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Specification



G00002

METHOD AND APPRATUS FOR THE DISINFESTATION OF BUILDINGS AND PARTS OF BUILDINGS

Field of Art

The invention relates to a method and an apparatus for the disinfestation of buildings and parts of buildings according to the precharacterizing clause of Claim 1 and Claim 2, respectively.

Background of the Invention

Harmful insects as well as mites and moulds are known to be present in rooms where food products are processed or stored, even if the greatest care is taken.

The infestation is not only caused by the organisms' own locomotion more often, the pests are brought in accidentally.

This applies all the more when the goods to be stored or processed have been transported over long distances and stored temporarily on the way, so that the final recipient can never be safe from pest infestation.

It applies especially when the surroundings and the nature of the food product do not permit complete cleanliness to be maintained. For example, in bakeries or flour mills it is practically impossible to operate in a completely dust-free manner or to avoid (flour) dust altogether in the interior of the building, on the machines, and so on. Furthermore, it is quite impossible to construct many kinds of equipment, such as silos, mechanical conveyors, cylinder mills etc., in such a way that they are free of all nooks and crannies in which the pests can take shelter.

A known means of combating such pests, i.e. for the disinfestation of buildings, machinery and other parts of an installation, is to employ chemicals, in particular poisons.

The use of poisons is not very desirable for a variety of obvious reasons. Furthermore, disinfestation by means of poisons is extremely expensive and laborious, especially when entire buildings such as mills must be treated. Then the buildings must be completely sealed.

It is also known that most insect pests, or mites and moulds, can be killed by heat if they are exposed to it for a long enough time. The temperatures needed for this purpose are in about the range 50 – 60° C; that is, a temperature is used at which the quality of most foods, in particular those of plant origin, is not altered.

Such a method is disclosed, for example, in the patent DE 40 25 828. This method is advantageous in as much as no substances deleterious to health or to the environment (i.e., poisons) are used. In practice, however, it is extremely difficult to carry out.

In particular, it also requires a substantially complete sealing of the building; furthermore, a certain amount of reconstruction must be undertaken so that the heat, produced by diesel generators situated outdoors, can be introduced into the building through tubes, and at the same time the efficiency of this procedure is necessarily relatively low.

The heating duration, i.e. the time needed not only to heat up the air within the building to be disinfested but also to reach the lethal temperature (50 – 60° C) even in the corners that are most inaccessible and hence most often occupied by pests, is very long.

The patent DE 40 25 828 C2 discloses an apparatus for disinfestation that operates according to the heating principle mentioned above. Here, again, the above – mentioned problem is encountered, namely that pests in inaccessible and therefore especially strongly infested corners are likely not to be reached.

As a means of reaching pests even in such difficult places, DE – PS 154 481 proposes a disinfestation device that employs multiple ventilators to conduct gas to particularly severely infested sites. However, the same problems as cited above arise during this

application of gas ,and at the same time the behaviour of gas currents does not necessarily parallel what happens within the cavities to be disinfested when heat is applied.

In EP 0 432 296 B1 a method of destroying pests by a temperature treatment is disclosed, in which to prevent damage to the objects being treated a careful management of humidity is proposed.A treatment of problem zones is not specifically mentioned.

In DE – OS 26 35 079 an apparatus for drying grain is disclosed, which proposes a special means of humidity control to prevent damage to the grain.Here, again, the problem of the crevices in which pests can shelter is unsolved.

The objective of the present invention is to disclose a method for disinfestation and a disinfestation device of the kind mentioned at the outset, by means of which it is possible reliably to kill pest populations in a simplified and inexpensive manner, with increased efficiency.

Object mentioned above is a basis of this invention.

Thus the present invention has been accomplished to provide a method and an apparatus that can destroy pests populations completely in an enhanced , easier and more saving of costs way.

Disclosure of the Invention

An essential point of the invention is that by means of the apparatus in accordance with the invention it is possible to eliminate the microclimate zones that form in inaccessible sites during the normal heating of rooms or buildings, and in which pest populations can survive.

That is, unfurnished rooms and rooms divided into compartments by buiit – in apparatus,channels and systems of channels for the movement of air are formed when heated air flows in these rooms, it always takes the path of least resistance,so that in places cool

zones develop.

