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ABSTRACT

There is disclosed a method and an apparatus for reducing the amount of waste, requiring special handling and possible destruction, in a process involving vaporization, in an evaporator apparatus (1-6, V1-V6), of a water solution containing environmentally hazardous substances. A considerable amount of the water content of said water solution is vaporized in a reusable vaporization chamber (2a), the water content of said water solution being vaporized into vapor, which is released, possibly after condensation into water, to an ambient system. At a certain time, the vaporization process is stopped, the water content in the vaporization chamber (2a) being reduced by 30% to 95%, so that the remaining water content is 70% to 5% of the initial water content. Thereafter, in a second step, the remaining water solution in the reusable vaporization chamber (2a) is transferred into a separate waste container (6), where the remaining water is subjected to at least one further water-reducing process, so that the water content in is further reduced by 10% to 100%. The combined water-reduction in the reusable vaporization chamber (2a) and the waste container (6) is such as to leave a final water content in the waste container (6) of 10% to 0% of the initial water content. The remaining waste, including the environmentally hazardous substances, is left in the waste container for separate handling and possible destruction. In this way, the production of waste material is reduced significantly.

METHOD AND APPARATUS TO REDUCE WASTE PRODUCTION IN AN ISOLATION PROCESS

FIELD OF THE INVENTION

The present invention relates to a method and an apparatus for reducing the amount of waste, requiring special handling and possible destruction, produced in an isolation process involving vaporization, in an evaporator apparatus, of a water solution containing environmentally hazardous substances, wherein

- a considerable amount of the water content is vaporized in at least one reusable vaporization chamber,
- the water content of said water solution being vaporized into vapor, which is released, possibly after condensation into water, to an ambient system, and
- the vaporization process is stopped at a certain time, at which the remaining water solution is removed from said at least one reusable vaporization chamber for handling as waste.

BACKGROUND OF THE INVENTION

Generally, there are several types of substances that may be unsuitable or harmful in the environment (environmentally hazardous substances). Some may be harmful to animals via a specific mechanism (such as hormones that may influence the normal reproduction of marine animals), others may be generally toxic (such as cytostatic drugs) while, in the case of antibiotics and antiviral drugs, there may be an increased risk for development of resistant bacteria and viruses if the environment contains antibiotics and antiviral drugs for a substantial amount of time. Environmentally hazardous substances include antibiotics, antifungal and antiviral drugs, NSAID (non-steroid anti-inflammatory drugs), cytostatic drugs, hormones (such as steroid hormones), antidepressants, antipsychotics, and many other pharmaceutical or non-pharmaceutical substances.

Today, much pharmaceutical and biotech research is performed on cells from cultures that grow for a varying amount of time in a medium. In order to prevent bacterial infections which can destroy cell cultures, various types of antibiotics are often added to the growth medium. See "The prophylactic use of antibiotics in cell culture", Ingrid Kuhlmann, Cytotechnology (1995), pp 95-105. When the cell culture is discarded, it is important to prevent that the antibiotics from the cell culture is released to the environment, which could enhance development of antibiotic resistant bacteria. This may be achieved by heating of the growth medium during autoclaving, if the substances being used are thermosensitive. However, many antibiotics and other hazardous substances are not sufficiently degraded by this process, and it may therefore be necessary to incinerate the substances in a high temperature oven instead. This can be problematic e.g. in a research institute that can generate very substantial amounts of liquid polluted with antibiotics every day. The disposal of large quantities of waste such as growth media and other liquids with environmentally hazardous substances such as antibiotics to suitable high temperature incinerators can result in high financial costs as well as logistic problems. Therefore, it is desirable to reduce the amount of waste that has to be destroyed to a minimum.

