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WARM AIR TREATMENT WITH RECIRCULATING AIR

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Abstract A warm air treatment is a non-toxic method to eradicate all stages of stored product insects or insects interfering with food hygiene and human health. The heating units reach temperatures of 50° to 60°C inside the buildings and rooms everywhere and are maintained during a sufficient period of time. This temperatures are never exceeded otherwise damage due to heat may occur to the building and the machinery. Our machines work only with warm air instead of heat, together with a constant air turnover and electronic regulation. The system was developed to be used in the flour milling industry and similar production facilities. In these environments the hazard caused by combustible dust has to be considered. The unit was constructed to satisfy the classification ex II 3 D according to the ATEX 100 which means it may be operated in the Zone 22 (areas containing conductive dusts). Treatments can be done in rooms as well as in whole buildings.
Key words Stored food pests, heat damage.

INTRODUCTION

Not only human beings but also a considerable number of insect species regard grain and cereal based products as an important basic food. The most common insects threatening this kind of stored products are the grain weevil (*Sitophilus granarius*), the flour moth (*Ephestia kuehniella*) and the rusty-red flour beetle (*Tribolium castaneum*). It is generally believed that the optimum temperature for these insects is somewhere between 15° and 35°C. At temperatures above 45°C both the insects and their eggs are killed within a few hours. As you all know insects cannot reduce their body temperature by perspiring or breathing. At this temperature they will die due to coagulation of their body proteins.

REQUIREMENTS

Warm air treatment is a convenient non-toxic method to eradicate all stages of stored product insects or insects interfering with food hygiene and human health. Several major prerequisites must be fulfilled to carry out the advanced method successfully. At the one hand a temperature of 50 to 60°C must be reached everywhere and be maintained during a sufficient period of time. At the other hand this temperature should never be exceeded, because otherwise damage due to heat to the building and the machinery may occur.

Furthermore inside the building should be optimal warming of walls, floors, machines and constructions in order to reach lethal temperature all over. The project time at a building has to be at least 48 hours and for single room min. 24 hours to guarantee a moderate warming. Also, the system must be flexible, modular and designed for different types of areas and uses energy utilization in an optimal way. One of the most important facts is that the method is able to handle certain plant conditions like explosive atmospheres generated by combustible dust.

METHOD

The procedure described here is based on the principle that only the air from inside the building has to be heated and so high air temperatures are not necessary. The heater causes a circulating airflow inside the building and results in a requested very low energy consumption.

During warm air treatment the temperature is controlled directly. Each heater automatically monitors and controls the temperature of its airflow and consequently that of the floor/area/sector it serves so that a treatment can work with lower temperatures and lower energy consumption. This is essential in factories with sensitive electrical components or electronic control boxes Two heaters can easily be installed in such a way that they produce a heat build-up. This is very helpful if you have to treat for example, flour storage bins that are several floors high. Owing to the construction of the heater and ground fans, the air movement and the heat transfer are encouraged to be at floor level because insects will emerge from machines, flanges and cable conduits and fall onto the floor but are not able to escape to cooler areas.

EQUIPMENT

The heater is equipped with an axial fan of 0.75 kW, two heating registers each of 9 kW, two control thermostats, a safety device to prevent overheating and a switch panel containing the electrical equipment. The three-phase power supply (380-400 Volt) is provided by a 15 meter long cable fitted with a CEE plug. The CEE plug is equipped with a switch to swop two of the phases if the fan direction needs to be changed. The dimensions of the heater are 430 by 610 mm by 1,040 mm high. The energy consumption is 9.75/ 18.75 kW (9/18 kW for heating, 0.75 kW for the fan). The weight of the heater including the 15 meter cable is 75 kg. An axial fan sucks in air at the floor level and blows it over the heating elements. The heated air leaves the top of the heater horizontally.

The temperature of the circulated air is controlled by the integral thermostats. When the room temperature reaches about 50°C the thermostat switches off the heating elements. As soon as the temperature falls the heating element is reactivated to maintain the lethal temperature in the room at between 50°-55°C. In case of a malfunction - when the air temperature in the heater exceeds 140°C the STB (safety-temperature-switch) automatically switches off the main energy supply. The heater is fitted with two wheels and a handle which makes it easy to reposition it during the heating period. The heater was primarily developed to be used in the flour milling industry and similar production facilities to replace methyl bromide and other toxic agents used for pest control. In these situations the hazard caused by combustible dust has to be considered.

In Europe the EU-regulation 94/9EG (also known as ATEX 100 a) concerning equipment used in explosive atmosphere has to be complied with. The heater was constructed to satisfy the classification ex II 3 D according to the 94/9/EG which means it may be operated in the Zone 22. The heaters are connected to existing CEE sockets. If the customer's plant does not have enough CEE sockets there is the possibility to provide one or more power distributors panels with up to fifteen 32A sockets. This distribution panel can be connected directly to the main energy supply.

For a better air distribution and to work against the thermal effect, ground fans are used in addition. They suck on the upper warm air on top of the machine and bring it out via an integrated pyramid in all four directions straight over the floor. The used fans have the same diameters like the heaters only without heating elements and 16A CEE plugs. The inserted amount of ground fans depends on the construction of the treated building. For a fewer needed number of CEE sockets there is the possibility to connect up to five ground fans with the help of a small distribution board on one 32A CEE socket. Adapters, deflectors and extension cables complete the equipment.

