Industrial exploitation also requires precise control of the different steps of the process. In particular, the flies are produced by batches of several thousands of individuals and it is desirable for the flies from the same batch to lay eggs substantially simultaneously. The larvae obtained then grow in the same manner, which improves the productivity.

An object of the invention is to provide an egg laying device which allows the productivity of such an installation to be improved.

Summary

In an aspect, the present disclosure refers to an egg laying device for flies, the device comprising:

- a fly cage and

- a laying nest which is intended to receive the eggs laid by flies which are enclosed in the cage,

in which device the cage is passed through by at least one egg laying aperture which opens towards the exterior of the cage via an external opening, and wherein the laying nest is arranged outside the cage and defines an egg laying zone which extends opposite the external opening.

In another aspect, the present disclosure refers to an installation comprising a unit for producing flies, a unit for producing eggs which are laid by the flies, a unit for producing young larvae from the eggs, a unit for producing adult larvae from the young larvae, and a unit for processing the adult larvae in order to produce a protein-containing product and/or a fertiliser and/or an oil, the unit for producing eggs comprising an egg laying device according to the above aspect.

In an example, the present disclosure sets out an egg laying device for flies, the device comprising:

- a fly cage preferably comprising a container comprising:

    - a base wall which defines a base surface which is orientated towards the interior of the cage, which is preferably horizontal, and

    - a lateral wall which surrounds the base surface and which defines a lateral surface which is orientated towards the interior of the cage, which is preferably vertical, and

- a laying nest which is intended to receive the eggs laid by flies which are enclosed in the cage.

The term “internal surface” of the container is intended to refer to the surface of the walls thereof which delimit the internal volume thereof.

According to an example, the cage is passed through by at least one egg laying aperture which opens towards the exterior of the cage via an external opening and the laying nest is arranged outside the cage and defines an egg laying zone which extends opposite the external opening of the egg laying aperture.

As will be seen in greater detail in the remainder of the description, such a device allows a fly enclosed in the cage to lay eggs outside the cage, on the egg laying zone, through the egg laying aperture. The eggs can thus be retrieved without it being necessary to enter the cage, which prevents the flies enclosed in the cage from being disturbed, and therefore promotes their development. Furthermore, the retrieval of the eggs outside the cage is advantageously very rapid. The productivity of the installation is thereby improved.

Finally, such a device according to the present disclosure advantageously allows any risk of flies escaping from the cage during the retrieval of the eggs to be prevented.

A device according to an example may further comprise one or more of the following optional and preferred features:

- the egg laying aperture has, in cross section, that is to say, in a plane of section perpendicular to the axis thereof, preferably in any cross section, a contour without any angle, which is preferably strictly concave when viewed from inside the egg laying aperture;
- the egg laying zone is spaced apart from the external opening of the egg laying aperture by a spacing greater than 3 mm, preferably greater than 5 mm, preferably greater than 8 mm and/or preferably less than 20 mm, preferably less than 15 mm, preferably less than 10 mm;
- the egg laying device comprises an odoriferous source which is arranged outside the cage in order to generate, in the cage and through the egg laying aperture, an odour which attracts the flies;
- the odoriferous source is separated from the external opening of the egg laying aperture by the laying nest which preferably comprises channels which are configured so that the odour emitted by the odoriferous source reaches the egg laying aperture.

According to an example, the egg laying zone defines a re-entrant edge, the length of which, following the axis of the edge, is greater than 10 mm, preferably greater than 20 mm, preferably greater than 30 mm, preferably greater than 40 mm, preferably greater than 60 mm, and/or less than 500 mm, preferably less than 300 mm.

The inventors have discovered that such a re-entrant edge length is very effective in order to attract the flies which wish to lay eggs, in particular in comparison with the lengths of small cells. It further facilitates the detachment of the eggs during the retrieval thereof. Without being limited by this theory, the inventors consider that a long edge prevents blockage of the eggs in the microcavity defined by the edge.

A device according to an example may further comprise one or more of the following optional and preferred features:

- the re-entrant edge is closed on itself;
- the re-entrant edge extends substantially parallel with the external opening when the device is in accordance with the first main aspect;

- the egg laying zone comprises only such re-entrant edges.