The process of vaporization is widely used to concentrate foods and chemicals as well as to salvage solvents. A solution containing the desired product is fed into the evaporator and passes across a heat source in a reusable vaporization chamber. The applied heat converts the water in the solution into vapor. The vapor is removed from the rest of the solution and is normally condensed before being released, while the now-concentrated solution is either fed into a second evaporator or is removed. An evaporator apparatus used in the present invention generally consists of four units:

- a liquid receiving unit for receiving the water solution,
- at least one reusable vaporization chamber for heating the water solution so as to vaporize water from said water solution,
- a vapor evacuation unit, and

- a vapor releasing unit, e.g. a condensation unit, which is connectable to an ambient system, such as a sewage system, for releasing vapor or condensed water during the vaporization process.

Evaporators can also be used to isolate environmentally hazardous substances which are dissolved in water solutions. An initial vaporization process removes much, but not all, of the water. The removed vapor, or water if a condensation unit is used, can be released into an ambient system, e.g. directly into the ambient air, a sewage system, a water tank or even a ditch. The remaining solution in the reusable vaporization chamber contains the hazardous substances, and can subsequently be taken care of for instance by destruction in an incinerator. This eliminates a potential environmental hazard.

However, there are considerable problems with this method.

Vaporization of the water solution results in fouling with hard deposits on the surfaces of the vaporization chamber, especially when a large portion of the liquid has been vaporized and the concentration of the solvents therefore has increased. It may require costly and labor-intensive cleaning to remove these deposits, or it may even require a replacement of the soiled unit. Another problem with removing much water in the vaporization chamber is that the viscosity of the water solution will gradually increase, which will make it increasingly difficult to transfer the water residue to a waste container. Therefore, before all of the water has been vaporized in the vaporization chamber, the vaporization process is stopped at a certain time, at which the remaining solution in the evaporator is removed from the reusable vaporization chamber for handling as waste and possible destruction. Accordingly, the present method of isolation of substances that are dissolved in water solutions necessarily results in the production of considerable amounts of waste material, which is uneconomic and cause logistic problems.

OBJECT OF THE INVENTION

Against this background, the object of the invention is to substantially reduce the amount of waste that is produced when environmentally hazardous substances are isolated from water solutions using vaporization. The vaporization chamber of the evaporator apparatus should preferably be reusable for a number of further vaporization processes.

SUMMARY OF THE INVENTION

The method according to the invention involves a two-stage or multi-stage removal of water from a water solution with dissolved environmentally hazardous substances, with the intention of isolating and possibly destroying the dissolved substances, with the first removal of water occurring in one or a number of reusable evaporators and the final removal of water occurring in one or more waste containers. The advantage of performing the final reduction of water in a waste container is that at this point it does not matter if dissolved substances cause deposits on the walls, and has a high viscosity, because this container is not reusable, but is instead normally sent for destruction.

This two-stage or multi-stage reduction with the final reduction of water occurring in the waste container will substantially reduce the total production of waste from the evaporator apparatus.

According to the present invention, a method and an evaporator apparatus are provided that will substantially reduce the amount of produced waste containing environmentally hazardous substances, wherein:

- said certain time, at which the first removal of water occurring in one or a number of reusable evaporators is stopped, is adjusted so that the water content is reduced by 30% to 95%, and the remaining water content is 70% to 5% of the initial water content and is high enough to result in the formation of only minor deposits in said at least one reusable vaporization chamber, and to allow an

easy removal of the remaining water solution (waste) from the reusable vaporization chamber,

- said remaining water solution (waste), at said certain time, is transferred from said reusable vaporization chamber into at least one waste container,
- whereupon said remaining water solution (waste) in said at least one waste container is subjected to at least one further water-reducing process, where the water content in said at least one waste container is further reduced by 10% to 100%,
- the combined water-reduction in said at least one reusable vaporization chamber and said at least one waste container being such as to leave a final water content in said at least one waste container of 10 % to 0 % of the initial water content of said water solution containing environmentally hazardous substances,
- and the remaining waste in said at least one waste container, including said environmentally hazardous substances, is left in said separate waste container for separate handling and possible destruction.

The term “reusable” vaporization chamber depicts that the vaporization chamber is refilled at least once to be used during two or more vaporization processes before being discarded.