The hot air flowing through a channel – for example, in a horizontal gap behind a silo – undergoes a lowering of pressure because of its flow velocity, which not only reduces its temperature (because of the lower pressure) but also causes air to be sucked out of narrower gaps that open into the broader air – conducting channels, so that the regions within the narrower gaps remain particularly cool, and the adjacent areas of wall or machinery also stay relatively cool in these regions. Therefore when hot air is being blown into a building in the known manner, there is an especially nonuniform heating within the parts of the building, so that although it seems at first glance that all the pests have been eliminated, the pest population soon afterwards has again reached an intolerably high level. In the method in accordance with the invention this is avoided by generating a dynamic pressure in a targeted but nevertheless simple manner, so as relatively rapidly to heat the confined regions in machinery and building structures that are especially preferred by insects and mites. Once these "critical zones" have been heated by appropriately aiming the blowers, it is very simple to keep even quite large spaces at the lethal temperature, so that the pest populations are reliably destroyed. Furthermore, if the temperature should exceed the lethal range (50 – 60° C), the heating is regulated in such a way that only part of the heating element provided for the purpose is turned off, and when the temperature falls below the lethal range, it is turned on again. By this means the temperature fluctuation can be kept within a very narrow region encompassing the lethal temperature ; hence neither is too much energy consumed owing to excessive heating, nor is too – cold and hence ineffective air introduced, which would increase the time needed for the treatment.

Preferably the air – conducting devices comprise at least one movable heating furnace for blowing out hot air. The second air

stream can then be generated either through an appropriate pipeline (tubes or the like) or by separate, unheated ventilators. In this case, the heating furnace that generates the hot air is set up within the building and during the heating process is repeatedly repositioned in such a way that, for example, it blows towards one side of a piece of equipment installed close to the wall of the room, while the other ventilation device is directed towards the other side. As a result, behind this structure a zone of elevated pressure (and hence elevated temperature) is formed, and at the same time hot air can also flow through narrow gaps upwards and downwards behind the structure.

Preferably the heating furnace is constructed so as to comprise an outlet through which hot air is blown out in a particular direction, as well as an opening through which ambient air is sucked in from all directions. This makes it possible to produce strong, directed air currents merely by orienting the outlet as desired, and this air flow is not disturbed by the movement of the air that is being taken in.

In this case the intake openings of the heating furnace are preferably situated lower than the outlets, so that the cooler air near the floor is drawn in, which considerably enhances the efficiency of the entire apparatus.

The heating furnace comprises at least one temperature sensor, which is disposed so as to measure the temperature of the hot air as it is blown out. By this means not only can it be ensured that the temperature of the hot air remains within a harmless range, well below the glowing temperature of the dusts in the vicinity; in addition, it becomes possible to monitor and control a final temperature. For this purpose the temperature sensor preferably regulates heating mechanism within the furnace in on – off operation so that the temperature of the hot air does not substantially exceed a predetermined level, at which the ambient air has reached the lethal temperature of 50 to 60° C, preferably substantially 55° C. Because the temperature of the expelled air is kept at a constant

value, preferably about 90° C, and the over all heat loss from the building or room to be disinfested likewise remains constant when its interior (including the various equipment installed) is heated to a constant temperature, this constant temperature can be kept within the range of the lethal temperature for an arbitrarily long time by a constant supply of energy, with no need for a complicated system of sensor to monitor the room temperature.

Preferably the furnace comprises a vertical flow section within which are disposed blowers, preferably together with an axial ventilator as well as heating elements. As a result, even in an arrangement with many heating elements and voluminous blowers, the construction can be such as to occupy only a small floor area, so that the furnace can be moved between even closely adjacent structures and pieces of equipment.

The vertical flow section preferably comprises an intake opening in a relatively low position and is supported (by means of feet) at some distance above a thermally insulating and/or fireproof floor plate, in such a way that ambient air can flow from substantially all sides through an intake opening, namely the gap between the floor plate and the vertical flow section, into the inlet of the vertical flow section. This arrangement ensures in a simple and structurally solid way that the air enters — as stipulated above — in an undirected manner.

The vertical flow section comprises an upper deflector or section with the outlet at its end. The deflector section is constructed, and preferably provided with air — conducting devices, in such a way that vertically flowing air is diverted within the vertical flow section so as to be blown out horizontally.

The heating furnace preferably comprises electrical heating elements, because by the use of electrical energy a particularly high input of energy is possible in a structure with relatively small volume. The surface temperature of the heating elements is so

adjusted as not to exceed about $190 - 250^{\circ} \text{C}$, and hence presents no danger even to environments risk of fire or explosion (flour dust). For this purpose commercially available heating elements can be used, but these should be operated in such a way (e.g., by disposing several elements in series and/or by thermostatic regulation) that their surface temperature does not exceed the values given above. Because of the vertical construction of the furnace, it is relatively simple to dispose within it a sufficient number of heating elements, preferably in a stacked arrangement.

