

Claims

1. Process for treating an aqueous fluid comprising a biodegradable organic substance in an installation comprising
- a bioreactor unit(1) wherein the aqueous fluid is anaerobically microbiologically treated, whereby a biogas is produced from the organic substance,
 - a degassing unit (2) wherein an aqueous suspension withdrawn from the bioreactor, said suspension comprising aqueous liquid, biogas and biomass, is subjected to batch degassing, and
 - a semi-continuously operated biomass separator unit (3), wherein degassed suspension withdrawn from the degassing unit is subjected to separation into (a) a sludge enriched in biomass and (b) an aqueous fluid having reduced biomass content, compared to said degassed suspension fed into biomass separator unit (3),
- the process comprising
- a bioreactor unit batch feeding stage, wherein the aqueous fluid that is to be treated is fed into the bioreactor unit;
 - a batch reaction stage, wherein the aqueous fluid is microbiologically treated under anaerobic conditions and biogas is produced in the bioreactor unit;
 - a semi-continuous biomass separator unit feeding stage, wherein the degassed aqueous suspension is withdrawn from the batch degassing unit and fed into the biomass separator, which semi-continuous feeding stage comprises an initial phase without withdrawal of aqueous fluid having reduced biomass content followed by a continuous phase wherein feeding and withdrawal take place continuously;
 - a degassing unit feeding stage, wherein an aqueous suspension comprising microbiologically treated aqueous fluid and biomass is withdrawn from the bioreactor unit and fed batch-wise into the degassing unit.
2. Process according to claim 1, wherein in the process comprises a plurality of cycles, wherein one or more subsequent process cycles

are performed after a start-up cycle, in which subsequent cycle or cycles

- 5 - the **bioreactor unit batch feeding stage (A)** is performed, wherein the aqueous fluid that is to be treated is fed into the bioreactor unit, whilst treatment of aqueous fluid already present in the bioreactor unit may continue, the aqueous suspension in the degassing unit (fed into it in a previous stage or previous cycle) is subjected to degassing whilst use is made of mixing;
- 10 - the **batch reaction stage (B)** is performed thereafter, wherein the batch of aqueous fluid is microbiologically treated and biogas is produced in the bioreactor unit (1) and the aqueous suspension in the degassing unit (2) is subjected to degassing, preferably whilst use is made of mixing in the degassing unit;
- 15 - the **biomass separator unit operation stage (C)** is performed thereafter, wherein degassed aqueous suspension is withdrawn continuously from the degassing unit (2) and fed into the biomass separator (3) until the biomass separator fills up to a height level at which the outlet for aqueous fluid (b) having reduced biomass content is present, and from then on during this stage continuous removal of the aqueous fluid having reduced biomass content from the biomass separator takes place and the sludge (a) enriched in biomass to the bioreactor is returned continuously to the bioreactor unit, whilst microbiological treatment of the aqueous fluid in the bioreactor unit may continue;
- 20 - **a further sludge return stage (D)** is performed thereafter, wherein feeding of degassed suspension from the degassing unit to the biomass separator has been completed, removal of the aqueous fluid having reduced biomass content from the biomass separator has stopped and sludge enriched in biomass continues to be returned to the bioreactor, whilst microbiological treatment in the bioreactor unit may continue;
- 25 - the **batch degassing tank fill-up stage (E)** is performed thereafter, wherein once the required volume of aqueous fluid having reduced biomass content (equal to volume fed to the bioreactor during batch feed stage (A)) is withdrawn from the biomass separator unit during previous stage, the remaining sludge enriched in biomass will then continue to be returned to
- 30

the bioreactor in this stage, whilst microbiological treatment in the bioreactor unit may continue.

