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DEVICE FOR STIRRING AND AERATING A LIQUID AND
ELIMINATING
FOAM IN A TANK FOR TREATING SAID LIQUID

The present invention relates to a device for
5 stirring and aerating a liquid and eliminating foam in
a tank or vat treating this liquid, such as for example
fatty waste products extracted from effluents of town
sewage or agricultural food industries.

As is known, the town sewage effluents which
10 circulate in discharging pipes such as drains are
collected in purification stations in which there are
carried out various treating operations to purify them
before returning them to the natural medium.

This purification produces by-products related to
15 the purification such as fat, sludges ...

Dumping sites are less and less inclined to accept
this type of products so that the purification stations
must now be capable of treating them and limiting them
as far as possible.

20 Thus, the fat trapped at the inlet of the
purification station are poured into a treating tank
such as for example a biological degradation tank which
comprises a mechanical stirrer for stirring the liquid.

Further, the tank may include internally and in
25 its lower part injection manifolds for injecting air
under pressure into the liquid for aerating and
accentuating the stirring of the liquid.





But this type of aerating and stirring device is more particularly suitable for fluids which are only lightly charged, i.e. of low viscosity, and its efficiency rapidly drops for fluids charged in particular with fat.

Further, in the course of the treatment of the liquid, such as for example fatty waste products, with this type of device there is formed on the surface of the liquid a layer of foam which flies away and pollutes the environment so that it is necessary to provide means for eliminating this foam floating on the surface of the liquid in the course of the treatment of the latter.

Up to the present time, these means have been formed by stirrers disposed at the level of the surface of the liquid and adapted to flatten the foam.

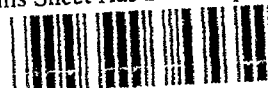
But these stirrers are not entirely satisfactory and a part of the foam flies away and pollutes the environment.

An object of the invention is to avoid these drawbacks by proposing a device for stirring and aerating a liquid, such as for example fatty waste products extracted from town sewage effluents or agricultural food industries, which permits, with simple means and a low consumption of energy, effectively treating this type of liquid and recovering

the foam floating on the surface of the liquid.

The invention therefore provides a device for stirring and aerating a liquid and eliminating the foam in a tank for treating said liquid, characterized in
5 that it comprises inside the tank:

- a vertical sheath extending in a part of the height of the tank, closed at its upper end and open at its lower end, the lower end of said sheath defining with the bottom of the tank a passage for the liquid,
- 10 - a funnel disposed around the upper part of the sheath and connected to said sheath, the upper edge of said funnel defining with the wall of the tank a free space for the passage of the liquid,
- a first series of ports provided in the upper
15 part of the sheath and situated at the level of the liquid inside the funnel,
- a second series of ports provided in the sheath and situated above the bottom of the funnel,
- a vertical shaft driven in rotation, disposed
20 inside the sheath and extending from the upper end of the sheath to the bottom of the funnel,
- a main propeller fixed to the free end of the shaft below the bottom of the funnel,
- an anti-vortex means disposed inside the sheath
25 below said propeller,
- means for regulating the level of the liquid in the funnel,





- means for injecting a gas under pressure into the sheath below the anti-vortex means.

According to other features of the invention:

- the tank is insulated,

5 - the device comprises means for regulating the flow of the liquid and of the foam sucked by the propeller inside the sheath,

 - the device comprises means for effecting a static stirring by cavitation of the liquid inside the
10 sheath and disposed below the anti-vortex means in said sheath,

 - the means for regulating the flow of the liquid and of the foam sucked by said propeller are formed, on one hand, by a first sleeve disposed around the
15 sheath at the level of the first series of ports and, on the other hand, by a second sleeve disposed around said sheath at the level of the second series of ports, the position of said sleeves relative to the corresponding ports being vertically adjustable,

20 - the means for effecting a static stirring by cavitation are formed, on one hand, by a vertical tube disposed inside the sheath and extending from the bottom of the tank to below the anti-vortex means and, on the other hand, by superimposed static obstacles
25 disposed inside said sheath and fixed to said tube,

 - the device comprises a second anti-vortex means disposed inside the sheath and above the main



propeller, said second anti-vortex means being formed by at least two vertical plates each extended upwardly by a stiffening rib extending up to the upper end of said sheath.