APPLICATION FIELDS

Within the last 15 years the system has been used successfully in different branches and industries: Food: processing industry, mill, bakery, pasta, baby food, catering; pet-food/feed: pet food plant, premix plant, feed-plant; non-food: clothes, tobacco industry, wooden subjects, IPPC-standard (ISPM 15), room drying, climate improvements. Bed bugs: hotel, motel, accommodation, living rooms, train, and plane. The maximum building volume that can be treated economically is between 50,000 cubic meters and 70,000 cubic meters. Larger buildings should be divided into sections which are treated one after another.

COSTS VS. BENEFITS

To carry out a treatment has with rental for equipment, performance man power, transportation charges and energy consumption four different parts of expenses for the customer. Opposing it isn't only a pest control procedure because it has further fundamental benefits. During the whole treatment it's possible to stay inside the treated rooms and especially during the warming up to see how insects leave their hidings. This fact helps the customer's employees for future hygiene management procedures. They are able to do intelligent cleanings or structural improvements. They learn to see their plants with different eyes. After the treatment the whole building inclusive inside machinery is dried out. All caking inside silos or inside tube systems which may contain mold are now easy to remove. Also the germ number is reduced compared with the former situation.

COMPARISON

Using the system brings a lot of different advantages compared with other applied methods. Warm air treatment vs. fumigation (SF2, PH3, MB, mixtures, etc.):

Non-toxic for person and no residues in products, no development of insect resistances, no pressure test of the building, no official authorization, rooms always accessible, insects are visible, lethal for all insect stages of development. Warm air treatment vs. heat treatment (oil or gas burning units, >80°C). No heat damages, more flexible, adaptable and modular, user-friendly, easier distribution of warm air, lower energy consumption, closed machines and facilities because of permanent warm circulating air. Heat treatments are independent from the outside temperature and can be performed all the year round. Also it's only an internal procedure without outside standing machines or any poison-warning sign outside of the building.

EXAMPLES OF USE

Use in a Mill

For an effective building treatment six basic rules have to be observed: 1) Shut down the entire production equipment, 2) Clean all the rooms carefully, remove dust deposits, wrapping paper, bags, packaged product and other removable inflammable objects from the rooms which are to be heated, 3) Remove gas containers (like spray cans) from the area to be heated, 4) Switch off compressors and ventilate the pressure tanks, 5) Remove combustible fluids, 6) Switch off all electronic components.

The heating period in production buildings with several floors could extend to 48 h. A single-room heat treatment, e.g. laboratory, sample room, normally takes 24 h.

During the heating period, inspect the heated areas at regular intervals, to check that the heat distribution is uniform and to identify cool areas. Normally, at least 2 (but often more) heaters WEO 9/18 and ground fans are used on each floor. It depends on the total base area and volume of the building. They

are positioned in such a way that they produce a uniform heat distribution. In a single-room heat treatment one heater should be enough. The heaters are connected to existing CEE sockets or in most cases via power distributors. A heating power of 18 kW needs a single 32A fuse. If the power socket is only fitted with a 16A fuse the heater can be used at half power (9 kW) as well.

Secluded Areas

Apart from treating whole buildings or areas this system is a great tool to treat separated areas within a building or any kind of premises. There are already treated fully successfully: Separated areas inside a plant (for example parts of a plant, production areas in the same areas as warehouse areas); production lines inside a plant; separated rooms inside plants (just one or a few floors of a building, production areas that are just by technical rooms); only parts of a production line (treating just fermentation chambers of a production line); just part of equipment such as trays or cups or similar items; hotel or Hospital rooms (mainly bed bugs).

It is important when you have to treat secluded areas inside buildings to previously plan how we are going to be able to treat them. It's fundamental to make sure that everything is taken into account so we don't face problems when we have to start the treatment or during the same treatment.

Things we should always think of when planning a job: How are we going to construct the separation between the area that has to be treated from the rest of the plant or building (use of a wooden structure, just use of frames covered with carton or plastic, plastic covers, etc.); when constructing the separation, we have to think that there's going to be heavy air moving inside the secluded area (the construction has to resist the heavy air pressure); minimization of the heat loss (in order to save energy and ensure the efficacy of the treatment). Make sure that pipe lines, the structure itself, etc., are being taken care of; how are we going to be able to enter and get out from the secluded area during treatment; during treatments is necessary to check for cold areas and act accordingly; how we will detect and control insects trying to escape from the treated zones.

NETWORK

The warm air treatment is being practiced in Europe and in several Asian countries and has been receiving a steadily growing appreciation. Partner companies are located in the main countries which have own equipment to be next to customer's requirements. Outside Europe there are plans to build up two new partner companies to meet increasing worldwide demand. For a quality assurance this system is distributed only through certifed operators to follow up the efficient practice and the safe use of heat treatment in food industry and other applications. The company headquarter in Germany provides partners, customers and smaller national partners with equipments, single machines, services, training and consulting.

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