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(54) **Device for drying a water-containing mixture**

(57) The present invention relates to a device (1) for drying a water-containing mixture comprising at least one body (2) which can be moved along a closed orbital path and is situated in the mixture during a first part of the orbital path and is situated outside the mixture during a

second part of the orbital path, said body (2) comprising a number of plate-shaped entraining elements (3) which are designed in such a manner that they entrain part of the mixture. By means of such a device, a large drying surface is created, as a result of which mixtures can dry and thus thicken much more quickly.

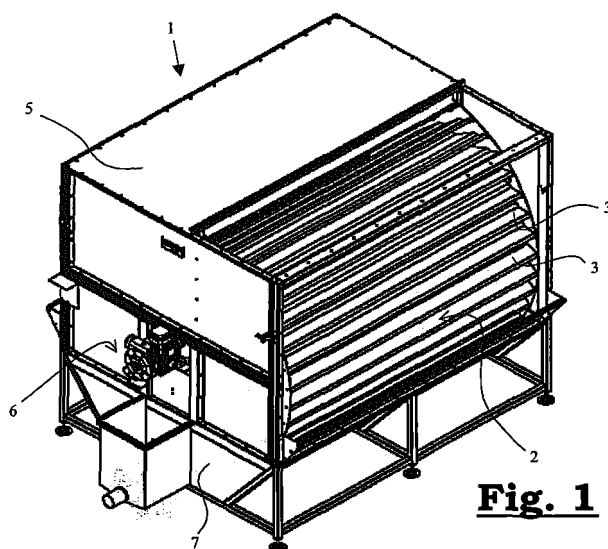


Fig. 1

Description

[0001] The present invention relates to a device for drying a water-containing mixture comprising at least one body which can be moved along a closed orbital path and is situated in the mixture during a first part of the orbital path and is situated outside the mixture during a second part of the orbital path. The present invention relates in particular to a device for drying slurry.

[0002] Many operating processes and agricultural activities produce sludge or manure waste (slurry) which has to be transported away and processed. However, the mixture to be transported away contains a great deal of water, so in order to reduce the transportation and processing costs significantly the water content of the mixture will be reduced by thickening this mixture.

[0003] During thickening, a large part ($\pm 70\%$) of the water which is present in water-containing mixtures, such as for example manure, slurry, sludge, industrial effluents, and the like, is separated off. This results in an increase in the solids content and a considerable reduction in the volume of the mixture.

[0004] Many techniques are already known for thickening water-containing mixtures. Thus, gravitational thickening techniques are known, in which the water is separated off by means of the force of gravity. Another known technique is flotation thickening. The flotation thickener comprises a tank into which small air bubbles are blown in order thus to create a separation between the solids and the water which is present.

[0005] A third technique is mechanical thickening, in which the water is separated off by means of mechanical forces, as a result of which higher solids contents can be achieved compared to the techniques mentioned earlier. The present invention relates in particular to such mechanical thickeners.

[0006] A number of (drying) devices are known for mechanically thickening water-containing mixtures. Thus, an endless-belt screen or thickening table, in which the mixture to be thickened is poured onto a movable endless belt, are known. Due to the screening action of the belt, the mixture can be drained, as it were.

[0007] With another method of mechanical thickening, the mixture to be thickened is poured into a container. This container is provided with a number of perforated conveyor belts which are situated next to one another and partly extend into the mixture. Thickening is achieved by conveying the mixture away from the mixture by means of the conveyor belts and subsequently drying the mixture by passing an air flow through the perforations. However, this thickening procedure has the drawback that the conveyor belts are subjected to high wear. In addition, the various components (e.g. shafts, roller bearings) of the device can be damaged or soiled by the mixture to be thickened, as a result of which these components become jammed and have to be replaced on a regular basis.

[0008] It is an object of the present invention to provide

an alternative device for drying and thus thickening water-containing mixtures.