According to an example, the base surface and/or the lateral surface and/or the internal surface of the container

- do not have any re-entrant edge or have one or more re-entrant edges, the cumulative length of which *La* is such that the ratio of this cumulative length to the surface-area *S* of the base surface and/or the lateral surface and/or the internal surface of the container, respectively, *La/S*, is less than 1200 mm/m^2, preferably less than 1000 mm/m^2, preferably less than 900 mm/m^2, preferably less than 850 mm/m^2, preferably less than 800 mm/m^2, without counting any re-entrant edges in the junction zone between the base surface and the lateral surface, preferably counting any re-entrant edges in the junction zone between the base surface and the lateral surface; and/or do not have any raised portion or depression, the height or depth of which is greater than 5 mm, greater than 4 mm, 3 mm, 2 mm, 1 mm, 0.5 mm, 0.3 mm, 0.2 mm, or 0.1 mm, respectively; and/or
- have, over more than 90% of the surface-area(s) thereof, preferably over more than 95%, more than 97%, more than 99%, more than 99.5% of the surface-area thereof, preferably substantially 100% of the surface-area(s) thereof, a radius of curvature greater than 0.5 cm, preferably greater than 1 cm, preferably greater than 2 cm, preferably greater than 3 cm, preferably greater than 5 cm, preferably greater than 7 cm, and/or less than 30 cm.

A device according to an example may further comprise one or more of the following optional and preferred features:

- the lateral wall comprises, preferably is constituted by, a plurality of substantially planar faces and the junction zone, which is preferably vertical, between two adjacent faces, preferably between any two adjacent faces, does not define any re-entrant edge on the lateral surface and/or has at any point a radius of curvature greater than 0.5 cm, preferably greater than 1 cm, preferably greater than 3 cm, preferably greater than 5 cm, preferably greater than 7 cm, and/or less than 30 cm;
- the internal surface of the container does not have any re-entrant edge in the junction zone between the lateral surface and the base surface;
- the junction zone between the lateral surface and the base surface has at any point a radius of curvature greater than 0.5 cm, preferably greater than 1 cm, preferably greater

than 3 cm, preferably greater than 5 cm, preferably greater than 7 cm, and/or less than 30 cm;

- the base surface and/or the lateral surface has/have a radius of curvature less than 7 cm, 5 cm, 3 cm, 1 cm or 0.5 cm only in junction zones with a laying nest support and/or a connection aperture which can be selectively closed and which is intended for the introduction of flies into the cage;
- no component is positioned or fixed on the base surface, at least when the egg laying device contains flies;
- the base surface and/or the lateral surface is/are smooth to the touch.

In a particularly advantageous example, the base surface is continuously planar, that is to say, it extends in a plane in an uninterrupted manner as far as the junction zone with the lateral surface.

No depression, for example, in the form of a slot, a groove, a cavity or a hole, which may or may not be a through-hole, is therefore arranged in the base surface. No protrusion, for example, in the form of a strip of material or a boss, projects from the base surface. In other words, any straight line marked on the base surface joins two points of the external contour of the base surface without being interrupted by a depression or a protrusion.

The inventors have found that an egg laying device according to an example leads to a substantial limitation of the undesirable clutches of eggs, that is to say, clutches of eggs outside the egg laying zone.

The features of the different main aspects of the invention, whether necessary or optional, may be and are preferably combined.

Independently of the main aspect, a device according to the present disclosure may further comprise one or more of the following optional and preferred features:

- the height of the lateral surface is between 0.4 m and 1.8 m;
- the lateral wall has a profiled shape with a polygonal cross section;
- the cover, which is preferably open-worked, is fixed in a removable manner to the lateral wall, preferably on an upper rim of the lateral wall, preferably by means of a hook-and-loop strip;

- the device comprises a light source, which may be natural or artificial and which emits light towards the lateral surface and/or the base surface, the egg laying aperture being arranged so as not to directly receive the light;
- the egg laying aperture is arranged in a region of the cage which receives the least of the light;
- the cage has more than 50 egg laying apertures which are arranged through a removable egg laying plate;
- the spacing between the external opening of an egg laying aperture and a corresponding egg laying zone is constant, whatever the egg laying aperture being considered, the spacing preferably being greater than 3 mm, preferably greater than 5 mm, preferably greater than 8 mm, and/or preferably less than 20 mm, preferably less than 15 mm, preferably less than 10 mm;
- the laying nest and the egg laying plate are arranged in a tubular support which extends through the cage, preferably the container, preferably the lateral wall of the container, and they extend, preferably perpendicularly to the axis of the tubular support, so as to substantially close the tubular support;
- the tubular support projects inside the cage and/or outside the cage over more than 5 cm;
- the base surface and/or the lateral surface has/have a white or yellow colour which is preferably uniform;
- the lateral wall of the container is perforated by a connection aperture which can be selectively closed and which is intended for the introduction of flies into the cage;
- the cage has a volume less than 10 m^3, preferably less than 5 m^3, preferably less than 2 m^3, preferably less than 1 m^3, and/or preferably greater than 0.2 m^3, preferably greater than 0.5 m^3.

