, prallethrin, and transfluthrin.

[15] The reservoir may comprise between about 3-1000 mg of transfluthrin, for example between 5-200 mg, or between about 6-150 mg, or between about 6-100 mg of transfluthrin. In some embodiments, the reservoir may comprise between 6-80 mg of transfluthrin, for example 9 mg of transfluthrin, or 64 mg transfluthrin.

[16] The receptacle may comprise a sealable or sealed bag.

[17] The mixture may comprise iron powder and any one or more of salt, water, absorbent resin, vermiculite, and active carbon.

[18] The mixture may comprise substantially between about 0.6 and 0.9 grams of mixture per square centimetre of an area of the sachet.

[19] The mixture may also comprise substantially between about 0.7 and 0.8 grams of mixture per square centimetre of an area of the sachet.

[20] The mixture may also comprise about 0.75 grams of mixture per square centimetre of an area of the sachet.

[21] The area of the sachet may be the area of any one of a top surface, bottom surface, or front and back surfaces.

[22] The sachet may comprise an adhesive such as glue or tape, applied to an external surface of the sachet.

[23] The external surface of the sachet may be comprised of any one of a top surface, bottom surface, or front and back surfaces.

[24] The tape may be double sided tape.

[25] Also disclosed herein is a method of disinsection of an interior space such as a unit loading device for an aircraft using the disinsection device of any one of the preceding claims, comprising opening the receptacle to expose the sachet to air and thereby activate the active ingredient.

[26] The interior space may be the interior of a container and may further comprise attaching the sachet to the interior of the container.

[27] The interior space may be the interior of an aircraft unit load device.

[28] The sachet may be attached using an adhesive such as glue or tape.

[29] The tape may be double sided tape.

[30] Throughout this specification the words "comprise", “have”, “include” and variations such as "comprises", "comprising", “has”, “having”, “includes” and “including” will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

[31] The device of the present disclosure has advantages over the prior art in that it does not require any electrical components to operate and is simple and easy to use. Furthermore,

the device of the present disclosure has been shown in tests to be effective in disinsecting unit load devices.

Brief Description of Drawings

[32] One or more embodiments of the present disclosure are described by way of example only, with reference to the following accompanying drawings:

[33] Figure 1 is a perspective view of a sachet of a disinsection device according to an embodiment;

[34] Figure 2 is a plan view of the sachet of Figure 1;

[35] Figure 3 is a perspective cross-sectional view of the sachet of Figure 2 at the line X-X;

[36] Figure 4 is a rear view of the sachet of Figure 1;

[37] Figure 5 is a schematic view of the disinsection device, including the sachet of Figure 1 in a sealed configuration;

[38] Figure 6 is a schematic view of the disinsection device, including the sachet of Figure 1 in an unsealed configuration; and

[39] Figure 7 is a schematic flow diagram of a method of disinsecting an interior space such as a ULD.

Description of Embodiments

[40] The disinsection device 1 of the present disclosure comprises a sachet 10 disposed inside a receptacle 40. Figure 1 shows a perspective view of the sachet 10 of the disinsection device 1. The disinsection device 1 including the receptacle 40 is shown in Figure 5 and Figure 6. The sachet 1 is suitable for disinsection of an interior space. The disinsection device 1 is intended to be placed inside an interior space, such as a Unit Load Device

(ULD) for use in an aircraft, to disinsect the interior space. The interior space may for example be a cargo container, or other enclosed storage space that may require disinsection. The sachet 10 generally comprises an exterior packaging 15, inside of which is a mixture 34 for generating heat upon exposure to air. The disinsection device 1 further comprises a reservoir 12 for containing an active ingredient. The generation of heat from the mixture 34 triggers activation of the active ingredient to release vapour into the interior and thereby disinsect the ULD or other interior space. The disinsection device 1 is intended to be fixed to the interior of a ULD for disinsecting the ULD. Disinsection may be most effectively achieved upon closing the ULD to trap the vapour in the interior space.

[41] The sachet 10 has an exterior packaging 15 that contains the mixture 34 within it and which allows air to access the mixture 34. The exterior packaging 15 may be formed from porous non-woven polyethylene, polypropylene, or polyester materials or another suitable porous packaging material that allows air to pass through it. It may take a number of suitable configurations, embodiments of which are described herein. For example, the exterior packaging 15 may be formed as a carton-type packaging as in the embodiment of Figure 1, or as a crisp packet type packaging as in the embodiment of Figure 4. In the embodiment shown in Figure 1, the exterior packaging 15 of the sachet 10 comprises a top surface 14, a bottom surface 18, a front surface 16 and back surface 17 between a sealed first end 26 and a sealed second end 28. In the embodiment shown in Figure 4, the exterior packaging 115 of the sachet 10 comprises a single surface that wraps substantially around the mixture 34 to form the sachet 10 between the sealed first end 26 and the sealed second end 28. As such, the single surface exterior packaging 115 of the embodiment of Figure 4 has at least a top side (not shown in Figure 4), and bottom side 118. It will be appreciated that other configurations are possible.