5 - the device comprises a liquid accelerator inside the sheath,

 - the device comprises means for aerating the surface of the liquid inside the tank,

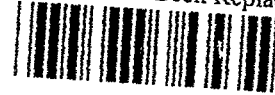
 - the device comprises a vortex pump for the
10 suction of the liquid surface inside the sheath, disposed above the second anti-vortex means and at the level of the first series of ports,

 - the device comprises a propeller having a single passage for the suction of the liquid inside the
15 sheath, disposed above the second anti-vortex means and at the level of the first series of ports,

 - the device comprises a propeller having two passages for the suction of the liquid inside the sheath, disposed above the second anti-vortex means and
20 at the level of the first series of ports.

Further features and advantages of the invention will be apparent in the course of the following description with reference to the accompanying drawings, in which:

25 - Fig.1 is a diagrammatic sectional view of a tank for treating a liquid provided with a first embodiment of a device for stirring and aerating said liquid



according to the invention,

- Fig.2 is a sectional view taken on line 2-2 of Fig. 1,

- Fig.3 is a diagrammatic sectional view of a tank
5 for treating a liquid provided with a second embodiment
of a device for stirring and aerating said liquid
according to the invention,

- Fig.4 is a sectional view taken on line 4-4 of Fig. 3,

10 - Fig.5 is a diagrammatic partial sectional view
of a third embodiment of a device for stirring and
aerating the liquid according to the invention,

- Fig.6 is a diagrammatic sectional view of a
liquid accelerator of the stirring and aerating device
15 according to the invention,

- Fig.7 is a diagrammatic sectional view of means
for aerating the surface of the liquid,

- Fig.8 is a diagrammatic partial sectional view
of a fourth embodiment of a device for stirring and
20 aerating the liquid according to the invention,

- Fig.9 is a diagrammatic view to a larger scale
of the vortex pump of the fourth embodiment of the
device according to the invention,

- Fig. 10 is a sectional view taken on line 10-10
25 of Fig. 9,

- Fig.11 is a diagrammatic partial sectional view
of a fifth embodiment of a device for stirring and



aerating the liquid according to the invention,

- Fig.12 is a sectional view taken on line 12-12 of Fig.11,

- Fig.13 is a diagrammatic partial sectional view
5 of a sixth embodiment of a device for stirring and aerating the liquid according to the invention,

- Fig.14 is a sectional view taken on line 14-14 of Fig. 13.

Shown in Figs. 1 and 3 is a tank or vat 1 provided
10 in its upper part with an inlet 2 for a liquid 3 to be treated, such as for example fatty effluents extracted from town sewage effluents.

The treating tank 1 is covered on its outer side with an insulation 4 and comprises a device, designated
15 by the general reference numeral 10, for stirring and aerating the 5 liquid and eliminating the foam.

The device 10 according to the invention, disposed inside the tank 1, comprises a vertical sheath 11 extending in a part of the height in the tank 1.

20 The upper end 11a of the sheath 11 is closed by a plate 12 and the lower end of the sheath 11 is open and defines with the bottom of the tank 1 a passage 13 for the liquid 3.

The device 10 further comprises an upwardly
25 divergent funnel 14 whose upper edge defines with the wall of the tank 1 a free space 15 for the passage of the liquid 3 and whose lower edge is connected to the



sheath 11 at a certain distance from the upper end of the sheath 11.

The assembly comprising the sheath 11 and the funnel 14 is fixed inside the tank 1 by suitable means, such as for example struts 16 which define therebetween passages for the liquid 3.

The sheath 11 comprises a first series of ports 17 evenly spaced apart on the periphery of the sheath 11 and situated at the level of the liquid in the funnel 14.

This sheath 11 is further provided with a second series of ports 18 evenly spaced apart on the periphery of the sheath 11 and situated above the bottom of the funnel. The device 10 is also provided with means for sucking the liquid and the foam inside the sheath 11 through the ports 17 and 18 and are formed by a vertical shaft 19 disposed inside the sheath 11 and extending from the upper end of the sheath 11 to the bottom of the funnel 14 and by a main propeller or screw 20 fixed on the free end of the shaft 19 below the bottom of the funnel 14.

The diameter of the main propeller 20 is slightly less than the inside diameter of the sheath 11.

The shaft 19 and the propeller 20 are driven in rotation by a motor-speed reducer unit 21 which is fixed to the plate 12 closing the upper end of the sheath 11.



The device 10 is provided with means for regulating the flow of the liquid and of the foam sucked by the main propeller 20 inside the sheath 11 through the ports 17 and 18.

5 These regulating means comprise, on one hand, a first sleeve 22 disposed around the sheath 11 at the level of the first series of ports 17 and, on the other hand, a second sleeve 23 disposed around the sheath 11 at the level of the second series of ports 18.

10 The position of each sleeve 22 and 23 relative to the ports 17 and 18 respectively is vertically adjustable by suitable clamping means (not shown).