BRIEF DESCRIPTION OF THE DRAWING

The invention will now be described in more detail with reference to the appended drawing with a single figure showing schematically an evaporator apparatus according to the present invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

The evaporator apparatus used in a preferred embodiment of this invention comprises a liquid receiving unit 1, an inlet valve V1, a vaporization unit 2 provided with a vaporization chamber 2a, a number of heating elements 2b, 2c, 2d placed outside but in contact with the metal walls of the chamber 2a, sensors 2t, 2p, 2l for determining the temperature, pressure and level of contents in the vaporization chamber, respectively, a vapor evacuation unit 3 with an associated valve V2, a vapor condensation unit 4 provided with a cooling water inlet 4a, an associated valve V3 and a cooling water outlet 4b, an outlet valve V4, and a pump 5 for reducing the pressure below the atmospheric pressure in the vaporization chamber 2a. In principle, these components form a prior art evaporator apparatus. As is also previously known, there may be at least one further reusable vaporization chamber (not shown) in the vaporization unit 2 for removal of liquid in consecutive steps.

According to the invention, a waste container 6 is connected, via a valve V5, to the vaporization chamber 2a. This waste container 6 is used for receiving waste generated in the vaporization unit 2, and in this container further water is removed from the waste material. The waste container is also connectable to the pump 5 via a valve V6. The waste container 6 is used only until the waste has reached a specified level, at which time the waste container is considered to be full. At this point the waste container will be taken away from the evaporator apparatus and normally sent to destruction, e.g. in an incinerator or high temperature oven (not shown).

The apparatus operates as follows below, it being understood that a computer (not shown) is used to control the whole process on the basis of signals received from various sensors, e.g. the above-mentioned temperature sensor 2t, pressure sensor 2p and level sensor 2l, preferably disposed inside the vaporization chamber 2a, and a temperature sensor 6t, a pressure sensor 6p and a level sensor 6l, preferably disposed in the waste container 6, and also on the basis of control signals being sent to the various valves V1, V2, V3, V4, V5 and V6. In addition, one or more pumps are used to move the water solutions to the appropriate compartment, as well as being able to reduce the ambient pressure in the vaporization chamber 2a and the waste container 6 to facilitate formation of water vapor through vaporization.

A batch of a water solution, containing environmentally hazardous substances, such as antibiotics or other hazardous substances, is fed into the liquid receiving unit 1 and to the reusable vaporization chamber 2a. There, the water solution is heated by the heating elements 2b, 2c, 2d so that water will vaporize and form vapor in the vaporization chamber 2a. The vapor is evacuated via the vapor evacuation unit 3. Thereafter, the vapor is circulated through the vapor condenser unit 4 by means of the pump 5. The condensed water is released into a regular sewage system, a water tank or even a ditch. Alternatively, the vapor can be let out for instance into the ambient air or into a water tank or to the sewer system without first being condensed into water.

The level sensor 2l detects the amount of water solution containing environmentally hazardous substances that is fed into the evaporator, and the vaporization process is continued, by means of the heating elements 2b, 2c, 2d, until the desired percentage of water has been removed from the solution.

The vaporization process in the vaporization chamber is stopped at an optimum time, when the remaining water content is still high enough to secure that there is a sufficient fluidity of the solution and that there is only a small tendency for formation of deposits on the walls of the vaporization chamber 2a, but the water content being as small as possible. The tendency to form deposits on the walls of the vaporization chamber differs between different water solutions, and has to be determined in preliminary examinations for all water solutions that are fed into the evaporator. At the optimum time, the vaporization process in the vaporization unit 2 is stopped, and the remaining, more concentrated water solution is transferred via the valve V5 to the waste container 6. Here, the water content of the water solution is reduced further, preferably by means of a heating plate 6a, possibly provided with a thermostat (not shown) set at a desired temperature, placed underneath the waste container 6. The further reduction of water in the waste container is continued until 10% to 100% of the remaining water content has been removed.

Alternatively, there may be many other ways to heat the contents in both the vaporization chamber and the waste container, including using heating elements at least partially immersed in the liquid, microwaves, induction and many more ways.