[42] The sachet 10 comprises the reservoir 12 for containing the active ingredient. As shown in Figure 1, the reservoir 12 is disposed on the top surface 14 of the exterior packaging 15/115 of the sachet 10 such that it is exposed to the heat generated by the mixture 34 upon exposure to air. In the embodiment shown, the reservoir 12 is disposed on the top surface 14, although, it may be disposed at any point on the exterior packaging at which

it is exposed to the heat generated by the mixture 34. The active ingredient of the reservoir 12 is an insecticide that becomes heat activated during the disinsection process. In embodiments, the reservoir 12 may comprise a sticker. The sticker may be impregnated with one or more insecticides including any one of transfluthrin, metofluthrin, prallethrin, and/or allethrin. In the present embodiment, the sticker comprises transfluthrin. Possible alternative embodiments of the reservoir 12 include a shallow well imprinted into the exterior packaging of the sachet 10.

[43] In an embodiment, the reservoir 12 may contain between about 3 and 50 milligrams of transfluthrin. The amount of transfluthrin may depend at least in part on the size of the interior space to be disinsected. For a typical size ULD, having an internal volume of between approximately $3.5m^3$ and $7.5m^3$, the reservoir may contain between about 3 and 1000 milligrams of transfluthrin, for example between about 5 and 200 milligrams, or between about 6 and 150 milligrams, or between about 6 and 100 milligrams or between about 6 and 80 milligrams of transfluthrin. In an embodiment, the reservoir 12 may contain substantially about 64 milligrams of transfluthrin, or about 9 milligrams of transfluthrin.

[44] In an embodiment, a single device may have a reservoir 12 containing a desired amount of transfluthrin. In some embodiments, one or more said devices may be used to achieve the desired amount of transfluthrin. For example, multiple devices may each have a reservoir 12 containing about 64 milligrams of transfluthrin, and may be used together to provide an overall higher amount of transfluthrin in an interior space.

[45] In the embodiment shown in Figure 1, the reservoir 12 has a substantially circular shape although it may have any suitable shape. Figure 2 shows a plan view of the sachet 10 with the reservoir 12 located substantially in the centre of the top surface 14 for effective exposure to the heat generated by the air activated mixture 34. In other embodiments the reservoir 12 may be located at any position on the top surface 14 of the sachet 10, or on another surface of the sachet 10.

[46] The exterior packaging of the sachet 10 may have a first seal 20 at the sealed first end 26, a second seal 22 at the sealed second end 28, and a third seal 24 on the bottom surface/side 18,118. The first seal 20 and second seal 22 extend substantially along a width 30 of the sachet 10. The third seal 24 extends substantially along a length 32 of the sachet 10 from the first end 26 to the second end 28 as shown in Figure 4.

[47] In embodiments not shown in the figures, the sachet 10 may comprise four seals around the perimeter of the sachet. That is, the sachet may be sealed along each of four edges of the sachet 10.

[48] The mixture 34 is sealed within the sachet 10 at all times during use of the disinsection device 1. Figure 3 shows a cross-sectional view of the sachet 10 comprising the mixture 34 contained therein. The mixture 34 comprises iron powder and any one or more of salt, water, absorbent resin, vermiculite, and active carbon. Preferably, the mixture 34 comprises iron powder, salt, water, absorbent resin, vermiculite and active carbon. It is desired to include a density of the mixture 34 within the sachet 10 that generates sufficient heat over a period of time so to activate the transfluthrin or other insecticide in the reservoir 12. The mixture density for an area of the sachet is configured such that a surface temperature of the sachet reaches a temperature of between about 35 degrees and 65 degrees within a time period of between about 10-60 minutes and such that the surface temperature is sustainable for a time period of between about 1-10 hours. In an example embodiment, the mixture density may be configured such that a surface temperature of the sachet reaches a temperature of between about 45 degrees to 55 degrees within a time period of between about 15-30 minutes and such that the surface temperature is sustainable for a time period of between about 2-5 hours. In some embodiments, the concentration of the mixture 34 is substantially between about 0.6 and 0.9 grams per square centimetre of the area of the sachet 10, or between about 0.7 and 0.8 grams per square centimetre of the area of the sachet 10, or between about 0.75 grams per square centimetre of the area of the sachet 10. In some embodiments, the area of the sachet 10 is calculated using the internal dimensions of the sachet 10, i.e. the internal length of the sachet multiplied by the internal width of the sachet.

