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(54) A METHOD AND A DEVICE FOR AERATING WASTE WATER
VERFAHREN UND VORRICHTUNG ZUR ABWASSERBELÜFTUNG
PROCEDÉ ET DISPOSITIF SERVANT À AERER DES EAUX USEES

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(73) Proprietor: HUBERT, B.V.
NL-8715 EP Stavoren (NL)

(72) Inventor: TEN HOVE, Dirk
NL-3829 MR Hooglanderveen (NL)

(74) Representative: Louet Feisser, Arnold et al
Trenté Van Doorne
De Lairessestraat 133
1075 HJ Amsterdam (NL)

(56) References cited:
NL-A- 6 903 806
US-A- 3 154 601
US-A- 3 360 460
US-A- 4 151 231

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Description

The invention relates to a device, a rotor and a method for aerating waste water. The device is provided with a container for waste water and with a rotor being rotatable about a substantially vertical axis, whose portion pointing downwards may extend into the waste water.

Such so-called surface aerators are known. They are often used in an aerating tank of an active sludge installation and their purpose is to dissolve oxygen in the water, thus providing the micro organisms in the aerating tank with oxygen. Such device is disclosed in US-A-3 360 460.

Transfer of oxygen mainly takes place at the interface between air and water, and an optimum transfer of oxygen of air to water is obtained by making the interface area as large as possible. Furthermore the transfer of oxygen is promoted by keeping near the interface the oxygen content in the water as low as possible, because the higher the oxygen content of the water at the interface the more difficult the dissolving of oxygen in water will be. Consequently it is important that the water near the interface is quickly renewed.

The amount of energy required for aerating constitutes the larger portion of the energy consumption of a waste water purification plant. It is of paramount importance, therefore, that the amount of oxygen dissolved in the water per energy unit (the oxygen input efficiency) is as large as possible.

The regulation of the oxygen input capacity of a surface aerator provided with a rotor which agitates the water takes place by changing the immersion depth and/or the speed of revolutions of the rotor. The immersion depth range of the surface aerator must be sufficiently large to cope with the normal variations in the water level of an aerating tank, whilst maintaining a high oxygen input efficiency. The speed range within which a high oxygen input efficiency is achieved should likewise be as wide as possible, so that, both when a large amount of oxygen is put in and when less oxygen is put in, the highest possible oxygen input efficiency is achieved.

The object of the invention is to aerate waste water with a high oxygen input efficiency. Furthermore the invention aims at obtaining a high and nearly constant oxygen input efficiency over a wide immersion depth range and a wide speed range.

Another object of the invention is to develop sufficient flow velocity and turbulence in the waste water for keeping the sludge in suspension and in contact with the dissolved oxygen.

Furthermore the invention aims at aerating waste water in such a manner, that the forces generated remain limited, so that it is possible to use a relatively light construction for the installation.

Another object of the invention is to provide a device for aerating waste water, which is relatively insensitive to fouling, in particular to substances, materials and material waste present in the waste water becoming attached to the rotor.

In order to accomplish these objectives the rotor for aerating waste water according to the invention comprises blades having plate-shaped portions which are substantially radially and axially oriented, whereby said portion of the blades extend on either side of a plate-shaped part extending perpendicularly to the axis of rotation, to which plate-shaped part the blades are connected, whereby the said plate-shaped part is provided with a recess at the leading side of each blade.

The plate-shaped portions may have a width, seen in a radial direction, of 0.07 - 0.3 times the outside diameter of the rotor. The width of the plate-shaped portions of the blades may decrease in downward direction thereby, and the height of the blades may be 0.05 - 0.3 times the outside diameter of the rotor.

According to the invention the plate-shaped portion of the blade may blend at its upper side into a portion bent in the direction of rotation of the blade, which portion slopes upwards in outward direction. In order to stiffen the construction the bent portion may be connected at the radially inward side to the connecting parts interconnecting the blades, for example the horizontal plate-shaped part. The term "bent portion" is understood to mean a portion of the blade which is inclined at an angle to the plate-shaped portion of the blade. The bent portion may be a loose part, which is secured to the other portion of the blade.

The invention furthermore relates to a method for aerating waste water as set forth in claim 6.

In order to more fully explain the invention an embodiment of the rotor for aerating waste water will be described below with reference to the drawing.

Figure 1 is a plan view of a rotor;

Figure 2 is a sectional view along the line II-II in Figure 1; and

Figure 3 is a view along the line III-III in Figure 1.

The Figures are only schematic illustrations of a rotor for aerating waste water. The rotor is provided with a central shaft 1, to which a plate 2 secured perpendicularly thereto is connected. The shaft 1 may be connected at its upper side to the rotor driving means. A plurality of recesses 3, 12 in the present embodiment, are provided in the outer edge of the plate 2, within which blades 4 are located. The blade 4 is plate-shaped and has a lowermost point 5, an edge 6 sloping upwards and outwards, which blends into a vertical edge 7 extending up to above the plate 2, an edge 8, which extends inwards and downwards up to the plate 2, and edge 9, which extends vertically downwards from the plate 2, and an edge 10, which extends downwards and outwards up to the lowermost point 5.

