GAS REGULATING APPARATUS AND METHOD

Field of Invention

The present invention generally relates to systems for fumigation and improving air quality. In particular, the invention relates to a system for controlling fumigation and improving air quality within an enclosed environment.

Background

Regular fumigation is typically required for transportation facilities such as air or sea freights. This is to ensure that loads such as goods or produce that are being transported in these facilities are essentially free from pests and other organisms that can cause unwanted damages to the loads.

Fumigation is also regularly carried out in buildings which have enclosed areas, for example public toilets and hospital patient wards. Fumigation is necessary for sanitizing these areas so as to provide a hygienic environment for people to visit or use.

Fumigating gas is usually used for fumigating the foregoing facilities and areas. The fumigating gas is pumped into the facilities and areas until a predetermined concentration level of the fumigating gas is attained. This concentration level of the fumigating gas is typically maintained for a predetermined period of time in order for the fumigation to take effect.

However, the required concentration level of the fumigating gas to be attained varies between different facilities and areas. Furthermore, different governing bodies have different regulatory requirements for stipulating the concentration level of the fumigating gas during fumigation of the facilities and areas.

Conventional fumigation apparatuses typically provide a fixed concentration level of fumigating gas. Undesirably, separate fumigation apparatuses are required for attaining specific concentration levels as required by the various facilities and areas or

stipulated by the different governing bodies. Furthermore, the concentration level of the fumigating gas varies at different parts of the facilities and areas.

There is therefore a need for varying the concentration level of fumigating gas within an enclosed environment and attaining an even distribution of the concentration level within the environment.

Summary

Embodiments of the invention disclosed herein vary the concentration level of fumigating gas within an enclosed environment and for attaining an even distribution of the concentration level within the environment.

Therefore, in accordance with a first embodiment of the invention, there is disclosed a regulator for regulating gas concentration. The regulator comprises a controller and a selector operable for selecting a control value, the selector being in data communication with the controller for providing the control value thereto. The regulator further comprises a detector for detecting concentration level of fumigating gas within a space, the detector being in data communication with the controller for providing the concentration level thereto. More specifically, the controller generates at least one control signal based on the control value and the concentration level for providing the at least one control signal to a generator for generating fumigating gas and providing the fumigating gas to the space, the at least one control signal for controlling generation of the fumigation gas by the generator to thereby regulate the concentration level of the fumigation gas in the space in response to the control value.

In accordance with a second embodiment of the invention, there is disclosed an apparatus for gas generation. The apparatus comprises a generator for generating fumigating gas and providing the fumigating gas to a space, and a controller couplable to the generator. The apparatus also comprises a selector operable for selecting a control value, the selector being in data communication with the controller for providing the control value thereto. The apparatus further comprises a detector for detecting concentration level of fumigating gas within the space, the detector being in

data communication with the controller for providing the concentration level thereto. More specifically, the controller generates at least one control signal based on the control value and the concentration level for providing the at least one control signal to the generator, the at least one control signal for controlling generation of the fumigation gas by the generator to thereby regulate the concentration level of the fumigation gas in the space in response to the control value.

In accordance with a third embodiment of the invention, there is disclosed a method for regulating gas concentration. The method comprises controlling a generator using a controller, the generator for generating fumigating gas and providing the fumigating gas to a space. The method also comprises selecting a control value using a selector, the selector being in data communication with the controller for providing the control value thereto. The method further comprises detecting concentration level of fumigating gas within the space using a detector, the detector being in data communication with the controller for providing the concentration level thereto. More specifically, the controller generates at least one control signal based on the control value and the concentration level for providing the at least one control signal to the generator, the at least one control signal for controlling generation of the fumigation gas by the generator to thereby regulate the concentration level of the fumigation gas in the space in response to the control value.

In accordance with a fourth embodiment of the invention, there is disclosed a regulator for regulating gas concentration. The regulator comprises a controller operable for selecting a control value, the controller being couplable to a generator for generating fumigating gas and providing the fumigating gas to a space. The regulator further comprises a detector for detecting concentration level of fumigating gas within the space, the detector being in data communication with the controller for providing the concentration level thereto. More specifically, the controller generates at least one control signal based on the control value and the concentration level for providing the at least one control signal to the generator, the at least one control signal for controlling generation of the fumigation gas by the generator to thereby regulate the concentration level of the fumigation gas in the space in response to the control value.

Brief Description Of The Drawings

Embodiments of the invention are disclosed hereinafter with reference to the drawings, in which:

Fig. 1 is a schematic view of an apparatus for varying gas concentration according to an embodiment of the invention; and

Fig. 2 is a flow diagram of a method for regulating gas concentration according to another embodiment of the invention.