[49] These configurations have been found to provide the desired level of heat over a desired period of time, however the skilled person will appreciate that there may be variations according to the specific mixture used. A commercially available mixture that has been found to produce the desired level of surface temperature of the sachet over a desired period of time is found in Kobayashi HotHands™ warmer sachets available from Kobayashi Healthcare. In a non-limiting example formula, the mixture may include iron powder 50-55%, active carbon 8%-13%, vermiculite 5-10%, water absorbent resin 0.1-3%, water 20-30%, salt 1-3%.

[50] Figure 4 shows a bottom plan view of the sachet 10, primarily of the bottom surface/side 18,118 and showing the third seal 24. The third seal 24 is positioned substantially at the centre of the width 30 of the sachet 10 and extends substantially the length 32 of the sachet 10 from the first end 26 to the second end 28 of the sachet 10. However, it will be appreciated by the skilled person that the location and size of the seal 24 could be different and may depend on the method of manufacture of the sachet 10. For example, in embodiments, the third seal 24 may not be located substantially at the centre of the width 30 of the sachet 10 and may be offset to one side.

[51] In an alternative embodiment (not shown), the sachet 10 may comprise of a top side and a bottom side 118 as in the embodiment of Figure 4, however the sachet 10 of this embodiment may be sealed around its entire periphery. That is, it may have a first seal 20 at the sealed first end 26, a second seal 22 at the sealed second end 28, as in the embodiment of Figure 4. Additionally, it may have a third seal extending along the length of the sachet 10 at the front 16 and a fourth seal extending along the length of the sachet 10 at the back 17.

[52] The device 1 includes an adhesive 36 attachable to the sachet 10 for affixing the sachet 10 to the interior of a container, for example a ULD. The adhesive 36 may be positioned anywhere on the sachet 10 that does not cover the reservoir 12 or otherwise impede the reservoir 12 from distributing the heat activated insecticide into the ULD. For example, the adhesive 36 may be positioned on a surface opposite the reservoir 12 so as to encourage the distribution of the activated transfluthrin or other insecticide through the

ULD or other enclosed space. For example, if the reservoir 12 is disposed on the top surface 14, the adhesive 36 may be on the bottom side 118 of the sachet 10 as shown schematically in Figure 4. The adhesive 36 may be any form of tape or glue, but is preferably double-sided tape. However, it is also envisaged that the sachet 10 may be manufactured with an adhesive backing.

[53] Figure 5 shows a schematic view of the device 1 comprising the receptacle 40 containing the sachet 10 within. The receptacle 40 includes a seal 42 that forms a substantially airtight seal of the receptacle 40 around the sachet 10 to prevent unintentional activation of the active ingredient. The receptacle 40 is initially in a sealed state, and is transitionable into an unsealed state as shown in Figure 6, by breaking the seal 42 and allowing air into the receptacle 40. As air enters the receptacle 40, it passes through the porous material of the exterior packaging 15/115 and thereby reaches the mixture 34 inside the sachet 10. The mixture 34 reacts exothermically to the air and begins to generate heat that in turn vaporises the insecticide in the reservoir 12, causing the insecticide to disperse into the ULD to disinsect the ULD.

[54] In some embodiments, the receptable 40 is a bag. The receptacle 40 is of a suitable size and shape to house the sachet 10 therein. The receptacle 40 may be formed from plastic, with the seal 42 or other form of airtight opening for a user to open the receptacle 40. As shown in Figure 5, during use the receptacle 40 may be opened or unsealed by a user at one end thereof. However, the receptacle 40 may take the form of a variety of shapes and materials as will be apparent to the skilled person, as long as it functions to provide an airtight enclosure around the sachet 10 until it is opened by a user.

[55] Figure 7 shows a method 50 used to operate the disinsection device 1 according to embodiments of the present disclosure. The method 50 includes opening the receptacle 40 to expose the sachet 10 to air. Exposing the sachet to air causes an exothermic reaction of the mixture 34 inside the sachet 10, which in turn activates the active insecticide ingredient. The method also includes attaching the sachet 10 with an adhesive 36 to the interior of a container such as an aircraft ULD. The method further includes sealing the

container to create an enclosed space for the device 1 to perform disinsection of the enclosed space.

