

HYGIENIC DESIGN AND INSTALLATION OF UV INSECT KILLERS

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Abstract

Insects are usually contaminated with 5 million germs that may be transferred onto food products. To eliminate flying insects, UV light insect traps are excellent. Commonly used are adhesive glue board traps that capture insects on a disposable glue board, and electric grid traps that attract flying insects to an electrocuting grid. Black Light Blue lamps emit only UV light that attracts Lepidoptera (e.g. moths); while Black Light lamps produce Near UV and Blue Visible Light to attract Diptera (e.g. flies). Lamps can be coated on the outside with a thin sheet of plastic, to contain shattering glass on lamp breakage.

Electrocuting traps should have an acceptable large and deep collection tray, to prevent spreading of burst insect debris (insects may explode during electrocution) over the process area. But, a too large collector tray creates a shadow zone in its vicinity, whereby insects no longer perceive the UV light. Light traps should ideally be mounted at least 2 m above the ground, to improve attraction of flying insects and to be invisible from the outside. They must be installed at right angles to entrances of process areas, at least 3-6 m away from food processing equipment, and away from high-velocity air streams that may entrain insect debris from the collector tray.

In the vicinity of open products, glue board traps (not industry areas!) are advocated. Installation of UV light traps at the outside of the food factory is useless, as sunlight (contains much more UV) renders them ineffective, and they may attract insects overnight. Light traps should be regularly cleaned; the lamps frequently changed as their UV output decreases; and the collection drawer should be emptied once a day.

Key words: *Insect light trap, UV.*

1. Introduction

Food premises and areas provide insects with everything they need: warmth, food and shelter. These insects, however, can contaminate food with bodies,

hair, and droppings (saliva and faeces). Only by care and good house-keeping, food areas can be prevented from being invaded and infested by these insects. From all insect traps (e.g. pheromone or food baits, containing a sticky strip or a solid insecticide) currently in use, light traps have proven to be the best choice, especially those that make use of UV light.

But instead of preventing contamination of food, these UV light traps can become a source of contamination, if not designed, installed and maintained appropriately. This paper gives an overview of these specific contamination risks, and outlines the hygienic measures that should be taken to avoid them.

2. Contamination of food products via insects

Insects can contaminate food products via two ways (Figure 1) (Füchs [1]).

- Insects are usually contaminated with 5 million germs, and can act as vector transferring these microorganisms onto food products. When eating a food, they contaminate it with microbes from their hair, their saliva, their faeces (they defecate the same time as they eat) and their previous meal (which may be dung).
- They can lay eggs, giving raise to larvae after a short while. Therefore, they must be killed as soon as possible when they enter the food plant.

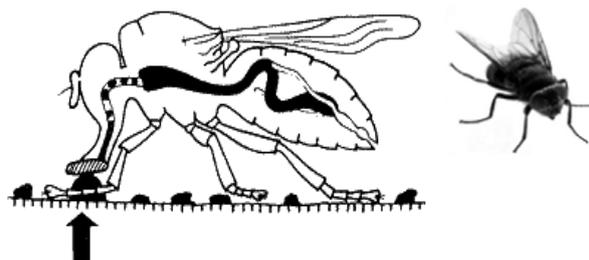


Figure 1. A housefly sucking in a liquefied and pre-digested food particle by dabbing (Füchs [1])

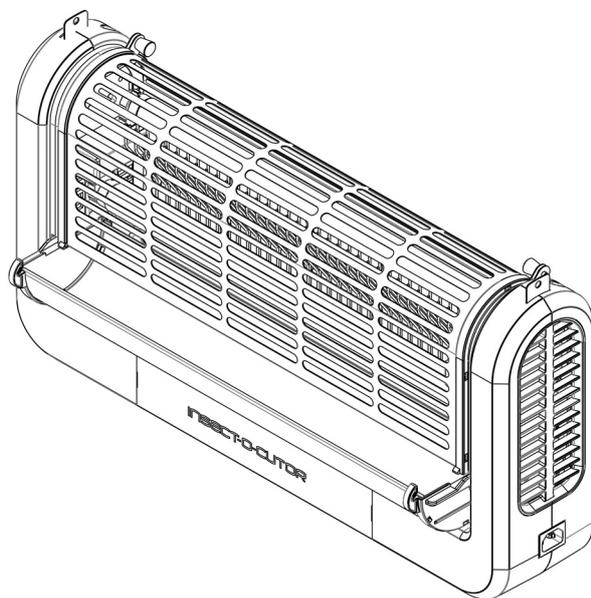
2.1 Two main groups of UV insect light traps

Many insects are sensitive to UV light. The frequency range of maximum response for most insects is 330-370 nm, with a maximum at 365 nm. Therefore, electronic insect killers utilize ultraviolet tubes to attract flying insects, and to finally kill them by electrocution or by trapping them on a sticky glue board (Füchs [1]).