In the further embodiment of the invention, instead of the electrical heating elements oil - filled heating elements are used, which comprise an additional temperature-limiting device in the associated heater to prevent overheating of the oil. This can be advantageous with respect to safety in operation,

Another component that is preferably included is a moistening device by means of which the heated air can be adjusted to a humidity that will reliably avoid damage the building (wooden parts, in particular) by desiccation. Furthermore, the lethal action of the heated air is enhanced if its humidity is in the "normal" range of $50 - 60 \%$. Preferably the air - moistening device is a nebulizer, positioned in such a way that the air being sucked into the furnace carries the water mist along with it. In this way a particularly high degree of efficiency is achieved, also with respect to the heating of the air, because the airborne droplets evaporate directly at the heating elements, i.e. at the lamellae provided there. Then the furnace can be cleaned by turning the heating off and running the blower while supplying atomized water, at place that provides for suitable disposal of the waste water.

Brief description of the drawings

Figure 1 is a schematic representation of a section through

a heating furnace, and Figure 2 is a circuit diagram to explain the temperature control in the furnace.

Best Mode For Carrying Out the Invention

In the drawing the reference numeral 10 designates a heating furnace that comprises an upper air outlet 11 and a lower air – suction intake opening 12. The suction intake 12 communicates with the outlet 11 by way of a flow section 13 that is open at the bottom and comprises an inlet 14. The inlet 14 is spaced apart vertically from a floor plate 15 and is kept at this distance by supporting feet 16,17. The heating furnace, including its floor plate 15, has a rectangular cross section and rests on the floor by way of fixed feet 18 on one side and wheeled feet 19 on the other side, so that when it is tilted towards the left in this drawing, it can be moved to a position such that the air current 9 emerging from the outlet 11 is appropriately directed.

Within the flow section 13 an axial blower 20 is disposed so that it covers the entire cross section of the low section 13. Above the blower 20 a plurality of heating elements 21 are arranged, which comprise lamellae 22 to increase the heat transmission from the heating elements to the air that is being propelled by the blower 20. The lamellae 22 are vertically oriented so that they can not form surfaces on which dirt, dust and the like can be deposited, so as to minimize the danger of fire.

The heating elements 21 are supplied with electrical energy by way of a switch box 23 into which a cable (not shown) can be plugged. They are so constructed that when in operation, they can never exceed a predetermined temperature of about 190 – 250° C, even if the ambient air sucked in through the opening 12 is already in the temperature range lethal to the pests that are to be destroyed.

As an added safety measure, a temperature sensor (not shown) is

disposed near the heating elements 21 and serves to control corresponding switching devices in the switch box 23, so as to turn off the heating elements. In this way the heating elements can also be regulated to a constant temperature.

Above the heating elements 21, i.e. after them in the direction of flow of the airstream, an air - temperature, sensor 24 is provided to measure the temperature of the heated air that is blown out of the outlet 11. The air - temperature sensor 24 sends to the control device for the heating elements 21, which is provided in the switch box 23, a temperature signal that is compared with a set point. As soon as the set - point value is reached, the energy supply to the heating elements 21 is turned off. If the temperature falls below the setpoint by a predetermined, small amount, the energy supply to the heating elements 21 is turned back on.

The set point is adjusted so that the temperature of the airstream 9 emerging from the furnace 10 does not exceed ca. 90° C. Experience has shown that this is substantially the temperature of the emerging air when the temperature of the air in a (fairly large) room to be disinfested is about 55° C, which is probably explainable by the constant situation regarding heat loss (to the surroundings) that prevails during "stationary" operation. Hence by simply keeping the temperature of the air current 9 constant, it is also possible to keep constant the temperature in the building or room in which the furnace 10 has been placed to destroy the pests.

It is evident in Figure 2 that the heating elements 21 are subdivided into two sections. This makes it possible to use the switch box 23 for controlling the heating elements 21 in dependence on the temperature measured by the sensor 24 in such a way that when the lethal temperature is exceeded, only a part of the array of heating elements is turned off, while the rest continue to be supplied with power. As a result, the range of fluctuation of the air temperature about the lethal temperature can be made very small.

The heating – element array in this case is dimensioned such that turning off this part of the array will ensure in every case that the temperature within the room to be disinfested cannot rise substantially above the lethal temperature that is, the heat loss from the room are greater than can be compensated by the heat generated by the remaining heating elements, which are not turned off.

It is in accordance with the invention that two such heating furnace 10 are provided, by means of which two air currents 9 are made available with which to produce an above – ambient pressure in channel systems formed by built – in structures in the building or installed equipment. This makes it possible to attain the temperature required for disinfestation, about 50 – 60 ° C, in a relatively short time even within such channel systems.