A plate 12 is secured along the entire upper edge 8.
in the direction of rotation 11 of the rotor, said plate including a certain angle, 90° in the present embodiment, to the blade 4. The plate 12 may also be formed by bending the plate-shaped material, from which the blade 4 is made, in the direction of rotation of the rotor at the edge 8.

In order to stiffen the attachment of the blade to the plate-shaped part 2 the plate 12 may be welded to the plate-shaped part 2 at the edge 14, or be secured thereto in any other manner, so that a stiff and solid connection between the blade and the plate-shaped part 2 is obtained.

The lowermost portions of the rotor blades 4 extend into the waste water, and by rotating the rotor as indicated by the arrow 11 the waste water is agitated. Thus an upward flow against the blade 4 is created, whereby the flow is deflected at a certain angle by the plate 12. The water falls back into the waste water 13 at some distance from the blade. This creates a turbulence, whereby air bubbles are formed, resulting in a high amount of interface renewal of the water.

The shape of the rotor with the blades 4 is such that the lowermost portion of the blades extends into the waste water 13, whilst the plate-shaped part 2 connecting the blades 4 together and to the rotor is located at a level above the surface of the waste water 13, in such a manner that there is no or virtually no contact between said plate-shaped part and the waste water. This reduces the amount of energy required for the rotation, so that a higher oxygen input efficiency is obtained. Moreover it is prevented in this manner that additional forces are exerted on the rotor, in particular upward forces which might be produced if shape of the rotor would be such that the horizontal plate-shaped part interconnecting the blades is located on or in the water. Such undesirable forces would be transmitted via the rotor shaft to the gear box driving the rotor, in which case the gear box would have to be constructed extra solid. Since the plate-shaped part 2 is located above the water surface 13, the rotor drive may be constructed lighter and the drive will have a longer life. Preferably the distance between the water surface and the plate-shaped part 2 is at least 0.025 times the diameter of the rotor.

The rotor is insensitive to fouling and is self-cleaning, due to the arrangement and the shape of the blades and due to the fact that the portion of the rotor extending into the waste water is kept as small as possible.

Of course the invention is not limited to the illustrated embodiment. In addition to many other variations it is possible not to provide the plate 12 on every blade 4, but on for example every other blade 4. Thus the water will be splashed by the rotor over a larger area. A similar effect may be obtained by varying the angle which the edge 8 of the blade 4 includes with the plate 2 for all or for some of the blades 4.

Claims

1. A rotor for aerating waste water, which rotor may extend into the waste water in a first axial direction, and which rotor comprises blades (4) having plate-shaped portions which are substantially radially and axially oriented, whereby said portion of the blades (4) extend on either side of a plate-shaped part (2) extending perpendicularly to the axis of rotation, to which plate-shaped part (2) the blades (4) are connected, whereby the said plate-shaped part (2) is provided with a recess (3) at the leading side of each blade (4).

2. A rotor according to claim 1, characterized in that the width of said plate-shaped portion of the blades (4) decreases in said axial direction.

3. A rotor according to claim 1 or 2, characterized in that the plate-shaped portion of the blade (4), at the axial direction opposed to said first axial direction, blends into a portion (12) bent in the direction of rotation of the blade, which portion (12) slopes radially inwards in said former axial direction.

4. A rotor according to claim 3, characterized in that said bent portion (12) is attached to the plate-shaped part (2) interconnecting the blades (4).

5. A device for aerating waste water provided with a container for waste water and a rotor according to any of the preceding claims, the rotor being rotatable about a substantially vertical axis, characterized in that the plate-shaped part (2) interconnecting the blades (4) is positioned above the level to which the container is to be filled with waste water.

6. A method for aerating waste water, wherein the interface area between air and waste water is enlarged by splashing the water by means of blades (4) and wherein the eddies present in the waste water is kept in suspension by creating flows and/or turbulence in the water, whereby the waste water is set in motion by moving a plurality of blades (4) arranged in a circle through the waste water, whereby said blades (4) are connected to a rotor rotating about a substantially vertical axis, in such a manner that a plate-shaped part (2), interconnecting the blades (4) which is provided with a recess (3) at the leading side of each blade (4), is positioned above the waste water level, so that the said plate-shaped part (2) substantially does not contact the waste water.

7. A method according to claim 6, characterized in that the number of revolutions at which said rotor rotates is such that the velocity of the blades (4) is 2-7 m/sec.
8. A method according to claim 6 or 7, characterized in that the water is brought up by the blade (4) and subsequently flung sideways with respect to its direction of movement by an upper edge (12) of the blade (4) which slopes upwards and which is bent in forward direction.

9. A method according to any one of the claims 6-8, characterized in that the level of the waste water is at least 0.025 times the outside diameter of the rotor below the said plate-shape part (2).