3. Process according to claim 2, wherein the aqueous fluid having reduced biomass content is withdrawn from the biomass separator via gravity overflow.
4. Process according to any of the preceding claims, wherein concentrated sludge (a) enriched in biomass is recycled to the bioreactor unit and clarified aqueous fluid (b) having reduced biomass content is removed from the biomass separator unit and discarded as effluent or subjected to further downstream processing.
5. Process according to claim 2, claim 3 or claim 4 dependent on claim 2 or 3, wherein recycle of the sludge (a) and removal of clarified aqueous fluid (b) take place during the biomass separator unit operation stage (C) or thereafter, yet before the start of the next of said stages (E) or (A).
6. Process according to any of the preceding claims, wherein the biomass separator unit has tilted internals, preferably lamellae, adapted to enhance the settleability of the biomass.
7. Process according to claim 6, wherein the tilted internals define a volume between 1/2 and 1/3 of the working volume of the biomass separator unit.
8. Process according to any of the preceding claims, wherein the volume of the aqueous fluid that is being subjected to microbiological treatment in the bioreactor unit per batch is about 2 to about 3 times the volume of the aqueous suspension that is being degassed in the batch degassing unit.
9. Process according to any of the preceding claims, wherein the microbiological treatment in the bioreactor unit is anaerobic, and wherein anaerobic conditions are maintained in the bioreactor unit and the degassing unit.
10. Process according to any of the preceding claims, wherein the aqueous fluid is a fluid waste having a total chemical oxygen demand in the range of 1.0-50 g/l, preferably in the range of 5-50 g/l, in particular in the range of 8-50 g/l, more in particular in the range of 8-30 g/l.

11. Process according to any of the preceding claims, wherein the aqueous fluid is a fluid waste having a total suspended solids content of 0.5 g/l or more
12. Process according to claim 11, wherein the aqueous fluid is a fluid waste having a total suspended solids content of 1.0-30 g/l.
13. Process according to any of the preceding claims, wherein the aqueous fluid is a fluid waste having a total suspended solids content of 0-20 g/l.
14. Process according to any of the preceding claims, wherein the aqueous fluid is a fluid waste having a total content of fat oil and/or grease (FOG-content) in the range of 0-4 g/l.
15. Process according to any of the preceding claims, wherein the aqueous fluid is a fluid waste having a total content of fat oil and/or grease (FOG-content) of 50 mg/l or more.
16. Process according to claim 15, wherein the fluid waste has a FOG-content in the range of 0.1-2 g/l.
17. Simultaneous phase operatable sequential batch reaction system, the system comprising a bioreactor unit wherein an agitator is present for agitating an aqueous suspension in the bioreactor unit for producing biogas, the installation further comprising a batch degassing unit wherein an agitator is present for agitating an aqueous suspension and configured to degas aqueous suspension that has been fed from the reaction unit into the batch degassing unit, the system further comprising a biomass semi-continuous separator unit configured to separate degassed aqueous suspension from the degassing unit into a sludge enriched in biomass and into an aqueous effluent having a reduced biomass content, compared to the degassed suspension, wherein the separate biomass separator unit comprises a space for holding treated aqueous suspension from the degassing chamber which spaces contains a liquid-solid separator unit, and further comprises an inlet for the degassed aqueous suspension that is connected to an outlet for treated aqueous suspension from the degassing chamber via a closable conduit, an outlet for removing the

- sludge and a separate outlet for removing the effluent from said separator unit via closable conduits
- wherein the bioreactor unit and the degassing unit have a joint or separate head space for biogas, the headspace or headspaces comprising an outlet for biogas
- the system further comprising an inlet for a fluid aqueous waste stream into the bioreactor unit, a provision to feed aqueous suspension from the bioreactor unit to the degassing unit.
18. System according to claim 17, wherein the liquid-solid separator, has tilted internals adapted to enhance the settleability of biomass in an aqueous fluid (such as a suspension or sludge).
19. System according to claim 17 or 18, the internal volume of the bioreactor unit (i.e. the volume for holding the suspension and headspace) is 2 to 10 times the internal volume of the batch degassing unit (i.e. the volume for holding the suspension and headspace), preferably 3-6 times the volume, in particular 3-5 times the volume.
20. System according to any of the claims 17-19, wherein the bioreactor unit and the degassing unit are separate sections of a single piece of equipment, in particular a single vessel, wherein the bioreactor unit is positioned in a central part of the equipment and is essentially surrounded by the degassing unit.
21. System according to claim 20, wherein the bioreactor unit and the degassing unit are part of a single vessel and both units share the same headspace.
22. System according to claim 20 or 21, wherein the bioreactor unit and the degassing unit are separated by an intermediate wall and provided with a channel configured to pass aqueous suspension from the bioreactor unit to the degassing unit by gravity flow.