to be a fouling of the filter which fouling must be removed in order to continue filtering. To this end, the device of EP 0122867 is configured as a dead-end filter in which no outlet is provided for the residue (the part remaining after the filtrate is extracted) at an end of the tubular filters distant to the inlet of the tubular filters; thereby no continuously one-way flow of fluid through the tubular filters are provided and the residue is, consequently, flushed out backwardly from the tubular filter elements to remove the cake. Moreover, in EP 0122867 the cake originates from the medium being filtered, and therefore constitutes a fouling layer deposited during the filtration stage.

Hence, an improved fine screening would be advantageous, and in particular a more efficient and/or reliable increase of the dry matter content in material to be digested would be advantageous.

OBJECT OF THE INVENTION

An object of the present invention is to provide an alternative to the prior art.

A further object of the invention may be seen as to improve the filtration of wastewater.

Yet a further object of the invention may be seen as to increase the treatment capacity of a plant treating wastewater.

In particular, it may be seen as a further object of the present invention to provide a filtering device that solves the above mentioned problems of the prior art.

SUMMARY OF THE INVENTION

Thus, the above described object and several other objects are intended to be obtained in a first aspect of the invention by providing a water treatment system comprising a filtering device for use in a water treatment, the water treatment system comprising

a biological treatment device adapted to provide a sludge from wastewater or filtrated wastewater and a digester adapted to provide digester sludge, the filtering device being in fluidic connection with the digester to receive digester sludge and in fluidic connection with the biological treatment device to receive sludge formed in the biological treatment device the biological treatment device being in fluidic connection with the filtering device for receiving

filtrated wastewater from the filtering device or for delivering sludge to be filtered to the filtering device,

wherein

- the filtering device is a cake filtration device comprising a fluid penetrable support structure, the support structure being provided as one or more tubular elements having a filtration cake provided on the inside of the fluid penetrable support structure, the filtering device having
    - an inlet being fludic connected to the biological treatment device to receive sludge or connected to receive wastewater to be filtered so that the flux direction of sludge or wastewater to be filtered is from the interior of the tubular element, through the filtration cake and to the outside of the tubular element thereby providing a filtrate,
    - an outlet for outletting liquid from the interior of the tubular element, and
    - a filtrate outlet for outletting filtrate from the filtering device, to the biological treatment device or for outletting treated water, a nozzle arranged to introduce gas, such as air, into the interior of the tubular element
- the filtration cake being provided by deposition of solids from the sludge formed in the biological treatment device and in the digester wherein the solids comprising digester sludge and at least one of activated sludge flocs and coagulated substances.

The sludge solids (solids from sludge) for e.g the filtration cake is typically provided by the biological treatment device; in embodiments including a digester a fraction of the sludge solids may come from the digester.

In the present context a number of terms are used as would be readily understood by a skilled person. Some of these terms are detailed in the following.

Sludge solids (solids from sludge) is preferably used to means activated sludge flocs and/or coagulated substances, typically, formed in a biological treatment device.

Cake filtration is used to indicate a process in which a liquid is filtrated by flowing through a filtration cake as disclosed herein

Filtration cake is used to indicate a layer of solid material deposited on a support structure, which solid material is in particulate form and origins typically as a

CLAIMS

1. A water treatment system comprising a filtering device (1), the water treatment system comprising

- a biological treatment device (2) adapted to provide a sludge from wastewater or filtrated wastewater and a digester (8) adapted to provide digester sludge,
- the filtering device (1) being in fluidic connection with the digester (8) to receive digester sludge and in fluidic connection with the biological treatment device (2) to receive sludge formed in the biological treatment device (2);
- the biological treatment device (2) being in fluidic connection with the filtering device (1) for receiving filtrated wastewater from the filtering device (1) or for delivering sludge to be filtered to the filtering device (1),

wherein

- the filtering device (1) is a cake filtration device comprising a fluid penetrable support structure (20), the support structure (20) being provided as one or more tubular elements (21) having a filtration cake (10) provided on the inside of the fluid penetrable support structure (20), the filtering device (1) having
    - an inlet (15) being fluidic connected to the biological treatment device (2) to receive sludge or connected to receive wastewater to be filtered so that the flux direction of sludge or wastewater to be filtered is from the interior (28) of the tubular element (21), through the filtration cake (10) and to the outside of the tubular element (21) thereby providing a filtrate,
    - an outlet (16) for outletting liquid from the interior (28) of the tubular element (21), and
    - a filtrate outlet (9) for outletting filtrate from the filtering device (1), to the biological treatment device (2) or for outletting treated water,
    - a nozzle (30) arranged to introduce gas, such as air, into the interior (28) of the tubular element (21),
- the filtration cake being provided by deposition of solids from the sludge formed in the biological treatment device (2) and in the digester (8),

wherein the solids comprise digester sludge and at least one of activated sludge flocs and coagulated substances.