[0009] The object of the invention is achieved by providing a device for drying a water-containing mixture comprising at least one body which can be moved along a closed orbital path and is situated in the mixture during a first part of the orbital path and is situated outside the mixture during a second part of the orbital path, said body comprising a number of plate-shaped entraining elements which are designed in such a manner that they entrain part of the mixture. This device has the advantage that, in use, only the plate-shaped entraining elements come into contact with the water-containing mixture, as a result of which downtime as a result of damaged or soiled components can be reduced to a minimum. This invention furthermore offers the advantage that a large number of plate-shaped entraining elements can be provided in the device, as a result of which, on the one hand, a large amount of mixture to be dried can be entrained and, on the other hand, a large drying surface is created in the second part of the orbital path. In this way, mixtures can be dried (thickened) much more quickly.

[0010] In order to achieve an improved drying effect, the device, in a preferred embodiment, comprises ventilation means for generating an air flow directed at the device in order to dry the entrained mixture during the second part of its orbital path. Preferably, the generated air flow is heated. Preferably, the temperature of the generated air flow is between 20 and 130°C.

[0011] In a more preferred embodiment of the device according to the invention, the plate-shaped entraining elements extend along approximately the entire length of the device.

[0012] In an advantageous embodiment of the device according to the present invention, said body is a rotor which is rotatable about a central shaft. In particular, the plate-shaped entraining elements extend substantially along the central rotation shaft.

[0013] According to a particular embodiment of the invention, according to the present invention said body comprises two side walls, with each plate-shaped entraining element being connected to both side walls. Said entraining elements are preferably fixedly arranged between both side walls.

[0014] In a more particular embodiment of the invention, according to the present invention said plate-shaped entraining elements are arranged in a fan-shaped way and in a curved manner, in the direction of rotation of the body, on this body. Such an arrangement offers the advantage that when the entraining elements come into contact with the mixture to be dried during their rotation, they scoop up this mixture, as it were.

[0015] In a more preferred embodiment, said body is provided in a housing, said housing comprising an inlet and outlet for the air flow generated by the ventilation means. In this manner, the generated air flow is, as it were, forced across the entraining elements which are situated in the second part of their orbital path, in order

to achieve an optimum drying effect in this manner.

[0016] The device furthermore comprises drive means for the body, in particular for the rotor. The drive means preferably consist of asynchronous motors.

[0017] In a particularly preferred embodiment of the device according to the present invention, said device comprises a storage container for the water-containing mixture.

[0018] In order to further illustrate the characteristics of the present invention and to indicate additional advantages and particulars, a more detailed description of the device according to the present invention will now be given. It will be clear that nothing in the following description can be interpreted as a limitation of the protection for this invention which is claimed in the claims.

[0019] In the present description, reference numerals are used to refer to the attached drawings, in which:

- **Fig. 1** is a perspective view of the device according to the present invention;
- **Fig. 2** is a front view of the device according to the present invention; and
- **Fig. 3** is a cross section of the device viewed along A.

[0020] The device (1) according to the present invention and as illustrated in the attached figures is a drying device for water-containing mixtures. This device (1) can in particular be used for drying (thickening) manure, slurry, sludge, industrial effluents, and the like.

[0021] The mixture to be dried is poured into a storage container (7), which may be carried out both continuously or batchwise. In order to now dry the mixture, the device (1) comprises a body (2) which can be moved along a closed orbital path and is situated in the mixture during a first part of the orbital path and is situated outside the mixture during a second part of the orbital path. It is obvious that it is also possible to achieve the effect of the invention by providing two or more of such bodies (2) next to one another.

[0022] The movable body (2) is in particular a rotor which is rotatable about a central shaft (8) and which comprises a number of fixedly arranged plate-shaped entraining elements (3) which are designed to entrain the mixture to be dried from the first part to the second part.

[0023] The plate-shaped entraining elements (3) extend along approximately the entire length of the device (1) in a direction along the rotation shaft. As the entraining elements (3) have a certain width (preferably variable between 0.5 and 2 m), they will also partly extend (see Fig. 3) in the direction of the central shaft (8).