There are thus two types of insect elimination light traps:

- Adhesive glue board traps that attract flying insects by means of UV light, to silently capture them on a disposable adhesive board (glue board).
- Electric grid traps that attract flying insects by means of UV light to an electrocuting grid, where they are electrocuted. Other names used for this type of light-based insect elimination systems are “zappers” or “electrocutors”.

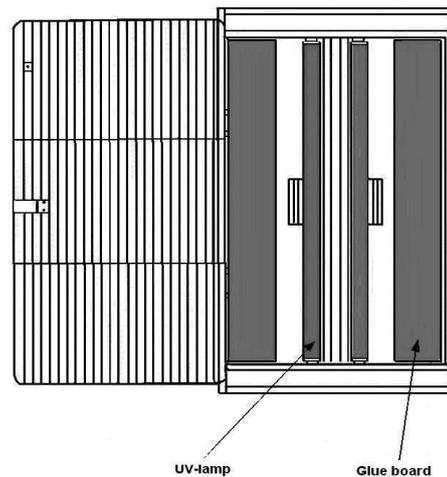
Electric grid traps contain a lamp holder for simple installation of the UV light tubes, a high-voltage (3000-5000 volt), low-amperage (9-12 mA) current contact grid, front and rear safety guards, an electric current interrupter and an insect collection tray (attached exteriorly or concealed as drawer within the electrocutor) (Figure 2).



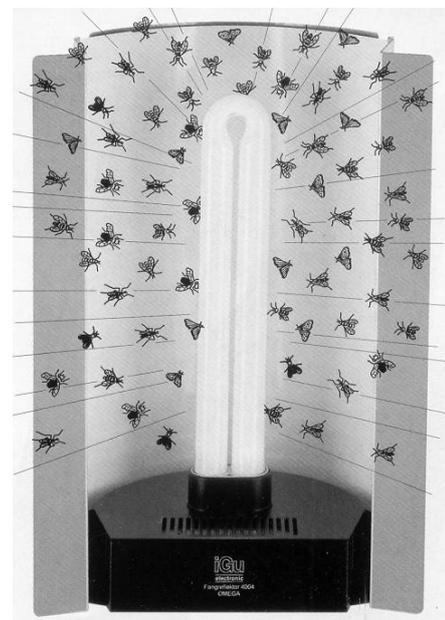
(Courtesy of P&L Systems Ltd.)

Figure. 2 Electrocuting grid trap with flying insect collection drawer

Glue board traps contain a lamp holder to mount the UV light tubes and a glue board that is sometimes impregnated with insect pheromones to further attract flying insects. The glue board is installed as a semicircle nearby or behind the UV lamp (Figure 3) (Füchs [1] and [2], Bitner [3], Harris [4] and Füchs and Faulde [5]).



(Courtesy of Gilbert Industries, Inc.)



(Courtesy of iGu® Transtrade Ltd.)

Figure. 3 Adhesive glue board traps

2.2. Two types of UV light producing tubes

The following 2 types of UV lamps are used:

- The BLB (Black Light Blue) lamp produces its energy in the same wavelength range like the BL lamp. However, the BLB lamp is constructed of special filtering glass which reduces the passage of energy in the visible light range between 400 to 460 nm. Because of this filtering of blue visible light, the lamp does not have the light blue colour that the BL lamp produces, but instead appears as a blue/black colour. The BLB lamp emits only UV-

light, that has been found to be very attractive for Lepidoptera (e.g. moths).

- The BL (Black Light) lamp produces most of its energy in the Near UV range. However, a portion of the energy is outside the UV range, more specifically in the Blue Visible Light range. The light of the BL lamp is very attractive for Diptera (e.g. flies).

Both can be combined within the same electrical flying insect elimination system. A combination of one light blue (known as a BL lamp) and one dark blue (known as a BLB lamp) lamp guarantees the most complete insect attraction currently available from insect light traps.

2.3 Hygienic construction

Insect light traps should preferably be made of non-corrosive metals like heavily galvanized steel, powder coated steel or stainless steel AISI 304. Although other materials that are resistant to splash and the action of aerosols generated during cleaning and disinfection procedures can be applied. Painting of insect light traps is less recommended. If possible, the insect killers should have a 30° sloped top surface. The light traps should be grounded for safety reasons and to avoid the electrostatic deposition of dust and aerosols on the exterior and interior surfaces of the executor.