In a preferred example, the base surface and/or lateral surface and/or internal surface of the container do not have any re-entrant edge or have one or more re-entrant edges, the cumulative length of which La (sum of the lengths of all re-entrant edges) is such that the ratio of this cumulative length to the surface-area S of the base surface and/or the lateral surface and/or the internal surface of the container, respectively, La/S, is less than 1200 mm/m^2, preferably less than 1000 mm/m^2, preferably less than 900 mm/m^2, preferably less than 850 mm/m^2, preferably less than 800 mm/m^2, and/or the base surface and/or lateral surface and/or internal surface of the

container do not have any raised portion or depression, the height or depth of which is greater than 5 mm, greater than 4 mm, 3 mm, 2 mm, 1 mm, 0.5 mm, 0.3 mm, 0.2 mm, or 0.1 mm, respectively.

In a preferred example, one or more through-openings are made through the walls of the container to provide fluid communication between the inside and the outside of the container.

In a preferred example, for the calculation of La, any re-entrant edges in the junction zone(s) between the said through-opening(s) and the internal surface of the container are not counted.

In a preferred example, for the calculation of La, any re-entrant edges in the junction zone(s) between the said through-opening(s) and the lateral surface of the container are not counted.

In a preferred example, for calculation of La, any re-entrant edges in the junction zone between the base surface and the lateral surface of the container are not counted.

In a preferred example, for calculation of La, any re-entrant edges in the junction zone(s) between the said opening(s) and the internal surface of the container are not counted, nor are any re-entrant edges in the junction zone(s) between the base surface and the lateral surface of the container.

The through-opening(s) may be substantially polygonal in shape, for example rectangular or square. Alternatively, the opening(s) may not be polygonal in shape, for example may be circular or elliptical. The container can have as many through-openings as there are faces of the lateral wall. Alternatively, the container may have fewer through-openings than faces of the lateral wall. For example, the container may have two through-openings on opposite sides of the lateral wall. For example, if the lateral wall has four planar faces defining a rectangular cross-sectional profile, the container may have one through-opening on each of the two larger faces. Alternatively, the container may have a through-opening on each of the two smaller faces. Alternatively, the container can be provided with a through-opening on each of the four faces.

The through-opening(s) height may be greater than 40% of the height of the face of the lateral surface carrying it, preferably greater than 50%, greater than 60%, greater than 75%, greater than 90% of the height of the face of the lateral surface carrying it. The through-opening(s) height may be less than 95% of the height of the face of the lateral surface that carries it. Through-opening(s) may be made in the upper half of the face of the lateral surface that carries it (them).

The through-opening(s) may extend over more than 40% of the area of the face of the lateral surface that carries them, preferably over more than 50%, over more than 60%, over more than 75%, over more than 90% of the area of the face of the lateral surface that carries it (them). The through-opening(s) may extend over less than 95% of the area of the face of the lateral surface that carries it (them).

The through-opening(s) may extend over more than 20% of the area of the face of the lateral surface that carries it (them), preferably over more than 30%, over more than 40%, over more than 50%, over more than 60% of this area, preferably substantially extend on 75% of the area of the face of the lateral surface that carries it (them). The through-opening(s) may extend over less than 95% of the area the face of the lateral surface that carries it (them).

The through-opening(s) may be covered with a wire mesh. This mesh can be fixed in a removable manner to the lateral wall, preferably by means of a hook-and-loop strip. These mesh-covered through-openings allow air to circulate inside the fly cage while preventing the individuals from escaping. Such a through-opening also makes it possible to observe the inside of the fly cage without having to open it.

The present disclosure further relates in an example to an installation comprising an egg laying device according to the invention, the cage preferably containing more than 1000 and/or less than 100,000 flies, preferably of the BSF type.

The present disclosure also relates in an example to an installation comprising a unit for producing flies, and in particular flies, a unit for producing eggs which are laid by the flies, a unit for producing young larvae from the eggs, a unit for producing adult larvae from the young larvae, and a unit for processing the adult larvae in order to produce harvestable products, for example, a protein-containing product, in particular a protein-containing flour, and/or preferably a fertiliser and/or an oil. These products can be used, for example, for animal feed, agriculture or technical applications.

According to an example, the unit for producing eggs comprises an egg laying device according to the present disclosure.

Preferably, the flies are flies of the BSF type (Black Soldier Fly) or *Hermetia illucens*.