[0024] When the movable body (2) is rotated, the plate-shaped entraining elements (3) will be immersed one by one and at least partly (first part) into the mixture provided in the storage container (7). Preferably, the entraining elements (3) are completely immersed in the mixture provided in the storage container (7). As a result of the immersion, part of the mixture will cling to the elements (3)

and be carried along to the second part, where the entrained mixture can dry.

[0025] The device (1) is furthermore provided with ventilation means (not shown) for generating an air flow (L) directed at the device (1) in order to dry the mixture carried along by the entraining elements (3) during the second part of its orbital path. This air flow is preferably a hot air flow and may, for example, emanate from an electrical group, flue gasses from a chimney, air from a stable, etc. In order for the air flow to pass over the surface of the entraining elements, the rotor is provided in a housing (5) (see Fig. 1), said housing (5) comprising an inlet and outlet for the air flow (L) generated by the ventilation means.

[0026] The rotor is arranged in such a manner that only the plate-shaped entraining elements (3) come into contact with the mixture. As a result thereof, downtime as a result of damaged or soiled components can be reduced to a minimum.

[0027] In particular, the rotor comprises two circular side walls (4) situated opposite one another. As can be seen in Figs. 1 and 2, one end of the plate-shaped entraining elements (3) is connected to the one side wall (4) and the other end is connected to the other side wall (2). Said entraining elements (3) are positioned at a certain distance from one another and are, as can be seen in Fig. 3, placed on this rotor in the shape of a fan in the direction (of rotation) (R) of the rotor.

[0028] The plate-shaped entraining elements (3) can be designed to be flat, deflected or profiled. They are preferably made of stainless steel. The entraining elements (3) may have both a smooth and a perforated surface. Their surface may also be provided with protuberances by means of, for example, sandblasting.

[0029] The device (1) according to the invention may be provided with a large number of plate-shaped entraining elements (3) as a result of which, on the one hand, a large amount of mixture to be dried can be entrained and, on the other hand, a much greater drying surface is created in the second part of the orbital path, compared to the known thickeners, as is clear from the following example.

[0030] Generally, each rotor comprises 40 plate-shaped entraining elements (3) which as it were move along a closed orbital path, as they form part of the movable body (2), with each entraining element (3) being situated in the mixture during a first part of its orbital path and being situated outside the mixture during a second part of its orbital path. The arrangement of the rotor and the dimensions (in particular the width) of the various entraining elements (3) are such that there are always 8 entraining elements (3) which are immersed in the water-containing mixture. Thus, there are 32 entraining elements (3) which are situated in the second part of their orbital path.

[0031] In a preferred embodiment, one entraining element (3) has the following dimensions: length: 3 m; width: 0.75 m; thickness: 1.5 mm. Thus, one side of an entrain-

ing element has a surface area of 2.25 m².

[0032] As 32 elements (3) are situated in the second part of their orbital path, the total drying surface of the device is formed by these 32 plates. The total drying surface thus is: 2.25 m² x 32 x 2 (each entraining element has two sides which can be moistened) = 144 m².

[0033] The above dimensions only serve as an illustration. Obviously, the dimensions of the entraining elements can be greater or smaller or the number of entraining elements (3) of the device can be higher (e.g. 60 or 80) or lower (e.g. 25 or 35).