The pump 5, or some other device for reducing the pressure in the vaporization chamber, and/or in the waste container, will make it possible for the contents in the vaporization chamber, and/or the waste container, to boil at temperatures below 100°C by creating a below-atmospheric pressure.

The water content in the waste container can be reduced also without boiling. By simply adding heat energy to its liquid, vaporization will be enhanced by evaporation, even if there is no boiling.

In the first liquid-reduction step occurring in one or more reusable vaporization chamber(s), preferably 30% to 95% of the liquid is removed, more preferably 50-95 % of the liquid is removed, most preferably 70-95 % of the liquid is removed, and in the final liquid-reduction step that occurs in one or more waste container(s), preferably another 10 % to 100%, more preferably 30% to 100% and most preferably 50% to 100% of the liquid in the waste container is removed.

An additional way to increase the vaporization of water from the waste container is to apply a below-atmospheric pressure in it for instance by use of a pump 5.

A further way to enhance the vaporization of water from the waste container is to feed a gas into the waste container via a gas inlet 6g, e.g. by bubbling a gas, such as air, into the waste container liquid, either at atmospheric pressure or below atmospheric pressure.

As is described in Examples 1 and 2 below, this final reduction of water in the waste container results in a very substantial reduction of produced waste material from the evaporator apparatus.

Example 1

The method and apparatus according to the invention has been tested with some different types of liquids, viz.:

* Dulbecco's Modified Eagle's Medium with Penicillin 120 microgram and Streptomycin 100 microgram (Sigma-Aldrich).

* Dulbecco's Phosphate Buffered Saline with Penicillin 120 microgram and Streptomycin 100 microgram (Sigma-Aldrich).

* Human urine with Ciprofloxacine (Sigma-Aldrich) 10 mg/liter.

During vaporization in the reusable vaporization chamber 2a, it was found that removal of gradually more water resulted in more and more fouling of the walls. A reduction of more than 30 % of the water of the tested liquids, resulted in some soiling on the walls of the vaporization chamber. Removal of more than 50 % of the water, resulted in more pronounced fouling, removal of more than 70 % of the water, resulted in even more pronounced fouling and removal of more than 90 % of the water, resulted in an additional amount of even more pronounced fouling. Furthermore, removal of more than 90 % of the water led to an increased viscosity of the tested liquids, and when more than 95-97 % of the water had been removed, it was virtually impossible to transfer the waste from the vaporization chamber to the separate waste container.

In order to further reduce the amount of waste material, additional water was removed in the waste container. The removal in the waste container of 10 % of the water in the liquid waste from the vaporization chamber resulted in some fouling on the walls and bottom of the waste container. The removal in the waste container of 40 % of the water in the liquid waste from the vaporization chamber resulted in large fouling on the walls and bottom of the waste container. Even further removal of water transformed the liquid waste into a hard, non-liquid material. In general, it was possible to reduce the volume of the waste from the vaporization chamber by 80 % or even more by this final liquid-reducing step in the waste container.

Example 2

100 liters of urine containing the antibiotic Ciprofloxacine (10 mg/liters, Sigma Aldrich) was transferred to a reusable vaporization chamber and heated. When the volume had been reduced by about 90 % through vaporization, the remaining 10 liters of urine containing antibiotics were transferred to a waste container. Here, all of the remaining water

was removed by the use of heat, by applying a pressure lower than the ambient air pressure and by feeding a gas into the waste container. As a result, the remaining urine turned into solid deposits on the walls and the bottom of the waste container, and the volume of the waste was reduced by about 80 %.