 An anti-vortex means 24 is disposed inside the sheath 11 below the propeller 20 to prevent rotation of
15 the liquid 3 in the sheath 11.

 As shown in Fig. 2, this anti-vortex means 24 is formed by three vertical plates 24a spaced 120° apart inside the sheath 11.

 The device 10 is also provided with means for
20 regulating the level of the liquid 3 in the funnel 14 which comprise an overflow pipe 25 disposed inside the funnel 14 in a vertically adjustable position.

 In a second embodiment shown in Fig. 3, the device
10 comprises means 30 for effecting a static stirring
25 by cavitation of the liquid 3 inside the sheath 11 and disposed below the anti-vortex means 24 in the sheath.

 As shown in Figs. 3 and 4 the means 30 for the



static stirring by cavitation of the liquid 3 comprise, on one hand, a vertical tube 31 disposed inside the sheath 11 and extending from the bottom of the tank 1 to below the anti-vortex means 24 and, on the other
5 hand, superimposed static obstacles 32 disposed inside the sheath 11 and fixed on the tube 31.

The tube 31 is fixed to the bottom of the tank 1 by suitable means.

The static obstacles 32 define with the inner wall
10 of the sheath 11 passages for the circulation of the liquid.

As shown in Fig. 1, the static obstacles 32 arranged along the tube 31, on one hand, below the anti-vortex means 24 and, on the other hand, in the
15 lower part of the sheath 11.

For example, the tube 31 comprises in its upper part below the anti-vortex means 24 two superimposed static obstacles 32 and in the lower part of the sheath 11 also two superimposed static elements 32.

20 In a variant, the static obstacles 32 may be evenly spaced apart throughout the portion of the tube 31 disposed in the sheath 11.

In an embodiment shown in Fig. 3, the static obstacles 32 are formed by cups whose concavity faces
25 toward the bottom of the tank 1.

In a variant, the static obstacles 32 may be formed by discs.



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Finally, the device 10 comprises means 33 for injecting a gas under pressure, such as for example air, into the sheath 11.

These injecting means 33 are formed by at least one pipe 34 which opens into the sheath 11 for example at a level situated below the static elements 32 disposed in the upper part of the tube 31.

The device just described operates in the following manner.

10 The liquid 3 to be treated is poured through the inlet 2 into the tank 1 up to a level above the upper edge of the funnel 14.

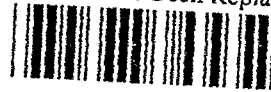
This liquid 3 is also poured into the funnel 14.

The motor-speed reducer unit 21 drives the shaft 15 19 in rotation which drives the main propeller 20 in rotation.

Simultaneously, the gas under pressure is injected into the sheath 11 through the pipes 34.

The rotation of the main propeller 20 causes the suction of the liquid 3 into the sheath 11 through the ports 17 and 18 so that this liquid 3 continuously circulates from the top to the bottom in the sheath 11, then passes through the space 13 and circulates from the bottom to the top between the sheath 11 and the inner wall of the tank 1, and so on.

The anti-vortex means 24 prevents the rotation of the liquid in the sheath 11 below the propeller 20.



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The level of the liquid 3 in the funnel 14 is below the level of the liquid in the tank 1 and this level of the liquid in the funnel 14 is regulated by the overflow pipe 25 so that it is substantially midway
5 of the height of the ports 17.

Further, owing to the suction created by the propeller inside the sheath 11, the level of the liquid in
in the sheath 11 is below the level of the liquid in the
10 funnel 14.

The air driven inside the sheath 11 by the rotation of the propeller 20 and the gas under pressure injected into the sheath 11 create gas bubbles which are dispersed in the liquid 3 in the sheath 11 under
15 the effect of the rotation of the propeller 20.

During the circulation of the liquid 3 in the sheath 11, the static obstacles 32 create below each of the latter a cavitation effect which promotes the stirring and the aeration of the liquid 3.

20 These obstacles 32 have the advantage of being static while promoting the stirring and the aeration of the liquid in the sheath 11 and prevent the catching of stringy 5 substances inside the sheath 11.

In this way, the liquid 3 is stirred and the gas
25 bubbles are divided into micro-bubbles promoting the dispersion of the gas and consequently the aeration of the liquid 3.



Between the inner wall of the tank 1 and the sheath 11, the gas bubbles accelerate the rising of the liquid and promote the circulation of this liquid in the tank 1, thereby improving the efficiency.

5 Thus the liquid to be treated passes several times through the sheath 11 and therefore undergoes several oxygenation treatments.

 The flow of the liquid 3 may be regulated by shifting the sleeves 22 and 23 relative to the ports 17
10 and 18.