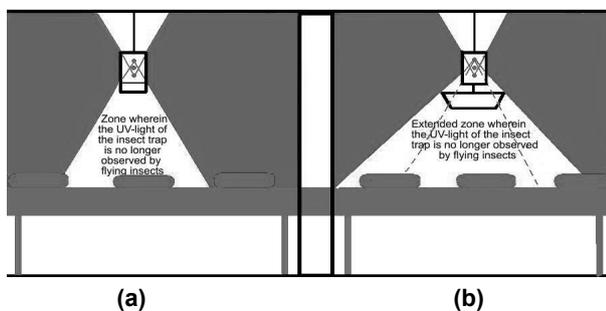


Figure 4. (a) A removable insect collection drawer forms part of the electrocuting grid trap, so that insect corpses can be removed in a hygienic manner (b) A large collector tray is fixed below the electrocuting grid trap. A shadow zone in the vicinity of the insect killer is created whereby flying insects no longer can perceive the UV light emitted by the insect light trap. This puts open food products in the neighbourhood at higher hygienic risk

Electrocuting grid traps should have an acceptable large and deep collection tray or drawer. During electrocution, insects can explode, sending insect particles and microorganisms all over the environment. Maximum efforts should be done to collect most of the burst insect debris. However, when the collector tray is too large, it creates a shadow zone in the vicinity of the insect killer whereby flying insects no longer can perceive the UV light emitted by the insect light

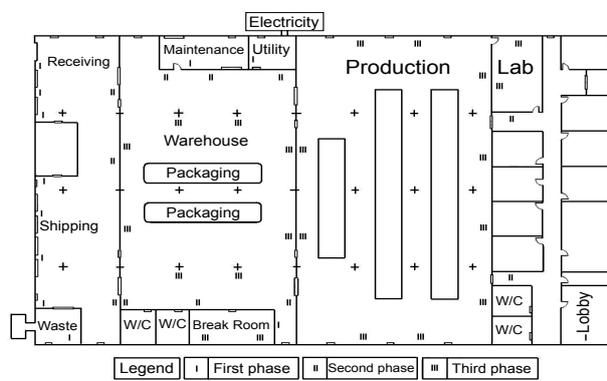
trap (Figure 4b). This puts open food products in the neighbourhood at higher hygienic risk. The collection drawer or tray should be deep enough, to prevent high velocity air from entraining insect debris out of the collector into the environment. Preference should be given to a removable insect collection drawer, because then, insect corpses can be removed in a hygienic manner (Figure 4a). An exteriorly attached collection tray is less easy to clean, with more hygienic risk. There is an increased risk for pooling water (deposition of water droplets during hosing procedures, drip from overhead piping) and for accumulation of dirt within a large outside collection tray; and hence, hygienic disassembly is less obvious.

2.4 Hygienic installation requirements

The UV light flying insect killers should ideally be mounted at least 2 m above ground level, to provide an increased opportunity for flying insects to be attracted to the UV light; to be invisible from the outside thereby avoiding attraction of flying insects from that outside; and to allow for sufficient clearance of forklift traffic. UV light flying insect killer systems should be positioned on the opposite wall to sources of natural light such as outside doors, windows and skylights. These sources compete with the UV tubes in attracting flying insects. Moreover, the installation of UV lighting near windows and outside doors increases the risk to attract flying insects over night. Insect light traps should preferably be positioned at right angles to openings; near entrances of processing, packaging and storage areas; or somewhere between the zones to protect the points where they intrude the factory. It is not recommended to install UV light based insect killers just above entrances to the process areas, because insects may not intrude these rooms. They should also not be positioned in a zone with high velocity air currents (e.g. just before the air supply, or in the neighbourhood of exhaust openings), because debris, insect corpses and particles can be entrained from the collector tray by these air streams (Bitner [3]).

The UV tubes should be visible from every part of the area to be protected. This means that extra thought should be given to complex areas with pillars, beams and other obstacles (e.g. canopies, overhead piping, large process equipment) (Figure 5). One insect light trap has the capacity to attract insects over a distance of maximum 30 m, and over an area of 150 to 350 m². The attraction perimeter depends on the location where the insect light trap is installed, and also depends on the amount of UV-light emitted. That UV output may diminish substantially with time because the phosphor coating that emits the correct wavelength of UV light gradually burns away during the lamp's lifetime. In complex or large areas, two or more flying

insect killers may be required to ensure appropriate protection against flying insects. However, insect light traps should not be positioned in the centre of an area, as this will attract insects throughout the area, in e.g. towards sensitive food products just below. They should be positioned at least 3 m away (preferably 6 m) from food processing equipment. This distance is especially recommended for electrocuting grid traps, because insects - as already told - can explode when hitting the electric wires. In the proximity of open products and preparation areas, adhesive UV light traps with "sticky" glue board strips that capture and firmly stuck the flying insects are advocated. However, glue board traps are not very appropriate in dusty environments (e.g. where dry materials are handled) (Bitner [3]).