CLAIMS

1. A method to reduce the amount of waste, requiring special handling and possible destruction, in a process involving vaporization, in an evaporator apparatus (1-6, V1-V6), of a water solution containing environmentally hazardous substances, wherein
   - a considerable amount of the water content of said water solution is vaporized in at least one reusable vaporization chamber (2a),
   - the water content of said water solution being vaporized into vapor, which is released, possibly after condensation into water, to an ambient system, and
   - the vaporization process is stopped at a certain time at which the remaining water solution is removed from said at least one reusable vaporization chamber for handling as waste,
   - **c h a r a c t e r I z e d in that**
   - said certain time is adjusted so that the water content in said vaporization chamber (2a) is reduced, in a first vaporization process, by 30% to 95%, and the remaining water content is 70% to 5% of the initial water content, the remaining water content being high enough to cause only minor deposits in said at least one vaporization chamber,
   - said remaining water solution, at said certain time, is transferred from said at least one reusable vaporization chamber into at least one separate waste container (6),
   - whereupon said remaining water solution in said at least one waste container is subjected to at least one further, final water-reducing process , where the water content in said at least one waste container is further reduced by 10% to 100%,
   - the combined water-reduction in said first and final water-reducing processes being such as to leave a final water content in said at least one waste container (6) of 10% to 0% of the initial water content of said water solution containing environmentally hazardous substances,

- and the remaining waste in said at least one waste container (6), including said environmentally hazardous substances, is left in said at least one waste container for separate handling and possible destruction.

2. A method as defined in claim 1, wherein, in said first vaporisation process in said at least one reusable vaporisation chamber (2a), the water content is reduced by 50% to 95%, so that the remaining water content is 50% to 5% of the initial water content.

3. A method as defined in claims 1 or 2, wherein, in said final water-reducing process in said at least one waste container (6), the water content is further reduced by 30% to 100%, the combined water-reduction in said at least one reusable vaporization chamber (2a) and said at least one waste container (6) being such as to leave a final water content in said at least one waste container (6) of 5 to 0% of the initial water content in said at least one reusable vaporization chamber (2a).

4. A method as defined in any one of the preceding claims, wherein, in said further water-reducing process in said at least one waste container (6), the remaining water solution (waste) is heated.

5. A method as defined in any one of the preceding claims, wherein, in said further water-reducing process in said at least one waste container (6), the remaining water solution is boiled.

6. A method as defined in any one of the previous claims, wherein, in said further water-reducing process in said at least one waste container (6), vaporization is enhanced by applying a pressure lower than the ambient air pressure in said at least one waste container.

7. A method as defined in any one of the previous claims, wherein, in said further water-reducing process in said at least one waste container (6), vaporization is enhanced by feeding a gas into said at least one waste container.

8. A method as defined in any one of the preceding claims, wherein said water solution contains at least cells, a growth medium, and one or more of said environmentally hazardous substances such as antibiotics.

9. A method as defined in any one of the claims 1 to 7, wherein said water solution comprises urine with one or more dissolved antibiotics and/or one or more antibiotic residues.

10. An evaporator apparatus (1-6, V1-V6) for vaporization of a water solution containing environmentally hazardous substances and leaving a limited amount of waste for special handling and possible destruction, said apparatus comprising a

- a liquid receiving unit (1) for receiving said water solution,
- at least one reusable vaporization chamber (2a) for heating said water solution so as to vaporize water from said water solution,
- a vapor evacuation unit (3), and
- a vapor releasing unit (4) which is connectable to an ambient system for releasing vapor or condensed water from the vaporization process,

characterized in that said apparatus also comprises:

- at least one waste container (6), which is connectable to said at least one vaporization chamber (2a) for receiving a remaining amount of said water solution after vaporizing 30% to 95% of the water content of an initial amount of said water solution being fed into said liquid receiving unit, and
- said at least one waste container (6) being adapted to be subjected to a further water-reducing processing of said remaining amount of water solution, so as to leave a final remaining water content of 10% to 0% of said initial amount in said at least one waste container (6) for special handling and possible destruction.

11. An evaporator apparatus as defined in claim 10, wherein said apparatus also comprises a pump (5) for reducing the pressure below the atmospheric pressure in said at least one reusable vaporization chamber (2a).

12. An evaporator apparatus as defined in claim 11, wherein said pump (5) is connectable for reducing the pressure below the atmospheric pressure in said at least one waste container (6).

