

System and method for reprocessing bilge water and
sludge

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The present invention relates to a system and a method for reprocessing bilge water.

10 Bilge water occurs during operation on ships, but, because of statutory regulations, should not be discharged, unpurified, into the ocean. It is therefore expedient to reprocess or purify the bilge water directly onboard ships to an extent such that it can be
15 discharged directly into the ocean after purification. For this purpose, sediments in the form of a sludge phase and oil residues in the form of an oil phase are separated out of the bilge water and, as a rule, are stored in a common sludge collection tank, together
20 with sludge residues from other processes, for example until the ship reaches port.

Since the capacity of the sludge collection tank is limited, it is expedient to reduce further the quantity
25 of liquid to be stored in the sludge collection tank.

The object of the invention is to solve this problem.

The invention achieves this object by means of a system
30 having the features of claim 1 and a method having the features of claim 11.

By products collected in the sludge collection tank, in this case, in particular, an aqueous sludge phase which
35 has settled in the sludge collection tank, being recirculated into the centrifuge, a second centrifugal reprocessing/purification of the recirculated part of the solid or sludge phase can take place, as a result of which, overall, the quantity of dischargeable water

can be increased or the quantity of sludge phase can be further reduced, so that there is a longer period of time until the sludge collection tank reaches its maximum filling level.

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Advantageous refinements are the subject matter of the subclaims.

10 Preferably, a nonreturn valve is connected, downstream of the sludge collection tank, into the recirculation line, in order to prevent a backflow of sludge into this collection tank.

15 Furthermore, a pump, preferably a regulated sludge pump, which allows a metered recirculation/return of the sludge phase, may be arranged in the recirculation line.

20 In this case, it is preferable, further, if a bilge water pump P1 is arranged in the line L1 downstream of the nonreturn valve and downstream of the issue of the recirculation line into the line.

25 Preferably, the power of the bilge water pump is higher is than that of the sludge pump.

30 In order to utilize optimally the power of the bilge water pump, it is advantageous if the line into which the recirculation line for the sludge phase issues is arranged between the bilge water tank for bilge water and the bilge water pump.

35 Preferably, the power of the bilge water pump is always higher than the power of the sludge pump, so that further transport in the direction of the centrifuge takes place. In this case, a nonreturn valve arranged downstream of the bilge water tank preferably and advantageously prevents further transport of the sludge

into the bilge water tank for bilge water, in the event that the bilge water pump fails.

5 Since it is primarily expedient to reprocess once more essentially only the sludge phase, but not also part of the separated oil phase, it is advantageous if recirculation is arranged in the bottom and/or on a wall in the lower third of the sludge collection tank. The sludge collection tank in this case acts as a kind of settling tank, in which the heavier aqueous sludge phase collects in the lower region of the tank and in which the oil phase floats on top.

15 The oil content of the bilge water before its clarification will preferably amount to less than 25% by volume, and therefore, when sludge is being metered into bilge water, care must be taken to ensure that sludge recirculation is stopped beyond a specific oil content, until more sludge with higher water fractions has settled again in the sludge collection tank. The oil content may be monitored directly by a checking device in the recirculation or in the line to the centrifuge or indirectly by a flowmeter in the water drain of the centrifuge.

25 In order additionally to increase the efficiency of the method, before the centrifugal purification/-reprocessing of the bilge water one or both of the following steps may be carried out: filtration and/or heating of the bilge water.

The recirculation of the sludge phase preferably takes place before the centrifuge carries out any emptying.

35 Since the sludge phase mostly has only a low oil content, it can be processed separately, so that less filling mass is delivered to the sludge collection tank. It is therefore advantageous if the sludge is

upgraded in a tank separated spatially from the sludge collection tank.

5 This upgrading may take place by heating, filtration or by separation in a sludge dewatering device ("sludge concentration unit").

10 The invention is described in more detail, with reference to exemplary embodiments, by means of the following figures in which:

fig. 1 shows a system according to the invention for reprocessing bilge water;

15 fig. 2 shows an already known system for reprocessing bilge water; and

fig. 3 shows a further variant of the system according to the invention.

20 Fig. 2 shows a known system for reprocessing bilge water which will be described first.

25 Bilge water usually collects/forms in the engine room of a ship. It may be formed, for example, from seawater and cooling water leakages, condensation water or cleaning water and contains the actual water as the main constituent and, as a rule, further constituents, such as residues of fuel, of lubricating oil or of
30 other oils.

The problem with this is that the bilge water should not be returned, untreated or simply diluted, to the ocean. Thus, an oil content of less than 15 ppm (IMO
35 regulations) is deemed to be a limit value for the introduction of bilge water into the ocean outside what are known as the 12 mile zones. In special protected areas, the permitted oil content sometimes even lies at

a maximum of 5 ppm. The presence of a licenced and fully functioning bilge water deciler onboard ships is therefore prescribed by law.

- 5 These limit values can be adhered to by means of the patented device and the method.

In the known system, depicted in fig. 2, for the purification of bilge water B, the bilge water from the
10 ship introduced into a bilge water tank 1 and preferably collected there.