 The stirring of the liquid 3 by the propeller 20 and the static obstacles 32 causes foam to be formed on the surface of the liquid 3 in the tank 1.

 The rotation of this propeller 20 inside the
15 sheath 11 produces a pumping effect at the level of the surface of the liquid 3 in the funnel 14, a suction of the foam floating on the surface of the liquid and a drop in the level of the latter in the sheath 11.

 The foam is consequently entrained, drowned in and
20 mixed with the liquid 3 in the tank 1 so that it is possible to progressively eliminate it.

 The position of the sleeves 22 and 23 relative to the ports 17 and 18 regulates the flow of liquid and foam 5 sucked inside the sheath 11 by the propeller 20.

25 The choice of the main propeller 20 and the speed of rotation of the latter permits adapting the consumption of energy in accordance with the liquid to



be treated.

In the case where the device according to the invention does not include static elements 32 as shown in Fig. 1, turbulences are created naturally inside the
5 sheath 11.

But the efficiency is low which is suitable for liquids only slightly charged.

The static obstacles 32 promote the stirring of the liquid by cavitation and this improves the
10 efficiency of the device.

In a variant, the static stirring means with the cavitation effect are formed by static obstacles fixed to the inner wall of the sheath 11 and defining an axial passage for the circulation of the liquid 3.

15 These static obstacles are evenly spaced apart throughout the portion of the sheath 11 below the anti-vortex means 24 or inside the sheath 11, on one hand below the anti-vortex means, 24 and, on the other hand, in the lower part of the sheath 11.

20 In this case also, the static obstacles are formed for example by cups the concavity of which faces toward the bottom of tank 1 or by discs.

In a third embodiment shown in Fig. 5, the device comprises a second anti-vortex means 40 disposed inside
25 the sheath 11 and above the main propeller 20.

This second anti-vortex means 40 comprises at least two vertical plates 40a each upwardly extended by



a reinforcing rib 41 extending up to the upper end of the sheath 11.

Preferably, the second anti-vortex means 40 is formed by four vertical plates 40a evenly spaced apart
5 inside the sheath 11 and each upwardly extended by a reinforcing rib 41.

In another embodiment shown in Fig. 6, the device comprises a liquid accelerator inside the sheath 11.

This liquid accelerator comprises a secondary
10 propeller 45 disposed above the second anti-vortex means 40 and fixed to rotate with the shaft 19.

The secondary propeller or screw 45 has a pitch oriented in the same direction as the pitch of the main propeller or screw 20.

15 Further, the liquid accelerator further comprises an anti-vortex means 46 disposed above the secondary propeller 45 and inside a cylindrical stack 47.

The stack 47 is fixed to the inner edge of the reinforcing ribs 41 so as to define with the sheath 11
20 and between the reinforcing ribs 41 passages 48 for the liquid.

The secondary propeller 45, the anti-vortex means 46 and the stack 47 are situated between the two series of ports 17 and 18 which are provided, in this
25 embodiment, with means for regulating the flow of the liquid 3 and the flow of the foam sucked inside the sheath 11.



The rotation of the main propeller 20 causes the suction of the liquid 3 into the sheath 11 through the ports 17 and 18 so that this liquid 3 continuously circulates downwardly in the sheath 11.

5 Further, owing to the rotation of the secondary propeller 45, the suction of the liquid 3 into the sheath 11 through the ports 17 and 18 is accelerated and a part of the liquid rises through the passages 48 provided between the sheath 11 and the stack 47 which
10 still further accentuates this phenomenon of the acceleration of the liquid in the sheath 11.

In this case also, the regulation of the level of the liquid 3 in the sheath 11 is again achieved by the position of the sleeves 22 and 23 relative to the ports
15 17 and 18.

The anti-vortex means 46 prevents the rotation of the liquid in the stack 47.

This embodiment is in particular suitable for products which have a particular tendency to foam.

20 Indeed, owing to the acceleration of the suction of the liquid 3 inside the stack 47 and the recirculation of a part of this liquid in the passages 48, the foam floating on the surface of the liquid 3 is sucked inside the stack 47.

25 In another embodiment shown in Fig. 7, the device comprises means for aerating the surface of the liquid 3 in the tank 1.



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As shown in this Fig. 7, the means for aerating the surface of the liquid 3 are formed by a secondary propeller or screw 50 disposed above the second anti-vortex means and fixed to rotate with the shaft 19.

5 This secondary propeller 50 has a pitch which is inverted relative to the pitch of the main propeller 20.

The means for aerating the surface of the liquid 3 also comprise an anti-vortex means 51 disposed above
10 the secondary propeller 50 and inside a cylindrical stack 52.