13. An evaporator apparatus as defined in any one of claims 10 to 12, wherein a separate heating device (6a) is arranged to heat the contents in said at least one waste container (6).

14. An evaporator apparatus as defined in any one of claims 10-13, wherein said at least one waste container (6) is provided with a gas inlet (6g) for feeding gas into said at least one waste container (6).

15. An evaporator apparatus as defined in any one of claims 10-14, wherein a level sensor (2l, 6l) is disposed in at least one of said at least one reusable vaporization chamber (2a) and said at least one waste container (6).

Ansökningsnummer / Patent application No: 1551412-8

I följande bilaga finns en översättning av patentkraven till svenska. Observera att det är patentkravens lydelse på engelska som gäller.

A Swedish translation of the patent claims is enclosed. Please note that only the English claims have legal effect.

PATENTKRAV

1. Sätt att minska mängden avfall i en process som innefattar evaporering i en evaporeringsapparat (1-6, V1-V6) av en vattenlösning som innehåller miljöfarliga substanser, varvid
   - en betydande mängd av vatteninnehållet i nämnda vattenlösning evaporeras i minst en återanvändbar evaporeringskammare (2a) i en första evaporeringsprocess,
   - varvid vatteninnehållet i nämnda vattenlösning evaporeras till ånga, som överförs, eventuellt efter kondensering till vatten, till ett omgivande system, och
   - evaporeringsprocessen avslutas vid en tidpunkt vid vilken den kvarvarande vattenlösningen bortförs från nämnda minst en återanvändbar evaporeringskammare för ytterligare behandling,
   - **kännetecknat av att**
   - nämnda tidpunkt väljes så att vatteninnehållet i nämnda minst en återanvändbar kammare (2a) minskas under nämnda första evaporeringsprocess med 30% till 95%, och den kvarvarande vattenhalten är 70% till 5% av den ursprungliga vattenhalten, varvid den kvarvarande vattenhalten säkerställer endast smärre avlagringar i nämnda minst en evaporeringskammare,
   - varvid den kvarvarande vattenlösningen vid nämnda tidpunkt överföres från nämnda minst en återanvändbar evaporeringskammare till minst en separat avfallsisoleringsbehållare (6),
   - varpå nämnda kvarvarande vattenlösning i nämnda minst en avfallsisoleringsbehållare undergår minst en ytterligare vattenreduceringsprocess genom uppvärmning av den kvarvarande vattenlösningen i nämnda avfallsisoleringsbehållare, varvid vattenhalten i nämnda minst en avfallsisoleringsbehållare minskas ytterligare med 10% till 100%,
   - varvid den sammanlagda vattenminskningen i nämnda första och andra vattenreducerande processer är sådan att man uppnår en slutlig vattenhalt i nämnda minst en avfallsisoleringsbehållare (6) på 10% till 0% av den ursprungliga vattenhalten i nämnda vattenlösning som innehåller miljöfarliga substanser,
   - varvid det kvarvarande avfallet i nämnda minst en avfallsisoleringsbehållare (6) inklusive nämnda miljöfarliga substanser, kvarhålles i nämnda minst en avfallsisoleringsbehållare, och

- nämnda vattenisoleringsbehållare bortföres från evaporeringsapparaten då det kvarvarande avfallet har nått en specificerad nivå däri, för efterföljande hantering som avfall.

2. Sätt enligt krav 1, varvid vattenhalten, i nämnda första evaporeringsprocess i nämnda minst en återanvändbar evaporeringskammare (2a), minskas med 50% till 95%, så att den kvarvarande vattenhalten är 50% till 5% av den ursprungliga vattenhalten.

3. Sätt enligt krav 1 eller 2, varvid i nämnda slutliga vattenminskningsprocess i nämnda minst en avfallsisoleringsbehållare (6), vattenhalten minskas ytterligare med 30% till 100%, varvid den kombinerade vattenminskningen i nämnda minst en återanvändbar evaporeringskammare (2a) och nämnda minst en avfallsisoleringsbehållare (6) är sådan, att det återstår en slutlig vattenhalt i nämnda minst en avfallsisoleringsbehållare (6) på 5% till 0% av den ursprungliga vattenhalten i nämnda minst en återanvändbar evaporeringskammare (2a).