Detailed Description

With reference to the drawings, embodiments of the invention for varying the concentration level of fumigating gas within an enclosed environment and attaining an even distribution of the concentration level within the environment are described hereinafter.

During operation, conventional fumigation systems typically provide a fixed concentration level of the fumigating gas. Undesirably, separate fumigation systems are required for attaining specific concentration levels as required by the various facilities and areas or stipulated by the different governing bodies. Furthermore, the concentration level of the fumigating gas varies at different parts of the facilities and areas.

Conventional fumigation apparatuses are typically used to provide a specific concentration level of the fumigating gas within an enclosed environment. However, this means that separate fumigation apparatuses are required for attaining specific concentration levels of the fumigating gas by the type of enclosed environment or stipulated by different governing bodies. However, the concentration level of the fumigating gas varies at different parts within the enclosed environment.

For purposes of brevity and clarity, the description of the embodiments of the invention is limited hereinafter to applications related to regulating the concentration

level of fumigating gas within an enclosed environment and attaining an even distribution of the concentration level within the environment. This however does not preclude embodiments of the invention from other areas of application that facilitate varying the concentration level of fumigating gas within an enclosed environment and attaining an even distribution of the concentration level within the environment. The fundamental inventive principles and concepts upon which embodiments of the invention are based shall remain common throughout the various embodiments.

Embodiments of the invention are described in greater detail hereinafter in accordance to illustrations provided in Figs. 1 to 2 of the drawings, wherein like elements are identified with like reference numerals.

An apparatus for fumigation is described hereinafter for addressing the foregoing problems.

In accordance with an embodiment of the invention, an apparatus 100 for fumigation is described with reference to Fig. 1. The apparatus 100 comprises a generator 102 and a regulator 104. The regulator 104 includes a controller 106, a selector 108 and a detector 110. The apparatus 100 is configurable for installation in, for instance a space 112 or other enclosed environments that require fumigation.

The generator 102 is for generating fumigating gas, for example ozone (O_3) or methyl bromide (CH_3Br). The fumigating gas is used to fumigate the space 112 for a specific period of time. The period of time is dependent on the volume of the space 112 and the required concentration level of the fumigating gas. The concentration level of the fumigating gas is typically measured in parts-per-million (ppm). In particular, the generator 102 is preferably capable of providing fumigating gas for attaining a concentration level of 0.01 to 3000ppm within the space 112.

Alternatively, the generator 102 is configurable for installation outside of an enclosed environment requiring fumigation but configured for operative communication

therewith. For example, a pipe (not shown) is extended from the generator 102 for introducing the fumigating gas into the enclosed environment.

The generator 102 is preferably portable and capable of varying the rate at which the fumigating gas is generated. The generator 102 is preferably further capable of generating fumigating gas at a rate where the required concentration level of the fumigating gas is attained fairly quickly, such as one hour.

The controller 106 is coupled to the generator 102 for controlling the generation of fumigating gas by the generator 102. The controller 106 is preferably operable for selecting a control value. The control value corresponds to a desired concentration level of the fumigating gas within the space 112. The controller 106 preferably has an interface (not shown) for allowing a user to vary and select the control value to activate the generator 102.

Alternatively, the selector 108 is used for varying and selecting the control value instead of the controller 106. The selector 108 is coupled to the controller 106 and provides data containing the control value to the controller 106. The controller 106 then controls the generation of fumigating gas based on the control value.

An example of the selector 108 include a remote controller or a wired controller having a user interface for allowing a user to control the generation of fumigating gas. In particular, the selector 108 is used to allow the user to set the concentration level of the fumigating gas within the space 112 to more than one control levels, for instance 0.01, 0.05 and 0.1ppm.

The detector 110 preferably detects the concentration level of the fumigating gas within the space 112. The detector 110 is coupled to the controller 106 for providing data containing the concentration level fumigating gas within the space 112 to the controller 106.

The detector 110 preferably comprises a plurality of sensors 114 for sensing the concentration level of the fumigating gas. An example of the plurality of sensors 114 is a ppm reader. Each of the plurality of sensors 114 is preferably positioned at the perimeter of the space 112 so that the distribution of the fumigating gas within the space may be determined. The plurality of sensors 114 then provides data relating to the concentration level of fumigating gas to the controller 106 for collation by the controller 106. The data is preferably transmitted in real time to the controller 106 either through wired or wireless means. The controller 106 preferably has a processor that computes an average concentration level based on readings obtained by each of the plurality of sensors 114.