The stack 52 is fixed to the inner edges of the reinforcing ribs 48 so as to define with the sheath 11 and said reinforcing ribs 48 passages 55 for the liquid
15 3.

The secondary propeller 50 and the anti-vortex means 51 are situated between the two series of ports 17 and 18 and the stack 52 extends substantially from the median part of the first series of ports 17 to the
20 upper edge of the second series of ports 18.

A cover 53 is mounted on the shaft 19 above the upper edge of the stack 52.

The vertical position of the cover 53 is adjustable in order to define with the upper edge of
25 the stack 52 an adjustable passage 54.

The rotation of the main propeller 20 sucks liquid 3 through the ports 17 and 18 so that this liquid



circulates upwardly in the sheath 11.

Thus a part of the liquid 3 is sucked into the sheath 11 through the ports 18 and another part of the liquid is sucked through the ports 17 and circulates
5 downwardly in the passages 55 defined between the stack 52 and the sheath 11.

Further, in view of the fact that the pitch of the secondary propeller 50 is inverted relative to the pitch of the main propeller 20, a part of the liquid is
10 sucked into the stack 52 in the upward direction and sprayed into the air on the surface of the liquid 3 inside the funnel 14 in passing through the passage 54.

Thus the spraying of a part of the liquid permits aerating the surface of the liquid 3 and consequently a
15 reduction in the formation of foam on this surface.

The anti-vortex means 51 prevents the rotation of the liquid in the stack 52 above the secondary propeller 50.

In this embodiment also, the flow of the liquid 3
20 in the sheath 11 may be regulated by shifting the sleeves 22 and 23 relative to the ports 17 and 18.

In an embodiment shown in Figs. 8 to 10, the device comprises a vortex pump 60 for the suction of the surface of the liquid into the sheath 11.

25 This vortex pump 60 is disposed above the second anti-vortex means 40 and at the level of the first series of ports 17.



This vortex pump 60 is driven in rotation by the shaft 19 and comprises, on one hand, a circular plate 61 fixed to the shaft 19 and provided on its upper side with radial and vertical blades 62 and, on the other
5 hand, a stack 63 fixed to the upper edge of the blades 62.

The assembly comprising the plate 61, the blades 62 and the stack 63 is maintained on the shaft 19 by means of a sleeve 61a whose position on the shaft 19 is
10 adjustable.

The sleeve 61a is fixed to the shaft 19 by means formed for example by a fixing screw (not shown).

As shown in Figs. 8 and 9 the upper edge of the blades 62 is provided with a ring 64 extending
15 outwardly of the stack 63.

This stack 63 extends from a position adjacent the top of the tank 1 substantially from the median part of the first series of ports 17 to the upper edge of the blades 62.

20 The stack 63 defines an inner passage 65 which communicates in its lower part with the interior of the sheath 11 through annular passages 66 formed between the blades 62 and between the ring 64 and the plate 61.

Preferably, the stack 63 is conical and tapers
25 toward the upper part of the tank 1 as shown in Fig. 9.

In a variant, the stack 63 may be cylindrical.

The blades 62 are planar or curved and preferably



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three in number angularly evenly spaced apart on the plate 61 as shown in Fig. 10.

The rotation of the main propeller 20 causes a suction of the liquid 3 into the sheath 11 through the ports 17 and 18 so that this liquid 3 continuously circulates downwardly in this sheath.

Further, the rotation of the vortex pump 60 driven by the shaft 19, i.e. the rotation of the assembly comprising the plate 61, the blades 62 and the stack 63, causes a suction of the surface of the liquid 3 into the passage 65 so that this liquid thereafter passes through the annular passages 66 and is reinjected into the tank 1.

In this embodiment, the regulation of the flow of the liquid by means of the sleeves 22 and 23 inside the sheath 11 is unnecessary.

This embodiment is particularly suitable for products having a great tendency to foam owing to the fact that the foam floating on the surface of the liquid 3 is sucked by the vortex pump 60 so that this foam can be rapidly and effectively eliminated.

In an embodiment shown in Figs. 11 and 12, the device comprises a single-passage propeller 70 for sucking the liquid 3 into the sheath 11.

This single-passage propeller 70 is disposed above the second anti-vortex means 40 and at the level of the first series of ports 17.



The single-passage propeller 70 is driven in rotation by the shaft 19 and comprises, on one hand, a circular plate 71 fixed to the shaft 19 and disposed above the level of the liquid 3 in the tank 1 and, on 5 the other hand, in the liquid 3, a vertical plate 72 forming a spiral and fixed to the lower face of the plate 71 around the shaft 19.