It is then sufficient, because even the inaccessible sites the equipment or within the rooms to be disinfested are warmed to this temperature, to operate the heating furnaces 10 in such a way as merely to keep constant the air temperature in the room to be disinfested, with no need to direct the airstream 9 towards a particular site.

After the room has once been heated, the energy required to maintain the temperature is so slight that in the case of fairly small room (with little heat loss) only a single furnace 10 is needed, so that the furnace 10 that is no longer required here can be used to heat up other rooms.

In general the disinfestation temperature is maintained for a period of about 12 – 36 hours after the initial heating.

Industrial Availability

As discribed above , a method and appratus for disinfestationof buildings and parts of buildings according to the

present invention is useful for disinfestating the entire sealed buildings i.e. flour mills , especially for disinfestating in inaccessible corners.

CLAIMS

1.Method for the disinfection of buildings and parts of buildings, wherein by means of at least one heating device with blowers to produce hot air currents,interior spaces of the building including equipment installed therein are warmed to a temperature lethal to pests and are kept at this temperature for a predetermined period of time, characterized in that at least two air currents in the interior of the building to be disinfested are directed towards at least two entrance regions of channels or channel systems formed by built - in structures or installed equipment in such a way that within the channels or channel systems an above - ambient pressure is generated for warming sites that are difficult to access,that the overpressure is generated consecutively in different channels and channel systems for the purpose of warming them and after the interior of the building has been heated up,the temperature is maintained at a predetermined value by substantially undirected air currents in order to kill the pests,and that the heating device is controlled in such a way that when the predetermined temperature is exceeded,part of the heating device is turned off to reduce the emitted heat energy,and when the temperature falls below the predetermined level,this part is turned on again.

2.Apparatus to implement the method according to Claim 1, comprising at least one heating device with blower to generate hot air currents for warming interior spaces of buildings,in cluding installed equipment, characterized in that at least two air - conducting devices are provided, which independently from one another can be separately adjusted and are movably constructed such that in the interior space currents (9) of hot air can be directed towards at least two input regions of channels or channel systems formed by built - in structures in the building or installed equipment,to produce an above - ambient pressure in these channels

or channel systems, and which emit hot air in a substantially undirected manner into the interior space to maintain its temperature, and in that the heating device (21) is so constructed that when a lethal temperature of 50 – 60°C in the interior spaces is exceeded, a part of the heating device is turned off to reduce the supply of energy, and when the temperature falls below this range, it is turned on again.

3. Apparatus according to Claim 2,
characterized in that the air – conducting devices comprise at least one movable heating furnace (10) for blowing out hot air.

4. Apparatus according to one of the Claims 2 or 3,
characterized in that the heating furnace (10) comprises an outlet (11) for expelling hot air in a particular direction and an intake opening (12) through which ambient air is brought in by suction in an undirected manner.

5. Apparatus according to Claim 4,
characterized in that the suction intake opening of the heating furnace (10) is situated in a lower position than the outlet (11).

6. Apparatus according to one of the claims 3 – 5,
characterized in that the heating furnace (10) comprises at least one temperature sensor (24), which is disposed so as to measure the temperature of the hot air as it is blown out.

7. Apparatus according to Claim 6, characterized in that the temperature sensor (24) controls heating devices (21) in the heating furnace (10) in such a way, preferably in on – off mode, that the temperature of the hot air does not substantially exceed a predetermined level at which the ambient air has reached a lethal

temperature of 50 – 60° C, preferably substantially 55° C.

8. Apparatus according to one of the Claims 3 – 7,
characterized in that the heating furnace (10) comprises a vertical flow section (13) within which are disposed (axial) blowers (20) and heating elements (21).

9. Apparatus according to Claim 8,
characterized in that the vertical flow section (13) comprises a lower inlet (14) and is spaced apart from a thermally insulating/ fireproof floor plate (15) so that ambient air can flow into the inlet (14) from substantially all directions, through a gap that serves as intake opening (12) between the floor plate (15) and the vertical flow section (13).

10. Apparatus according to one of the Claims 8 or 9,
characterized in that the vertical flow section (13) comprises an upper deflecting section with outlet (11) on one side, and is so constructed that air flowing vertically within the vertical flow section (13) is redirected so as to be blown out horizontally.

11. Apparatus according to one of the Claims 3 – 10,
characterized in that the heating furnace (10) comprises, electrical heating elements (21) that are so constructed, and preferably equipped with substantially vertically oriented lamellae (22), that the surface temperature of the heating elements (21) does not exceed 100 – 250° C.

12. Apparatus according to one of the Claims 3 – 11,
characterized by a humidifying device that is preferably so disposed that nebulized water is sucked in by the heating device and is vaporized.