

CLAIMS

1. A dialysate regenerator (100), comprising:
 - a purification means (110);
 - at least one reversible retainer (120) comprising an ion reservoir;
 - a dialysate flow path comprising a dialysate inlet (130) for receiving a dialysate, and a dialysate outlet (140) for dispensing the dialysate;
 - a pump (150) connected to the dialysate flow path and configured to generate a flow of the dialysate from the dialysate inlet (130) via the reversible retainer and the purification means to the dialysate outlet (140),
 - wherein a direction of the dialysate flow path through the reversible retainer (120) is reversible.
2. The dialysate regenerator (100) of claim 1, wherein the ion reservoir comprises an ion exchanger.
3. The dialysate regenerator (100) of claim 1 or claim 2, wherein the dialysate regenerator (100) comprises a volume control means (115) configured to direct a predetermined volume of the dialysate from the dialysate inlet (130) via the reversible retainer and the purification means (110) to the dialysate outlet (140).
4. The dialysate regenerator (100) of claim 2 or claim 3, wherein the ion exchanger is in the form of particles, granules, beads, fabric, membrane, or a combination thereof.
5. The dialysate regenerator (100) of any of claims 2 to 4, wherein the ion exchanger is a reversible ion exchanger capable of retaining and releasing ions.
6. The dialysate regenerator (100) of any of claims 2 to 5, wherein the ion exchanger is an amphoteric ion exchanger.

7. The dialysate regenerator (100) of any of claims 2 to 6, wherein the ion exchanger changes from being predominantly an anion exchanger at a pH value of below 5 to predominantly a cation exchanger at a pH value of above 8.
8. The dialysate regenerator (100) of any of claims 2 to 7, wherein the ion exchanger is hydrous zirconium oxide (HZO).
9. The dialysate regenerator (100) of any of claims 2 to 8, wherein the ion exchanger is present in a quantity of less than about 50 gram for each of the at least one reversible retainer.
10. The dialysate regenerator (100) of any of claims 2 to 9, wherein the ion exchanger has an average particle size in the range of about 25, or about 50 micrometer to about 100 micrometer.
11. The dialysate regenerator (100) of any of claims 2 to 10, wherein the ion exchanger in a pristine state comprises essential ions.
12. The dialysate regenerator (100) of any of claims 2 to 11, wherein the ion exchanger is embedded in a filter pad and/or an additional sorbent bed.
13. The dialysate regenerator (100) of any of claims 1 to 12, wherein the at least one reversible retainer (120) is positioned upstream of the purification means (110) in a first direction of the dialysate flow path and positioned downstream of the purification means (110) in a second direction of the dialysate flow path, wherein the second direction of the dialysate flow path through the reversible retainer (120) is reverse to the first direction of the dialysate flow path through the reversible retainer (120).
14. The dialysate regenerator of any one of claims 1 to 13, wherein the dialysate regenerator (100) comprises one or more valves for alternating the direction of the dialysate flow path through the reversible retainer (120) between a first direction and a second direction, the second direction being reverse to the first direction.

15. The dialysate regenerator (100) of any of claims 1 to 14, wherein the reversible retainer (120) is configured to decrease the pH of a dialysate upstream of the purification means (110) by retaining ions from the dialysate.
16. The dialysate regenerator (100) of any of claims 1 to 15, wherein the reversible retainer (120) is configured to increase the pH of a dialysate downstream of the purification means (110) by releasing ions into the dialysate.
17. The dialysate regenerator of any one of claims 1 to 16, wherein the dialysate regenerator (100) comprises a pressure sensor (PS1).
18. The dialysate regenerator (100) of any of claims 1 to 17, wherein the dialysate regenerator (100) comprises one reversible retainer (120) positioned upstream of the purification means (110) in a first direction of the dialysate flow path through the reversible retainer (120) and the same reversible retainer (120) positioned downstream of the purification means (110) in a second direction of the dialysate flow path, wherein the second direction of the dialysate flow path through the reversible retainer (120) is reverse to the first direction of the dialysate flow path through the reversible retainer (120).
19. The dialysate regenerator of any of claims 1 to 18, wherein the dialysate regenerator comprises a temporary storage volume (180).
20. The dialysate regenerator of claim 19, wherein the dialysate regenerator (100) comprises one or more valves for alternating the dialysate flow path between
a first flow phase from the dialysate inlet (130) to the temporary storage volume (180) via the reversible retainer (120); and
a second flow phase from the temporary storage volume (180) to the dialysate outlet (140) via the purification means (110) and the reversible retainer (120), wherein a direction of the dialysate flow path through the reversible retainer (120) in the second flow phase is reverse to the direction of the dialysate flow path through the reversible retainers in the first flow phase.

21. The dialysate regenerator (100) of any of claims 1 to 17, wherein the dialysate regenerator (100) comprises a first reversible retainer (120A) upstream of the purification means (110) and a second reversible retainer (120B) downstream of the purification means (110).
22. The dialysate regenerator of claim 21, wherein the dialysate regenerator (100) comprises a volume control means (115) configured to direct a predetermined volume of the dialysate from the dialysate inlet (130) via the reversible retainer (120) and the purification means (110) to the dialysate outlet (140), wherein the volume control means (115) comprises a fluid portioning system (160) to divide a dialysate flow into uniform portions for sequential regeneration.
23. The dialysate regenerator of claim 21 or claim 22, wherein the dialysate regenerator (100) comprises one or more valves for alternating the dialysate flow path between the dialysate inlet (130) and the dialysate outlet (140) in a first state via the reversible retainer (120A), the purification means (110), the reversible retainer (120B) and in a second state via the reversible retainer (120B), the purification means (110), the reversible retainer (120A), wherein a direction of the dialysate flow path through the reversible retainers (120A, 120B) in the second state is reverse to the direction of the dialysate flow path through the reversible retainers (120A, 120B) in the first state.
24. The dialysate regenerator of claim 23, wherein the one or more valves are synchronized and alternate the dialysate flow path between the first and second state upon a pressure change detected by the pressure sensor (PS1).
25. The dialysate regenerator of any one of claims 1 to 24, wherein the dialysate regenerator (100) comprises a flow adjuster (165), optionally comprising a pressure sensor (PS2).
26. Use of an ion reservoir in the manufacture of a dialysate regenerator (100) comprising said ion reservoir comprised in at least one reversible retainer (120) for the treatment of a patient suffering from renal insufficiency with abnormally high levels of one or more toxins,

said treatment comprising moving a dialysate of the patient through a dialysate flow path including a dialysate inlet for receiving a dialysate by action of a pump (150), a dialysate outlet (140) for dispensing the dialysate, and a purification means (110), wherein a flow of the dialysate is generated from the dialysate inlet (130) via the reversible retainer (120) and the purification means (110) to the dialysate outlet (140), wherein a direction of the dialysate flow path through the reversible retainer (120) is reversible.

27. A dialysis device (200) comprising the dialysate regenerator (100) of any of claims 1 to 25.