As shown more particularly in Fig. 12, the plate 72 defines a lateral inlet 73 for the liquid which 10 extends throughout the height of the plate 72, a vertical passage 74 for the downward circulation of this liquid and a lower outlet 75 for the liquid.

The assembly comprising the plate 71 and the vertical plate 72 is maintained on the shaft 19 by 15 means of a sleeve 71a whose vertical position on the shaft 19 is adjustable.

For this purpose, the sleeve 71a is fixed to the shaft 19 by means formed for example by a fixing screw (not shown).

20 The inner edge of the vertical plate 72 includes a vertical deflector 76 inclined in the direction toward the center of the spiral formed by the plate 72.

Further, the distance between the plate 72 and the axis of the shaft 19 progressively decreases as shown 25 in Fig. 12.

The rotation of the single-passage propeller 70 driven by the shaft 19, i.e. the rotation of the



assembly comprising the plate 71 and the plate 72, in the direction indicated by the arrow in Fig. 12, causes the suction of the liquid into the interior of the plate 72 through the lateral inlet 73.

5 This liquid is stirred inside the vertical passage 74, circulates downwardly in the latter and is discharged into the sheath through the lower outlet 75.

 The deflector 76 improves the stirring of the liquid in the vertical passage 74 and prevents a return
10 of the liquid through the lateral inlet 73.

 In a last embodiment shown in Figs. 14, the device comprises a double-passage propeller 80 for the suction of the liquid 3 into the sheath 11.

 This double-passage propeller 80 is disposed above
15 the second anti-vortex means 40 and at the level of the first series of ports 17.

 The double-passage propeller 80 is driven in rotation by the shaft 19 and comprises, on one hand, a circular plate 81 fixed to the shaft 19 and disposed
20 above the level of the liquid 3 in the tank 1 and, on the other hand, in the liquid 3, two vertical plates 82 and 83.

 The vertical plates 82 and 83 are fixed to the lower face of the plate 80 and each have the shape of
25 two half-shells which are in opposed and offset relation to each other as shown in Fig. 14.

 The two plates 82 and 83 define two lateral inlets



84 and 85 for the liquid, two passages 86 and 87 for the downward circulation of the liquid and a lower outlet 88 for the liquid.

The assembly comprising the plate 81 and the
5 vertical plates 82 and 83 is maintained on the shaft 19 by means of a sleeve 81a whose vertical position on the shaft 19 is adjustable.

The sleeve 81 is fixed to the shaft 19 by means constituted for example by a fixing screw (not shown).

10 As shown more particularly in Fig. 14, the edge of each plate 82 and 83 facing toward the passage 86 or 87 defined by the other plate comprises a vertical deflector respectively 89 and 90.

The rotation of the double-passage propeller 80
15 driven, by the shaft 19, i.e. the rotation of the

assembly comprising the plate 81 and the two vertical plates 82 and 83 in the direction indicated by the arrow in Fig. 14, causes the suction of the liquid 3 through the ports 17.

20 This liquid enters through the lateral inlet 84 and 85, is stirred inside the passages 86 and 87 and circulates downwardly in these passages 86 and 87 and is thereafter discharged into the sheath 11 through the lower outlet 88.

25 The deflectors 89 and 90 increase the stirring of the liquid in the passages 86 and 87 and prevent the liquid from flowing back through the lateral inlets 84



and 85.

In these last two embodiments, the regulation of the flow of liquid by means of the sleeves 22 and 23 of the sheath 11 is unnecessary and these last two
5 embodiments are more particularly employed in the case where the level of the liquid in the tank 1 is variable.

To improve the flow of the liquid of the single-passage propeller 70 or the double-passage propeller
10 80, a pumping propeller (not shown) may be disposed on the shaft 19 below the single-passage propeller or below the double-passage propeller.

The device according to the invention may be applied for example to the treatment of water, town
15 effluents, industrial waste waters, fats by biodegradation, drainage substances, cattle-raising waste products and generally any biodegradable industrial products.

The device according to the invention may also be
20 employed for example in the ozonization of water by an ozonized gas with or without a catalyst, in the stabilization of sludges, or may be employed in a thermophile treatment or for liquids charged with substances in suspension for example organic or mineral
25 substances.

The device according to the invention may also be employed as a reactor operating with a fluidized or



moving bed.

The device according to the invention has the advantage of treating the liquid and simultaneously progressively eliminating the foam floating on the
5 surface of the liquid in the treating tank and thereby ensuring that this foam does not pollute the environment.