The controller 106 generates control signals based on the control value and preferably the average concentration level of the fumigating gas within the space 112. The control signals are sent to the generator 102 for controlling generation of the fumigating gas. The generator 102 preferably responds to the control signals by either increasing or decreasing the rate of generation of the fumigating gas.

The detector 110 and controller 106 therefore form a feedback system to allow the concentration level of the fumigating gas within the space 112 to be set and maintained at a desired level. This means that the concentration level of the fumigation gas in the space 112 is constantly regulated towards the selected control value. The apparatus 100 is therefore advantageously capable of varying the concentration level of fumigating gas within an enclosed environment and attaining an even distribution of the concentration level within the environment.

The apparatus 100 preferably further comprises a fumigating gas destructor (not shown) such as an ozone destructor for facilitating the removal of the fumigating gas once fumigation of the space is completed. The fumigating gas destructor is preferably controlled by the controller 106 and is operated for a predetermined period of time once the fumigation of the space is completed.

Additionally, the apparatus 100 is used for purifying the air within the environment where people are staying or visiting. The generator 102 generates and provides ozone to the environment while the selector 108 is set to a desirable level of ozone concentration, such as 0.1ppm as stipulated by regulatory requirements. The detector 110 and controller 106 ensure that the ozone concentration is regulated towards the desired level. In this manner, the apparatus 100 is capable of improving the quality of air within the environment.

The apparatus 100 is further capable of sterilizing air within the environment that has been contaminated by harmful substances such as volatile organic compounds (VOCs) or organisms such as air borne bacteria. The apparatus 100 is therefore advantageously used for continuously providing people with clean and safe air.

With reference to Fig. 2, a flow diagram of a method 200 for regulating gas concentration is shown, according to a second embodiment of the invention. The method 200 involves the apparatus 100 as shown in Fig. 1 and a step 202 of controlling the generator 102 using the controller 106. The generator 102 is used for generating fumigating gas.

The method 200 also comprises a step 204 of selecting the control value using the selector 108. The selector 108 is in data communication with the controller 106 for providing the control value thereto.

The method 200 further comprises a step 206 of detecting concentration level of fumigating gas within the space 112 using the detector 110. The detector 110 is in data communication with the controller 106 for providing the concentration level thereto.

Additionally, the controller 106 generates control signals based on the control value and the concentration level. The control signals are sent to the generator 102 for controlling generation of the fumigation gas. The method 200 specifically comprises

a step 208 of regulating the concentration level of the fumigation gas in the space 112 towards the control value.

In the foregoing manner, an apparatus and a method are described according to embodiments of the invention for addressing the foregoing disadvantages of conventional fumigation systems. Although only a few embodiments of the invention is disclosed, it will be apparent to one skilled in the art in view of this disclosure that numerous changes and/or modification can be made without departing from the scope and spirit of the invention.

Claims

1. A regulator for regulating gas concentration, the regulator comprising:

a controller;

a selector being operable for selecting a control value, the selector being in data communication with the controller for providing the control value thereto; and

a detector for detecting concentration level of fumigating gas within a space, the detector being in data communication with the controller for providing the concentration level thereto,

wherein the controller generates at least one control signal based on the control value and the concentration level for providing the at least one control signal to a generator for generating fumigating gas and providing the fumigating gas to the space, the at least one control signal for controlling generation of the fumigation gas by the generator to thereby regulate the concentration level of the fumigation gas in the space in response to the control value.

2. The regulator as in claim 1, wherein the fumigation gas is ozone.

3. The regulator as in claim 1, wherein the controller comprises a processor for processing the concentration level received as control signals from the detector.

4. The regulator as in claim 1, wherein the controller receives the concentration level as control signals from the selector by at least one of wired and wireless means.

5. The regulator as in claim 1, wherein the controller receives the concentration level as control signals from the detector by at least one of wired and wireless means.

6. The regulator as in claim 1, wherein the detector comprises a plurality of sensors disposed and spatially distributed within the space.

7. The regulator as in claim 6, wherein the plurality of sensors collates data relating to the concentration level of fumigating gas within the space.

8. The regulator as in claim 1, wherein the concentration level of the fumigating gas is measured in parts-per-million (ppm) by the detector.

9. The regulator as in claim 1, wherein the selector comprises an interface for displaying the concentration level of fumigating gas within the space.