The bilge water is first conducted from the bilge water tank 1 by a line L1 by means of a bilge water pump P1
15 through a filter system 2, in order to remove solid particles S1 from the water.

The water emerging from the filter system is led further on by a line L2, preferably through a heating
20 device, such as a steam heater 4, which has a steam inflow 3 for the introduction of hot steam and a condensate outflow 5 for the discharge of hot condensate.

25 The heated/warmed bilge water, which can consequently be purified more effectively, in particular, in terms of the oil constituents, flows out of the heating device through a line L3 and a changeover valve V1 into a centrifuge 6, preferably a separator, in particular a
30 three-phase separator, where separation of the bilge water into a water phase W, an oil phase O and a sludge phase S takes place in the centrifugal field.

The centrifuge 6 is assigned a process water line L4
35 for the addition of control water L6 and filling and displacement water L5 which can be introduced via the valve V6 into the closing chamber of the separator drum

or via the valve V5 into the supply line L6 to the centrifuge 6.

5 The purified bilge water W is discharged out of the centrifuge through a line L7 which is bypassed (valve V3) by an oil monitor 13, in order to monitor it continuously for its residual oil content. The changeover valve V4 is controlled by the oil monitor.

10 If the oil content lies below a desired value of preferably 15 ppm or, optionally, 5 ppm, disposal of the clarified bilge water into the ocean through a drainage line L8 can take place. If, by contrast, the oil content lies above a stipulated desired value, the
15 bilge water is not sufficiently clarified and is returned to the bilge water collection tank 1 via a recirculation line L10.

The sludge phase S2 expelled from the centrifuge 6 into
20 a solids trap 7 is collected in an intermediate container 9 and conducted by means of a pump P2 through the line L9 into a sludge tank 10.

The oil phase O discharged from the centrifuge 6 is
25 discharged from the latter through a line L11 which preferably issues into the line L9 for introducing the sludge phase into the sludge collection tank 10 or directly into the sludge collection tank 10.

30 Overall, the method of fig. 2 affords the particular advantage that the main constituent of the bilge water, that is to say the water contained in it, can, as a rule, be conducted directly into the ocean after clarification, so that already a relatively low storage
35 capacity is required for collecting and storing the bilge water.

This system and a correspondingly accompanying method have therefore basically proved to be successful, but, according to the invention, are developed substantially even further.

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Fig. 1 shows a system according to the invention which has a set-up similar to that of fig. 2.

10 However, in addition to the components of figure 1, the system also has the following feature: a recirculation line L12, by means of which liquid, in particular a still free-flowing aqueous sludge phase, can be recirculated out of the sludge collection tank 10 into a line, connected between the bilge water collection
15 tank 1 and the pump P1, and into the centrifuge 6.

This recirculation is especially advantageous for the following reasons.

20 The sludge collection tank 10 acts as a kind of settling tank, in which the (still water-containing) sludge phase S2 gradually settles, while the oil-containing phase O floats on the sludge phase S2. Via the settled sludge phase S2 being recirculated out of
25 the sludge collection tank 10 through the recirculation line L12, the level in the sludge collection tank 10 is lowered, so that it can accommodate a larger volume of sludge and oil.

30 Preferably and especially advantageously, the recirculation line L12 issues from the sludge collection tank 10 into the (suction) line L1 between the sludge collection tank 10 and the bilge water inflow pump P1.

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Preferably, a nonreturn valve V7 is arranged in the line L1, so that no backflow of the aqueous sludge phase S2 out of the sludge collection tank 10 into the

comparatively cleaner bilge water of the bilge water tank 1 can take place.

5 Since the pressure conditions with regard to aqueous sludge phases may present a problem in terms of the pressure resistance of the lines, one of the lines L1, L12 or both lines L1, L12 preferably has or have a pressure relief valve (not illustrated here).

10 In fig. 1, the recirculation of the aqueous phase is taken over by a (sludge) pump P3 which, during operation, preferably works with a lower power, preferably with less than 15% of the power of the bilge water pump P1.

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Recirculation may take place continuously or else only intermittently. As a result of the recirculation of the sludge phase, the latter is mixed with the bilge water to be conducted into the centrifuge and is purified together with this bilge water, thus, overall, reducing the water content in the sludge phase, as compared with the system of fig. 2. In this way, the disposable quantity of purified bilge water phase W is increased in a simple way or the volume to be stored per unit of volume of bilge water in the sludge collection tank 10 is reduced.

30 Preferably, recirculation through the line L12 or the pump P2 is stopped when a program for emptying the centrifuge starts (if the latter has a piston slide emptying function) or when an alarm has been triggered.

35 The filter 2 may be utilized in order to establish whether the sludge content in the inflow to the centrifuge is too high. In this case, the pump P2 is stopped.

A pressure transmitter and vibration monitoring further increase safety, where appropriate.