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CLAIMS

1. Device for stirring and aerating a liquid and eliminating the foam in a tank (1) for treating said liquid, characterized in that it comprises inside the
5 tank (1):

- a vertical sheath (11) extending in a part of the height of the tank (1) and closed at its upper end and open at its lower end, the lower end of said sheath (11) defining with the bottom of the tank (1) a passage
10 (13) for the liquid (3),

- a funnel (14) disposed around the upper part of the sheath (11) and connected to said sheath (11), the upper edge of said funnel (14) defining with the wall of the tank (1) a free space (15) for the passage of
15 the liquid (3),

- a first series of ports (17) provided in the upper part of the sheath (1) and situated at the level of the liquid (3) in the funnel (14),

- a second series of ports (18) provided in the
20 sheath (11) and situated above the bottom of the funnel (14),

- a vertical shaft (19) driven in rotation, disposed inside the sheath (11) and extending from the upper end of the sheath (11) to the bottom of the
25 funnel (14),

- a main propeller (20) fixed to the free end of the shaft (19) below the bottom of the funnel (14),



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- an anti-vortex means (24) disposed inside the sheath (11) below said propeller (20),

- means (25) for regulating the level of the liquid (3) in the funnel (14),

5 - and means (33) for injecting a gas under pressure in the sheath (11) below the anti-vortex means (24).

2. Device according to claim 1, characterized in that the tank (1) is insulated.

10 3. Device according to claim 1, characterized in that it comprises means (22, 23) for regulating the flow of the liquid (3) and of the foam sucked by the propeller (20) into the sheath (11).

4. Device according to claim 1, characterized in
15 that it comprises means (31, 32) for effecting a static stirring by cavitation of the liquid (3) in the sheath (11) and disposed below the anti-vortex means (24) in said sheath (11).

5. Device according to claims 1 and 3,
20 characterized in that the means for regulating the flow of the liquid (3) and of the foam sucked in by said propeller (20) are formed, on one hand, by a first sleeve (22) disposed around the sheath (11) at the level of the first series of ports (17) and, on the
25 other hand, by a second sleeve (23) disposed around said sheath (11) at the level of the second series of ports (18), the position of said sleeves (22, 23)





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relative to the corresponding ports (17, 18) being vertically adjustable.

6. Device according to claims 1 and 4, characterized in that the means for effecting a static stirring by cavitation are formed, on one hand, by a vertical tube (31) disposed inside the sheath (11) and extending from the bottom of the tank (1) to below the anti-vortex means (24) and, on the other hand, by superimposed static obstacles (32) disposed inside said sheath (11) and fixed to said tube (31).

7. Device according to claim 6, characterized in that the static obstacles (32) define with the inner wall of the sheath (11) passages for the circulation of the liquid (3).

8. Device according to claims 6 and 7, characterized in that the static obstacles (32) are evenly spaced apart throughout the portion of the tube (31) disposed inside the sheath (11).

9. Device according to claims 6 and 7, characterized in that the static obstacles (32) are arranged on the tube (31), on one hand, below the anti-vortex means (24) and, on the other hand, in the lower part of the sheath (11).

10. Device according to claim 6, characterized in that the static stirring means employing cavitation are formed by static obstacles fixed to the inner wall of the sheath (11) and defining an axial passage for the





circulation of the liquid (3).

11. Device according to claim 10, characterized in that the static obstacles are evenly spaced apart throughout the portion of the sheath (11) situated
5 below the anti-vortex means (24).

12. Device according to claim 11, characterized in that the static obstacles are arranged inside the sheath (11), on one hand, below the anti-vortex means (24) and, on the other hand, in the lower part of the
10 sheath (11).

13. Device according to any one of the claims 6 to 12, characterized in that the static obstacles are formed by cups (32) the concavity of which faces toward the bottom of the tank (1).

15 14. Device according to any one of the claims 6 to 12, characterized in that the static obstacles are formed by discs.

15. Device according to claim 1, characterized in that the means for regulating the level of the liquid
20 (3) in the funnel (14) are formed by an overflow pipe (25) disposed inside the funnel (14) in a position which is vertically adjustable.

16. Device according to any one of the preceding claims, characterized in that it comprises a second
25 anti-vortex means (40) disposed inside the sheath (11) and above the main propeller (20), said second anti-vortex means (40) being formed by at least two vertical





plates (40a) each extended upwardly by a stiffening rib (41) extending up to the upper end of said sheath (11).

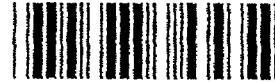
17. Device according to any one of the preceding claims, characterized in that it comprises a liquid
5 accelerator (45, 46, 47) inside the sheath (11).