(Courtesy of insect-o-cutor)

Figure 5. Electric grid traps can be installed according to a three phase concept. In the first phase, perimeter defence units should be located in positions where they will intercept flying insects immediately after entry. If the receiving dock is covered, an electric grid trap should be located on the dock to reduce the number of flying insects gaining entry through the receiving dock doors. In a second phase, units should be located along the probable insect flight path, between phase I and sensitive areas, processing/manufacturing and packing areas, or any area where flying insects might contact or contaminate product or cause personnel annoyance. In a third phase, units provide final interception immediately outside sensitive areas. Units located within processing/manufacturing, production and food preparation areas are also considered as third phase

Installation of electrical insect control devices at the outside of the food factory is useless, as sunlight renders them ineffective. The sun has more ultraviolet radiation than could ever be produced by fluorescent type lamps. Notice that UV light insect traps placed in the near perimeter of the food factory also attract insects towards the food plant. It is also idle to place insect light traps in cold rooms lower than 12°C, because insects stop flying at temperatures <12 °C (Bitner [3]).

The insect eliminators can be wall mounted, set off the wall for cleaning access; or they can be directly mounted on the wall, caulk-sealed to prevent microbial and soil niches between the insect light trap and the wall. It is more common practice to hang them onto the ceiling. Ceiling suspension must be done hygienically, with smooth rods (no all thread), smooth plastic coated steel cable, or galvanized or stainless steel chain with large open links. When a suspending frame is used to support the insect light trap, that frame must be made of smooth round tubing sealed at its ends. Angle iron and unistrut supports are not acceptable.

2.5 Maintenance & cleaning

Maximizing the emission of near ultraviolet (near-UV) light is the key to the overall effectiveness of any electrical flying insect elimination system. Most black light lamps have an average lifespan of 7000 hours (9.5 months of continuous use). To maintain insect attracting effectiveness in light traps, it is important to replace the lamps at least annually. Preferably before the heavy seasonal flying infestation begins (spring). In tropical and sub-tropical climates, black light lamps should be replaced twice a year (Bitner [3] and Harris [4]).

The light tubes in electrical flying insect elimination system can be coated on the out-side with a thin sheet of plastic, several micrometres thick. In the event of lamp breakage, all glass particles are contained within the protective lamp envelope, protecting personnel, product and the workplace against glass shatter (Bitner [3] and Harris [4]).

In addition to lamp replacement, an UV light based flying insect elimination system should also periodically be cleaned. This constitutes brushing debris from the grid kill area, wiping exterior surfaces with a dampened cloth to remove dirt, dust and grease, and emptying the collection drawer or tray. Aerosols formed during hosing procedures make the insect light trap surfaces wet, and the collection drawer or tray can contain water. To prevent microbial contamination, it is recommended that the collecting drawer or tray should be emptied once every day during periods of high insect activity. This practice also provides interesting information about the nature and concentration of particular insects, and it prevents other insects from using the contents of drawers as a food source (Bitner [3]).

In UV light based glue board traps, glue boards have an effective life of approximately thirty days due to a decrease in the viscosity of the glue. Therefore, the glue board should be replaced every month to ensure the glue effectively retains the caught insect. Glue boards are also quickly fouled with dust (Bitner [3] and Harris [4]).

3. Conclusions

- (a) Prevent insects from entering food areas rather than controlling them once there.
- (b) UV light traps should be hygienically designed, with a removable insect collection drawer of sufficient depth and appropriate dimensions. A too large collection drawer gives rise to shadow areas, whereby flying insects no longer can perceive the UV light emitted.
- (c) UV light flying insect killer systems should be positioned on the opposite wall to sources of natural light, at right angles to openings, at least 3 m away (preferably 6 m) from food processing equipment, and 2 m above ground level to be invisible from the outside. They should also not be positioned in a zone with high velocity air currents, and in the outside perimeter of the food factory.
- (d) In the proximity of open products, UV light traps with “sticky” glue board strips should be used. However, these adhesive glue board traps can’t be used in dusty environments.
- (e) Collection drawers should be emptied every day; all parts of the insect traps should be regularly cleaned; and the lamps should be replaced at least annually.

Acknowledgement

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