4. Sätt enligt något av föregående krav, varvid i nämnda ytterligare vattenminskningsprocess i nämnda minst en avfallsisoleringsbehållare (6), den kvarvarande vattenlösningen kokas.

5. Sätt enligt något av föregående krav, varvid i nämnda ytterligare vattenreduceringsprocess i nämnda minst en avfallsisoleringsbehållare (6), evaporeringen underlättas genom påläggning av ett tryck som är lägre än det omgivande lufttrycket i nämnda minst en avfallsisoleringsbehållare.

6. Sätt enligt något av föregående krav, varvid i nämnda ytterligare vattenreduceringsprocess i nämnda minst en avfallsisoleringsbehållare (6), evaporeringen underlättas genom tillförsel av en gas i nämnda minst en avfallsisoleringsbehållare.

7. Sätt enligt något av föregående krav, varvid nämnda vattenlösning innehåller åtminstone celler, ett tillväxtbefrämjande medel och en eller flera miljöfarliga substanser, såsom antibiotika.

8. Sätt enligt något av kraven 1-6, varvid nämnda vattenlösning omfattar urin med en eller flera lösta antibiotika och/eller en eller flera antibiotikarester.

9. Evaporeringsapparat (1-6, V1-V6) för evaporering av en vattenlösning som innehåller farliga substanser och minskning av den mängd som skall hanteras som avfall, vilken apparat omfattar

- en vätskemottagande enhet (1) för mottagning av nämnda vattenlösning,

- minst en återanvändningsbar evaporeringskammare (2a) för upphettning av vattenlösningen för evaporering av vattnet från nämnda vattenlösning,

- en ångevakueringsenhet (3), och

- ångbortförselenhet (4), som är ansluten till ett omgivande system för mottagning av ånga eller kondenserat vatten från evaporeringsprocessen,