18. Device according to any one of the preceding claims, characterized in that the liquid accelerator is formed by, on one hand, a secondary propeller (45) disposed above the second anti-vortex means (40),
10 connected to rotate with the shaft (19), and having a pitch oriented in the same direction as the pitch of the main propeller (20) and, on the other hand, an anti-vortex means (46) disposed above the secondary propeller (45) and inside a cylindrical stack (47)
15 fixed to the reinforcing ribs (41), the secondary propeller (45), the anti-vortex means (46) and the stack (47) being situated between the two series of ports (17, 18).

19. Device according to any one of the claims 1
20 to 16, characterized in that it comprises means (50, 51, 52) for aerating the surface of the liquid in the tank (20).

20. Device according to any one of the claims 1 to 16 and 19, characterized in that the means for
25 aerating the surface of the liquid comprise, on one hand, a secondary propeller (50) disposed above the second anti-vortex means (40), connected to rotate with





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the shaft (19) and having a pitch inverted relative to the pitch of the main propeller (20) and, on the other hand, an anti-vortex means (51) disposed above the secondary propeller (50) and inside a cylindrical stack
5 (52) fixed to the reinforcing ribs (41), the secondary propeller (50) and the anti-vortex means (51) being situated between the two series of ports (17, 18) and the stack (52) extending substantially from the median part of the first series of ports (17) to the upper
10 edge of the second series of ports (18).

21. Device according to claim 20, characterized in that a cover (53) is mounted on the shaft (19) above the upper edge of the stack (52) and defines with said upper edge an adjustable passage (54).

15 22. Device according to any one of the claims 1 to 4 and 6 to 16, characterized in that it comprises a vortex pump (60) for the suction of the surface of the liquid into the sheath (11), disposed above the second anti-vortex means (40) and at the level of the first
20 series of ports (17).

23. Device according to claim 22, characterized in that the vortex pump (60) comprises, on one hand, a circular plate (61) connected to rotate with the shaft (19) and provided on its upper side with radial and
25 vertical blades (62) and, on the other hand, a stack (63) fixed to the upper edge of the blades (62) and extending from a position adjacent the upper end of the





tank (1) substantially from the median part of the first series of ports (17) to said upper edge of the blades (62).

24. Device according to claim 23, characterized
5 in that the stack (63) is conical and tapers toward the upper part of the tank (1).

25. Device according to claim 23, characterized in that the stack (63) is cylindrical.

26. Device according to claim 23, characterized
10 in that the blades (62) are planar or curved.

27. Device according to any one of the claims 1 to 4 and 6 to 16, characterized in that it comprises a single-passage propeller (70) for the suction of the liquid (3) into the sheath (11), disposed above the
15 second anti-vortex means (40) and at the level of the first series of ports (17).

28. Device according to claim 27, characterized in that the single-passage propeller (70) comprises, on one hand, a circular plate (71) connected to rotate
20 with the shaft (19) and disposed above the level of the liquid (3) in the tank (1) and, on the other hand, in the liquid (3), a vertical plate (72) forming a spiral and fixed to the lower face of said plate (71) around the shaft (19), said plate (72) defining a lateral
25 inlet (73) for the liquid, a vertical passage (74) for the downward circulation of the liquid and a lower outlet (75) for the liquid.





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29. Device according to claim 28, characterized in that the inner edge of the vertical plate (72) comprises a vertical deflector (76) which is inclined in the direction toward the center of the spiral.

5 30. Device according to any one of the claims 1 to 4 and 6 to 16, characterized in that it comprises a double-passage propeller (80) for the suction of the liquid (3) into the sheath (11), disposed above the second anti-vortex means (40) and at the level of the
10 first series of ports (17).

31. Device according to claim 30, characterized in that the double-passage propeller (80) comprises, on one hand, a circular plate (81) connected to rotate with the shaft (19) and disposed above the level of the
15 liquid (3) in the tank (1) and, on the other hand, in the liquid (3), two vertical plates (82, 83) fixed to the lower face of said plate (81) and having the shape of two half-shells which are in opposed and offset relation to each other, said plates (82, 83) defining
20 two lateral inlets (84, 85) for the liquid, two vertical passages (86, 87) for the downward circulation of the liquid and a lower outlet (88) for the liquid.

32. Device according to claim 31, characterized in that the edge of each plate (82, 83) situated in
25 facing relation to the passage (86, 87) defined by the other plate includes a vertical deflector (89, 90).

33. Device according to claim 27 or 29.

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characterized in that a pumping propeller (19) is fixed on ~~the~~ shaft (19) below the single passage propeller (70) or the double-passa~~ge~~ propeller (80).



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