Preferably, a nonreturn valve (V8) is connected into
5 the recirculation line L12 downstream of the sludge
collection tank 10, in order to prevent a possible
backflow of the bilge water into this container.
Furthermore, especially advantageously, the bilge water
pump P1 is connected into the line L1 downstream of the
10 nonreturn valve and downstream of the issue of the
recirculation line L12 into the line L1.

Fig. 3 shows a further preferred development in which
the system of fig. 1 is additionally supplemented by a
15 sludge upgrading device ("sludge concentration unit"),
here a settling tank (or, in particular, a press) 11
for dewatering the sludge phase S2 expelled from the
centrifuge, said sludge upgrading device being
connected into the line L9. By means of this device 11,
20 the sludge phase is additionally upgraded, the liquid
phase settling out of the sludge preferably statically.
The settled liquid phase can be returned through a line
L13 into the sludge collection tank 10 which preferably
has the recirculation line L12 (of fig. 1). The sludge
25 S3 can then be disposed of separately from the
oil-containing phase. Moreover, in this way, the sludge
content in the collection tank 10 for the sludge is
reduced, this having a positive effect upon
returnability through the line L12.

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List of Reference Symbols

P1, P2	Pumps
L1, L2, ...	Lines
S1,S2,O,W	Sludge, oil and water phases
B	Bilge water
V1, V2,...	Valves

1	Bilge water collection tank
2	Filter system
3	Steam inflow
4	Steam heater
5	Condensate drain
6	Centrifuge
7	Solids trap
8	Checking device
9	Intermediate tank
10	Sludge collection tank
11	Sludge upgrading device

Patent Claims

1. A system for the purification of bilge water,
5 which has at least the following features:
A) a bilge water tank (1) for bilge water,
B) a centrifuge (6) for separating an oil phase
(O) and a solid-like sludge phase (S2) out of
the bilge water to be purified, and
10 D) a sludge collection tank (10) for collecting
the separated oil phase (O) and the sludge
phase (S2),
characterized in that
E) the sludge collection tank (10) has a
15 recirculation line (L12) which issues into a
line (L1) which is arranged between the bilge
water tank (1) for bilge water and the
centrifuge (6).
- 20 2. The system as claimed in claim 1, characterized in
that a nonreturn valve (V8) is connected into the
recirculation line (L12) downstream of the sludge
collection tank.
- 25 3. The system as claimed in claim 1 or 2,
characterized in that a nonreturn valve V7 is
connected into the line L1 downstream of the bilge
water tank.
- 30 4. The system as claimed in claim 1, 2 or 3,
characterized in that the bilge water pump (P1) is
connected into the line (L1) downstream of the
nonreturn valve and downstream of the issue of the
recirculation line (L12) into the line (L1).
- 35 5. The system as claimed in one of the preceding
claims, characterized in that the power of the
bilge water pump (P1) is higher than that of the
sludge pump (P3).

6. The system as claimed in one of the preceding claims, characterized in that the line (L1), into which the recirculation line (L12) issues, is arranged between the bilge water tank (1) for bilge water and the bilge water pump (P1).
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7. The system as claimed in one of the preceding claims, characterized in that the line (L1) into which the recirculation line (L12) issues is a suction line (L1).
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8. The system as claimed in one of the preceding claims, characterized in that the recirculation line (L12) is arranged in the bottom and/or on a wall in the lower third of the sludge collection tank (10).
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9. The system as claimed in one of the preceding claims, characterized in that, during operation, the power of the sludge pump (P3) amounts to less than 25%, preferably to less than 15%, of the power of the bilge water pump (1).
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10. The system as claimed in one of the preceding claims, characterized in that it has a sludge upgrading device (11).
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11. A method for the combined reprocessing of bilge water and sludge by means of a system as claimed in one of the preceding claims, characterized by the following steps:
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 - a) provision of bilge water in a bilge water tank (1);
 - b) transfer of the bilge water from the bilge water tank (1) into a centrifuge (6);
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- c) purification of the bilge water, along with the separation of an oil phase (O) and of a sludge phase from a water phase (W), in a centrifuge (6), preferably a separator;
 - d) collection of the sludge phase (S2) and of the oil phase (O) in a sludge collection tank (10); and
 - e) at least partial recirculation of sludge phase (S2) from the sludge collection tank (10) into the centrifuge (6) or into a system element connected upstream of the centrifuge.
12. The method as claimed in claim 11, characterized in that the oil content of the bilge water before its clarification amounts to less than 25% by volume.
13. The method as claimed in claim 11 or 12, characterized in that, during the transfer of the bilge water according to step b), filtration and/or heating of the bilge water take place/takes place.
14. The method as claimed in one of the preceding claims 11 to 13, characterized in that recirculation according to step e) is interrupted in so far as emptying of solids from the separator is carried out or when an alarm is triggered. Note: an alarm may be: temperature too high, oscillation limit values of the separator exceeded, etc.
15. The method as claimed in one of the preceding claims 11 to 14, characterized in that the solid content of the sludge phase (S2) discharged from

the centrifuge is reduced further before introduction into the sludge collection tank (10).

- 5 16. The method as claimed in claim 15, characterized in that the reduction in the solid content takes place by means of a press or in the settling tank (11).