2. A water treatment system according to claim 1, characterized by the filtering device (1) further comprises a fluid tight casing (17) encapsulating the support structure (20) and providing a cavity (27) outside the support structure (20) in fluid communication with the filtrate outlet (9).

3. A water treatment system according to claim 1 or 2, characterized by each of the tubular elements (21) comprising an inner layer (22) and an outer layer (23) being concentrically arranged, wherein each layer comprises through-going openings, and the through-going openings in the inner layer (22) has a larger cross sectional area than the through-going openings in the outer layer (23).

4. A water treatment system according to any of the preceding claims, characterized by the thickness of the filtration cake on the tubular elements (21) is less than 3 mm, such as less than 2 mm.

5. A water treatment system according to any of the preceding claims, characterized by the tubular element(s) is(are) cylindrical element(s) having an internal diameter less than 15 mm, such as less than 12 mm and even less than 10 mm.

6. A water treatment system according to any of the preceding claims, characterized by a plurality of tubular elements (21) which are arranged in parallel having a common inlet (15) for receiving wastewater to be treated.

7. A water treatment system comprising a filtering device (1) according to any of the preceding claims, characterized by the filtrate outlet (9) of the filtering device (1) is fluidic connected or fluid connectable to a downstream biological treatment device (2).

8. A water treatment system comprising a filtering device (1) according to any of the preceding claims , characterized by the inlet (15) of the filtering device (1) for receiving liquid to be filtered is fluidic connected or fluid connectable to an upstream biological treatment device (2).

9. A method for providing a filtration cake (10) on the support structure (20) of the filtration device (1) of the water treatment system according to any of the preceding claims wherein,

- feeding sludge formed in the biological treatment device (2) and in the digester into the interior of the tubular element(s) (21) wherein the sludge comprises digester sludge and at least one of activated sludge flocs and coagulated substances,
- an accumulation phase (A) comprising accumulating solids from said sludge on the interior surface of the tubular elements (21) by inducing a pressure difference to generate a flow of said sludge, towards and through fluid penetrable support structure (20) until a layer of said solids has been established on the interior surface of the support structure (20)
- a compression phase (B) comprising increasing the pressure difference to a level being sufficient to compress the layer of accumulated flocs on the support structure (20) into a filtration cake (10),

wherein,

- the filtration cake thereby being provided from digester sludge and at least one of activated sludge flocs and coagulated substances formed in the biological treatment device (2) arranged upstream or downstream of the support structure (20).

10. The method according to claim 9, characterized in that the sludge fed into the interior of the tubular elements (21) are provided by separating the sludge formed in the biological treatment device (2) by use of a separator (3) into an effluent and activated sludge having a higher dry matter content than the effluent.

11. A method of removing a filtration cake from a filtering device (1), the filtering device (1) is a cake filtration device comprising a fluid penetrable support structure (20), the support structure (20) being provided as one or more tubular elements (21) having a filtration cake (10) provided on the inside of the fluid

penetrable support structure (20), characterized by the tubular element(s) being vertically arranged, and the method comprising

- introducing gas bubbles, such as air bubbles, by use of a nozzle (30) into the tubular element(s) (21) at a lower end thereof, and
- arresting the introduced gas bubbles inside the tubular element(s) by closing the upper end of the tubular element(s) (21)

until a slug of gas (24) has formed occupying the entire void (28) inside the tubular element(s) (21).

12. The method according to claim 11, characterized in that the gas bubbles are being arrested by closing the inlet (15) of the filtering device (1) for receiving liquid to be filtered, and alternatively or in combination by further comprising preventing fluid flow through the fluid penetrable support structure (20).

13. The method according to claim 12, characterized by the prevention of fluid flow through the support structure (20) by establishing a zero pressure gradient between the interior and outside of the support structure (20).

14. The method according to any of the claims 11-13, characterized by subsequently to the formation of slug of gas (24) which occupies the entire void (28) in the tubular element(s) (21) to:

- establish a flow of sludge inside the tubular element(s) (21) along its longitudinal axis from bottom to top of the tubular element(s) (21), while
- injecting gas, preferably atmospheric air, in an amount to allow formation of portions of sludge (25) neighbouring by slugs of gas (24), preferably slugs of air (24).

15. The method according to claim 14, characterized by further comprising subsequently to injecting gas, establishing a back-flow into the inside of the tubular element(s) (21).