

WHAT IS CLAIMED IS:

1. A treatment system, comprising:
 - a precipitation unit configured to treat a solution using one or more miscible organic solvents to produce a mixture of precipitate solids and a liquid;
 - a solid-liquid separation unit configured to receive the mixture of precipitate solids and liquid from the precipitation unit and to discharge a solids reduced liquid stream;
 - a recovery unit configured to receive the liquid stream from the solid-liquid separation unit and to facilitate separating the liquid stream at least into an organic phase liquid and an aqueous phase liquid comprising a portion of the one or more miscible organic solvents;
 - a purification unit comprising one or more membrane devices configured to receive the aqueous phase liquid comprising a portion of the one or more miscible organic solvents from the recovery unit and to separate at least a portion of the one or more miscible organic solvents from the aqueous phase liquid comprising a portion of the one or more miscible organic solvents; and,
 - a plurality of heat-exchanging devices at least disposed between the precipitation unit and the recovery unit and between the recovery unit and the purification unit.
2. The treatment system of claim 1, wherein the solution comprise a saline solution.
3. The treatment system of claim 1, wherein the precipitation unit comprises an organic solvent source and a precipitation device in fluid communication with the organic solvent source, and wherein the organic solvent source is configured to provide the one or more miscible organic solvents into the precipitation device, and the precipitation device is configured to accommodate the one or more miscible organic solvents and the solution for the precipitation of the precipitate solids.
4. The treatment system of claim 1, wherein the one or more membrane devices comprises one or more of one or more reverse osmosis devices, one or more nanofiltration devices, and one or more membrane distillation devices.

5. The treatment system of claim 4, wherein the one or more membrane devices comprise the one or more reverse osmosis devices.

6. The treatment system of claim 1, wherein the purification unit further comprises an ionization source configured to provide one or more ionization materials to ionize at least a portion of the one or more organic solvents in the aqueous phase liquid so that at least a portion of the one or more ionized organic solvents are removed using the one or more membrane devices.

7. The treatment system of claim 6, wherein the ionization source comprises a pH adjustment source configured to provide one or more pH adjustment materials to adjust pH values of the aqueous phase liquid so as to ionize at least the portion of the one or more residual miscible organic solvents.

8. The treatment system of claim 1, further comprising a pretreatment unit disposed upstream from and in fluid communication with the precipitation unit, and configured to remove one or more ion species in the solution.

9. A treatment system, comprising:
a precipitation unit configured to treat a solution using one or more miscible organic solvents to produce a mixture of precipitate solids and a liquid;
a recovery unit in fluid communication with the precipitation unit and configured to facilitate separating the liquid at least into an organic phase liquid and an aqueous phase liquid comprising a portion of the one or more miscible organic solvents;
a purification unit comprising an ionization source and a removal device in fluid communication with the recovery unit, wherein the ionization source is configured to provide one or more ionization materials to ionize at least a portion of the one or more organic solvents in the aqueous phase liquid, and the removal device is configured to receive the aqueous phase liquid to separate at least a portion of the one or more ionized residual miscible organic solvents from the aqueous phase liquid; and,
a plurality of heat-exchanging devices at least disposed between the precipitation unit and the recovery unit and between the recovery unit and the purification unit.

10. The treatment system of claim 9, wherein the precipitation unit comprises an organic solvent source and a precipitation device in fluid communication with the organic solvent source, and wherein the organic solvent source is configured to provide the one or more miscible organic solvents into the precipitation device, and the precipitation device is configured to accommodate the one or more miscible organic solvents and the solution for the precipitation of the precipitate solids.

11. The treatment, system of claim 9, wherein the one or more miscible organic solvents comprises one or more of isopropylamine, propylamine, acetone, methanol, ethanol, acetonitrile, diisopropylamine, tetrahydrofuran, tetrahydropyrimidine, N-methyltetrahydropyrimidine and dioxane.

12. The treatment system of claim 9, wherein the removal device comprises one or more ion removal devices, and wherein the one or more ion removal devices comprises one or more of one or more reverse osmosis devices, one or more electrodialysis reversal devices, one or more ion exchange resins, one or more membrane distillation devices, and one or more supercapacitor desalination devices.

13. The treatment system of claim 12, wherein the one or more ion removal devices comprises one or more of the one or more reverse osmosis devices and the one or more membrane distillation devices.

14. The treatment system of claim 9, wherein the ionization source comprises a pH adjustment source configured to provide one or more pH adjustment materials to adjust pH values of the aqueous phase liquid so as to ionize at least the portion of the one or more organic solvents residual in the aqueous phase liquid.

15. The treatment system of claim 14, wherein one or more pH adjustment materials comprise one or more of hydrochloric acid and sulphuric acid.

16. The treatment system of claim 9, further comprising a pretreatment unit disposed upstream from and in fluid communication with the precipitation unit, and configured to precipitate one or more ion species in the solution.

17. The treatment system of claim 9, wherein the solution comprises fracturing water.

18. A treatment process, comprising:
treating a solution using one or more miscible organic solvents to produce a mixture of precipitate solids and a liquid;
heating the liquid to a temperature effective to cause the liquid to separate into co-existing liquid layers including at least an organic phase liquid in one liquid layer and an aqueous phase liquid comprising a portion of the one or more miscible organic solvents in another liquid layer with a liquid-liquid interface between the organic phase liquid layer and the aqueous phase liquid layer; and
introducing the aqueous phase liquid into a purification unit to separate at least a portion of the one or more miscible organic solvents in the aqueous phase liquid from the aqueous phase liquid.

19. The treatment process of claim 18, wherein the one or more miscible organic solvents comprises one or more of isopropylamine, propylamine, acetone, methanol, ethanol, acetonitrile, diisopropylamine, tetrahydrofuran tetrahydropyrimidine, N-methyltetrahydropyrimidine and dioxane.

20. The treatment process of claim 18, further comprising introducing one or more ionization materials into the aqueous liquid to ionize at least a portion of the one or more miscible organic solvents in the aqueous liquid so that at least a portion of the one or more ionized organic solvents are removed using the one or more of one or more membrane devices and one or more ion removal devices.

21. The treatment process of claim 20, wherein the one or more ionization materials comprise one or more pH adjustment materials to adjust pH values of the aqueous phase liquid so as to ionize at least the portion of the one or more organic solvents in the aqueous phase liquid.

22. The treatment process of claim 21, wherein the one or more pH adjustment materials comprise one or more of hydrochloric acid and sulphuric acid.

23. The treatment process of claim 18, wherein one or more of one or more reverse osmosis devices, one or more electrodialysis reversal devices, one or more membrane distillation devices, one or more nanofiltration devices, one or more ion exchange resins, and one or more supercapacitor desalination devices are employed to separate at least the portion of the one or more miscible organic solvents residual in the aqueous phase liquid from the aqueous phase liquid.

24. The treatment process of claim 18, further pretreating the solution to reduce concentrations of one or more ion species in the solution before the solution is treated using the one or more miscible organic solvents.