Patentansprüche

1. Ein Rotor zur Abwasserbelüftung, wobei sich der Rotor in das Abwasser in einer ersten axialen Richtung erstrecken kann, und wobei der Rotor Schaufen (4) mit plattenförmigen Abschnitten umfaßt, die im wesentlichen radial und axial ausgerichtet sind, wobei sich der Abschnitt der Schaufen (4) zu jeder Seite eines plattenförmigen, sich senkrecht zur Drehachse erstreckenden Teils (2) erstreckt und die Schaufen (4) mit diesem plattenförmigen Teil (2) verbunden sind, und wobei das plattenförmige Teil (2) mit einer Aussparung (3) an der (vorderen) Führungseite jeder Schaufel (4) versehen ist.

2. Ein Rotor nach Anspruch 1, dadurch gekennzeichnet, daß sich die Breite des plattenförmigen Abschnittes der Schaufen (4) in der axialen Richtung verringert.

3. Ein Rotor nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der plattenförmige Abschnitt der Schaufel (4) in der ersten axialen Richtung entgegengesetzt, axialen Richtung in einen in Drehrichtung der Schaufel gebogenen Abschnitt (12) übergeht, wobei sich der Abschnitt (12) radial nach innen in der erstgenannten, axialen Richtung neigt.

4. Ein Rotor nach Anspruch 3, dadurch gekennzeichnet, daß der gebogene Abschnitt (12) an dem plattenförmigen Teil (2), das die Schaufen (4) miteinander verbindet, angebracht ist.

5. Eine Vorrichtung zur Abwasserbelüftung, die mit einem Container für Abwasser und einem Rotor nach einem oder mehreren der vorhergehenden Ansprüche versehen ist, wobei der Rotor um eine im wesentlichen vertikale Achse drehbar ist, dadurch gekennzeichnet, daß die Schaufen (4) miteinander verbindende, plattenförmige Teil (2) über dem Niveau angeordnet ist, bis zu welchem der Container mit Abwasser zu füllen ist.


Revendications

1. Rotor pour aérer les eaux usées, qui peut plonger dans les eaux usées selon une première direction axiale et qui comprend des lames (4) ayant des parties en forme de plaques orientées sensiblement radialement et axialement, où la partie des lames (4) s'étend de chaque côté d'une partie en forme de plaque (2) s'étendant perpendiculairement à l'axe de rotation, partie en forme de plaque (2) à laquelle les lames (4) sont connectées, la partie en forme de plaque (2) présentant une échancrure (3) du côté du bord d'attaque de chaque lame (4).

2. Rotor selon la revendication 1, caractérisé en ce que la largeur de la partie en forme de plaque des lames (4) diminue axialement.

3. Rotor selon la revendication 1 ou 2, caractérisé en
ce que la partie en forme de plaque de la lame (4), selon la direction axiale opposée à la première direction axiale, se raccorde à une partie (12) pliée dans le sens de rotation de la lame, cette partie (12) étant inclinée radialement vers l'intérieur de la direction axiale nommée en premier.

4. Rotor selon la revendication 3, caractérisé en ce que la partie pliée (12) est fixée à la partie en forme de plaque (2) interconnectant les lames (4).

5. Dispositif pour aérer les eaux usées, comprenant un conteneur pour les eaux usées et un rotor selon l'une des revendications précédentes, le rotor pouvant tourner autour d'un axe sensiblement vertical, caractérisé en ce que la partie en forme de plaque (2) interconnectant les lames (4) est placée au-dessus du niveau où le conteneur va être rempli des eaux usées.

6. Méthode pour aérer les eaux usées, dans laquelle la zone d'interface entre l'air et les eaux usées est augmentée en brassant les eaux au moyen de lames (4) et dans laquelle la boue présente dans les eaux usées est maintenue en suspension en créant des flux et/ou des turbulences dans l'eau, les eaux usées étant maintenues en mouvement en déplaçant à travers les eaux usées une pluralité de lames (4) arrangées en cercle, les lames (4) étant connectées au rotor tournant autour d'un axe sensiblement vertical, de telle façon que la partie en forme de plaque (2) interconnectant les lames (4), présentant une échancrure (3) du côté du bord d'attaque de chaque lame (4), est placée au-dessus du niveau des eaux usées, en sorte que la partie en forme de plaque (2) ne vienne normalement pas en contact avec les eaux usées.

7. Méthode selon la revendication 6, caractérisée en ce que le nombre de tours du rotor correspond à une vitesse de lames (4) de 2 à 7 m/s.

8. Méthode selon la revendication 6 ou 7, caractérisée en ce que l'eau est reprise par les lames (4) et chassée ensuite sur le côté par rapport au sens de son mouvement par le bord supérieur (12) de la lame (4) qui est inclinée vers le haut et pliée vers l'avant.

9. Méthode selon l'une des revendications 6 à 8, caractérisée en ce que le niveau des eaux usées représente au moins 0,025 fois le diamètre extérieur du rotor en-dessous de la partie en forme de plaque (2).