[56] Shown below in Table 1 are tested parameters of the disinsection device 1. The tests were conducted on the *Aedes aegypti* species of mosquito. Susceptible and resistant strains were tested to determine the efficiency of the disinsection device 1 with regard to several variables. These variables included the time taken to completely exterminate the mosquitoes, the mortality of the mosquitoes after 24 hours, and the weight loss of the disinsection device 1 from disinsection. Two rounds of testing (R-1, R-2 in Table 1) were completed with an average calculated for each variable. From the testing, it is clear that the susceptible strain of mosquito is eliminated much more quickly than the resistant strain, although both were just as effectively eliminated.

Test Mosquito Species	Test Strain	Test Parameters	R-1	R-2	Average
Aedes aegypti	Susceptible	100 % KD Time (Min.)	105.00	120.00	112.50
		24 Hrs Mortality in numbers	25.00	25.00	25.00
	Resistance	100 % KD Time (Min.)	285.00	315.00	300.00
		24 Hrs Mortality in numbers	25.00	25.00	25.00

Table 1

[57] Accordingly, the disinsection device 1 according to embodiments of the present disclosure works effectively to disinsect an enclosed space without the use of electricity or chemical batteries. This makes the disinsection device 1 suitable for use in a ULD in an aircraft hold, where other disinsection devices may not be suitable. The disinsection device 1 disinsects the enclosed space using dispersal of vaporised insecticide, which may be more effective at treating hard to reach areas of the enclosed space than aerosol sprays, and does not rely on user application of a spray. The method of use of the disinsection device 1 is simple and quick. Accordingly, the disinsection device 1 and its method of use represent an improvement in the disinsection of ULDs and other interior spaces.

[58] It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the above-described embodiments, without departing from the broad general scope of the present disclosure. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

CLAIMS:

1. A disinsection device for disinsection of an interior space such as an aircraft unit load device, comprising:

a reservoir comprising an active ingredient;

a sachet comprising a mixture configured to facilitate heat activation of the active ingredient upon exposure of the sachet to air; and

a receptacle in which the sachet is disposed, wherein:

the receptacle is initially in a first configuration in which the receptacle forms a substantially airtight compartment around the sachet to prevent activation of the active ingredient, and is transitionable to a second configuration to expose the sachet to air to cause activation of the active ingredient.

2. The disinsection device of claim 1, wherein, in the second configuration, exposure of the sachet to air causes an exothermic reaction of the mixture and thereby vaporisation of the active ingredient.

3. The disinsection device of claim 1 or 2, wherein the reservoir comprises an active-impregnated sticker.

4. The disinsection device of any one of the preceding claims, wherein the active ingredient is an insecticide.

5. The disinsection device of any one of the preceding claims, wherein the active ingredient comprises one or more of metofluthrin, allethrin, prallethrin, and transfluthrin.

6. The disinsection device of any one of the preceding claims, wherein the reservoir comprises between about 3-1000 mg of transfluthrin or between about 5-200 mg of transfluthrin or between about 6-150 mg of transfluthrin or between about 6-100 mg of transfluthrin or between about 6-80 mg of transfluthrin or between about 3-50 mg of transfluthrin or between about 6-12 mg of transfluthrin.

7. The disinsection device of any one of the preceding claims, wherein the receptacle comprises a sealable or sealed bag.

8. The disinsection device of any one of the preceding claims, wherein the mixture comprises iron powder and any one or more of salt, water, absorbent resin, vermiculite, and active carbon.

9. The disinsection device of any one of the preceding claims, wherein the mixture comprises substantially between about 0.6 and 0.9 grams of powder per square centimetre of an area of the sachet.

10. The disinsection device of any one of the preceding claims, wherein the mixture comprises substantially between about 0.7 and 0.8 grams of powder per square centimetre of an area of the sachet.

11. The disinsection device of any one of the preceding claims, wherein the mixture comprises about 0.75 grams of powder per square centimetre of an area of the sachet.

12. The disinsection device of any one of the preceding claims, wherein the sachet comprises an adhesive such as glue or tape, applied to an external surface of the sachet.

13. The disinsection device of claim 18, wherein the tape is double sided tape.

14. A method of disinsection of an interior space such as an aircraft unit load device using the disinsection device of any one of the preceding claims, comprising opening the receptacle to expose the sachet to air and thereby activate the active ingredient.

15. The method of claim 14, wherein the interior space is the interior of a container and further comprising attaching the sachet to the interior of the container.

16. The method of claim 14 or 15, wherein the interior space is the interior of an aircraft unit load device.

17. The method of any one of claims 14 to 16, wherein the sachet is attached using an adhesive such as glue or tape.

18. The method of claim 17, wherein the tape is double sided tape.