10. The regulator as in claim 9, wherein the interface displays the control value.

11. An apparatus for gas generation, the apparatus comprising:

a generator for generating fumigating gas and providing the fumigating gas to a space;

a controller couplable to the generator;

a selector being operable for selecting a control value, the selector being in data communication with the controller for providing the control value thereto; and

a detector for detecting concentration level of fumigating gas within the space, the detector being in data communication with the controller for providing the concentration level thereto,

wherein the controller generates at least one control signal based on the control value and the concentration level for providing the at least one control signal to the generator, the at least one control signal for controlling generation of the fumigation gas by the generator to thereby regulate the concentration level of the fumigation gas in the space in response to the control value.

12. The apparatus as in claim 11, wherein the fumigation gas is ozone.

13. The apparatus as in claim 11, wherein the controller comprises a processor for processing the concentration level received as control signals from the detector.

14. The apparatus as in claim 11, wherein the controller receives the concentration level as control signals from the selector by at least one of wired and wireless means.

15. The apparatus as in claim 11, wherein the controller receives the concentration level as control signals from the detector by at least one of wired and wireless means.

16. The apparatus as in claim 11, wherein the detector comprises a plurality of sensors disposed and spatially distributed within the space.

17. The apparatus as in claim 16, wherein the plurality of sensors collates data relating to the concentration level of fumigating gas within the space.

18. The apparatus as in claim 11, wherein the concentration level of the fumigating gas is measured in parts-per-million (ppm) by the detector.

19. The apparatus as in claim 11, wherein the selector comprises an interface for displaying the concentration level of fumigating gas within the space.

20. The apparatus as in claim 19, wherein the interface displays the control value.

21. A method for regulating gas concentration, the method comprising:

controlling a generator using a controller, the generator for generating fumigating gas and providing the fumigating gas to a space;

selecting a control value using a selector, the selector being in data communication with the controller for providing the control value thereto; and

detecting concentration level of fumigating gas within the space using a detector, the detector being in data communication with the controller for providing the concentration level thereto,

wherein the controller generates at least one control signal based on the control value and the concentration level for providing the at least one control signal to the generator, the at least one control signal for controlling generation of the fumigation gas by the generator to thereby regulate the concentration level of the fumigation gas in the space in response to the control value.

22. The method as in claim 21, wherein the fumigation gas is ozone.

23. The method as in claim 21, wherein the controller comprises a processor for processing the concentration level received as control signals from the detector.

24. The method as in claim 21, wherein the controller receives the concentration level as control signals from the selector by at least one of wired and wireless means.

25. The method as in claim 21, wherein the controller receives the concentration level as control signals from the detector by at least one of wired and wireless means.

26. The method as in claim 21, wherein the detector comprises a plurality of sensors disposed and distributed spatially within the space.

27. The method as in claim 26, wherein the plurality of sensors collates data relating to the concentration level of fumigating gas within the space.

28. The method as in claim 21, wherein the concentration level of the fumigating gas is measured in parts-per-million (ppm) by the detector.

29. The method as in claim 21, wherein the selector comprises an interface for displaying the concentration level of fumigating gas within the space.

30. The method as in claim 29, wherein the interface displays the control value.

31. A regulator for regulating gas concentration, the regulator comprising:

a controller operable for selecting a control value, the controller couplable to a generator for generating fumigating gas and providing the fumigating gas to a space;

a detector for detecting concentration level of fumigating gas within the space, the detector being in data communication with the controller for providing the concentration level thereto,

wherein the controller generates at least one control signal based on the control value and the concentration level for providing the at least one control signal to the generator, the at least one control signal for controlling generation of the fumigation gas by the generator to thereby regulate the concentration level of the fumigation gas in the space in response to the control value.

32. The regulator as in claim 31, wherein the controller comprises a processor for processing the concentration level received as control signals from the detector.

33. The regulator as in claim 31, wherein the controller receives the concentration level as control signals from the detector by at least one of wired and wireless means.

34. The regulator as in claim 31, wherein the detector comprises a plurality of sensors disposed and spatially distributed within the space.

35. The regulator as in claim 34, wherein the plurality of sensors collates data relating to the concentration level of fumigating gas within the space.

36. The regulator as in claim 31, wherein the concentration level of the fumigating gas is measured in parts-per-million (ppm) by the detector.

37. The regulator as in claim 31, wherein the controller comprises an interface for displaying the concentration level of fumigating gas within the space.

38. The regulator as in claim 37, wherein the controller displays the control value.

39. The regulator as in claim 31, further comprises a destructor couplable to the controller for removing fumigating gas.

40. The regulator as in claim 31, wherein the controller controls the operation of the destructor.