k ä n n e t e c k n a d av att

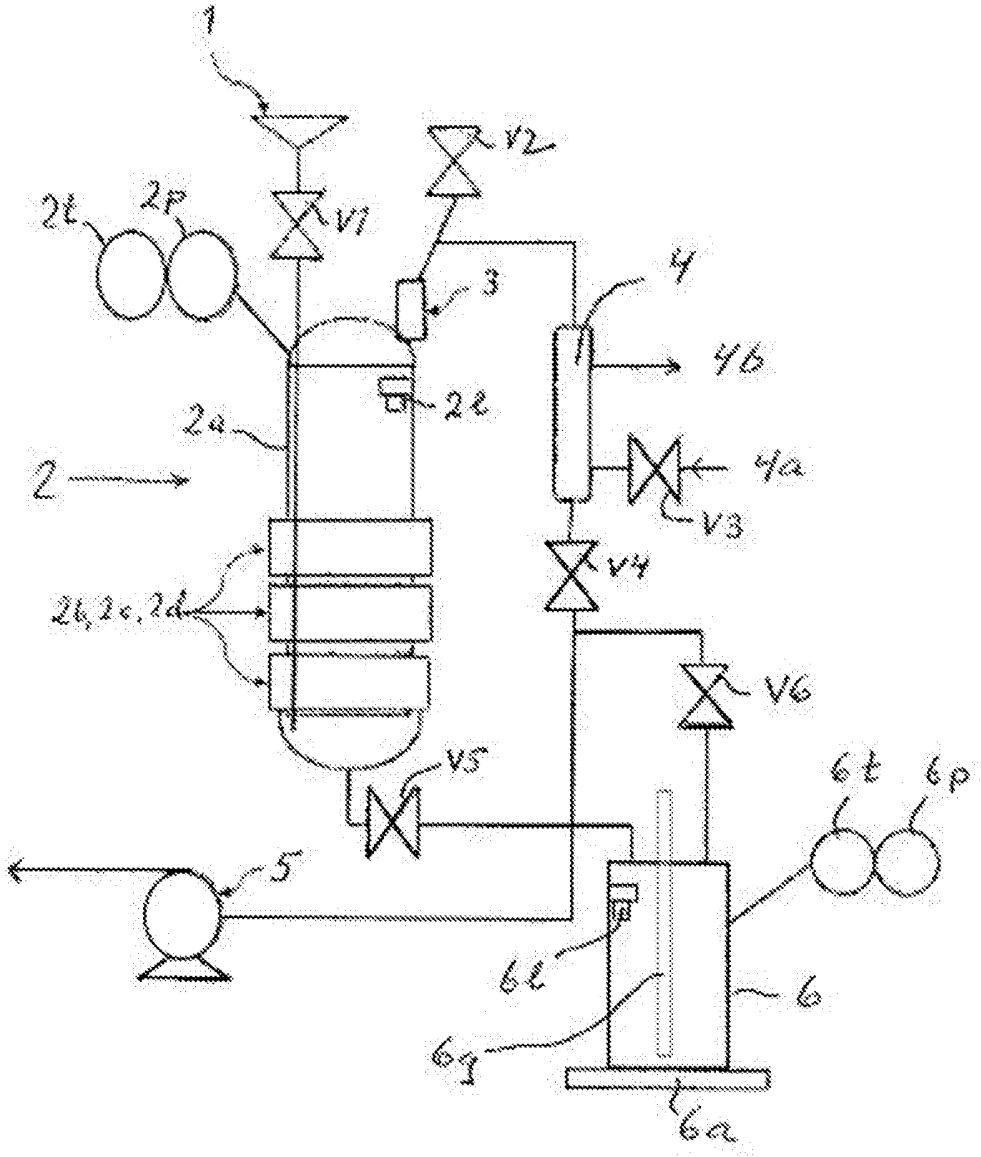
- evaporeringsapparaten innefattar minst en avfallsisoleringsbehållare (6),
- varvid nämnda minst en avfallsisoleringsbehållare (6) är ansluten till nämnda minst en återanvändbar evaporeringskammare (2a),
- varvid nämnda minst en avfallsisoleringsbehållare är försedd med en separat upphettningsanordning (6a) anordnad att utsätta den kvarvarande mängden av vattenlösning i nämnda avfallsisoleringsbehållare för minst en ytterligare upphettnings- och vattenreducerande process, och att isolera en slutlig kvarvarande mängd vattenlösning däri såsom mer koncentrerat material, innefattande nämnda miljöfarliga substanser och eventuella avlagringar som bildats på dess väggar, och
- nämnda minst en avfallsisoleringsbehållare även är försedd med en nivåavkännare (6l) för avkänning när avfallet däri har nått en viss nivå, vid vilken tidpunkt avfallsisoleringsbehållaren anses vara full och ersättes, så att nämnda avfallsisoleringsbehållare med sitt isolerade material kan hanteras som avfall.

10. Evaporeringsapparat enligt krav 9, varvid nämnda apparat även innefattar en pump (5) för reduktion av trycket under atmosfärstryck i nämnda minst en återanvändbar evaporeringskammare (2a).

11. Evaporeringsapparat enligt krav 10, varvid nämnda pump (5) för minskning av trycket under atmosfärstrycket användes även för nämnda minst en avfallsisoleringsbehållare (6).

12. Evaporeringsapparat enligt något av kraven 9-11, varvid nämnda minst en avfallsisoleringsbehållare (6) är försedd med ett gasinlopp (6g) för införande av gas i nämnda minst en avfallsisoleringsbehållare (6).

13. Evaporeringsapparat enligt något av kraven 9-12, varvid en nivåavkännare (2l) också är anordnad i nämnda minst en återanvändbar evaporeringskammare (2a).


1
V2
2t
2P
V1
3
4
4b
2d
2a
4a
2
V3
V4
2b,2c,2d
V6
V5
6t
6p
5
6c
6
6g
6a