Claims

1. Device (1) for drying a water-containing mixture comprising at least one body (2) which can be moved along a closed orbital path and is situated in the mixture during a first part of the orbital path and is situated outside the mixture during a second part of the orbital path, **characterized in that** said body (2) comprises a number of plate-shaped entraining elements (3) which are designed in such a manner that they entrain part of the mixture. 15
2. Device according to Claim 1, **characterized in that** the device comprises ventilation means for generating an air flow (L) directed at the device in order to dry the entrained mixture during the second part of its orbital path. 20
3. Device (1) according to Claim 1 or 2, **characterized in that** the plate-shaped entraining elements (3) extend along approximately the entire length of the device (1). 25
4. Device (1) according to one of the preceding claims, **characterized in that** said body (2) is a rotor which is rotatable about a central shaft (8). 30
5. Device (1) according to Claim 4, **characterized in that** the plate-shaped entraining elements (3) extend substantially along the central rotation shaft. 35
6. Device (1) according to one of the preceding claims, **characterized in that** said body (2) comprises two side walls (4), with each plate-shaped entraining element (3) being connected to both side walls. 40
7. Device (1) according to one of the preceding claims, **characterized in that** said plate-shaped entraining elements (3) are arranged in a fan-shaped way and in a curved manner, in the direction of rotation (R) of the body (2), on this body (2). 45
8. Device (1) according to one of Claims 2 to 7, **characterized in that** said body (2) is provided in a housing (5), said housing (5) comprising an inlet and outlet for the air flow (L) generated by the ventilation means. 50
9. Device (1) according to one of the preceding claims, **characterized in that** said device (1) comprises drive means (6) for the body (2). 55
10. Device (1) according to one of the preceding claims, **characterized in that** said device (1) comprises a storage container (7) for the water-containing mixture.

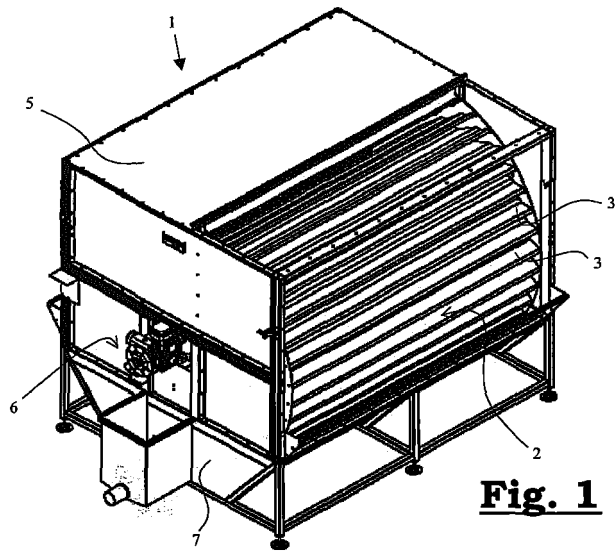


Fig. 1

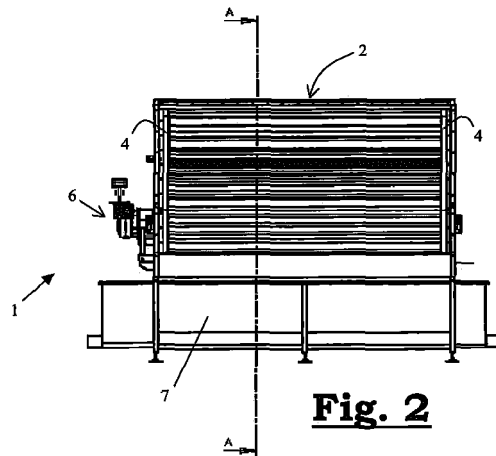


Fig. 2

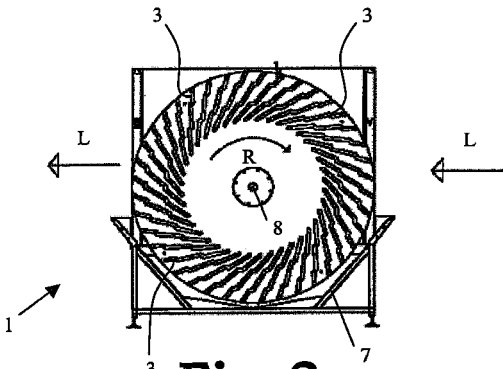


Fig. 3



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Application Number
EP 09 15 3726

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Place of search The Hague		Date of completion of the search 11 June 2009	Examiner Silvis, Henk
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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