CLAIMS

1. A system for recovering ammonia from an aqueous solution, comprising:

a plurality of modules arranged in series, each module comprising a plurality of membranes, each membrane having a lumen side and a shell side,

the plurality of modules comprising a lead module having a shell inlet fluidly connected to a source of the aqueous solution comprising ammonia, a shell outlet, a lumen inlet, and a lumen outlet,

the plurality of modules comprising an end module having a lumen inlet fluidly connected to a source of an acidic solution, a lumen outlet, a shell inlet, and a shell outlet,

the shell outlet of the lead module being fluidly connected to the shell inlet of the end module, and the lumen outlet of the end module being fluidly connected to the lumen inlet of the lead module.

2. The system of claim 1, further comprising at least one intermediate module having a shell inlet, a shell outlet, a lumen inlet, and a lumen outlet, the shell inlet of the intermediate module being fluidly connected to the shell outlet of the lead module, the shell outlet of the intermediate module being fluidly connected to the shell inlet of the end module, the lumen inlet of the intermediate module being fluidly connected to the lumen outlet of the end module, and the lumen outlet of the intermediate module fluidly connected to the lumen inlet of the lead module.

3. The system of claim 1, wherein the aqueous solution is substantially homogeneous.

4. The system of claim 3, further comprising a temperature control subsystem configured to control temperature of the aqueous solution.

5. The system of claim 3, further comprising at least one sensor configured to measure at least one property of the aqueous solution selected from temperature pH, ammonia concentration, or concentration of a contaminant.

6. The system of claim 6, wherein the lumen outlet of the lead module is fluidly connected to a reservoir comprising the source of the acidic solution by a return conduit.

7. The system of claim 6, wherein the reservoir comprises an inlet fluidly connectable to a source of an acid and a discharge outlet.

8. The system of claim 7, further comprising at least one sensor configured to measure at least one property of the acidic solution selected from temperature, pH, density, specific gravity, conductivity, ammonia concentration, concentration of the acid, or ionic concentration.

9. The system of claim 7, further comprising a pH control subsystem configured to control pH of the acidic solution.

10. The system of claim 1, further comprising a flow control subsystem configured to control flow rate of the aqueous solution.

11. The system of claim 1, further comprising a flow control subsystem configured to control flow rate of the acidic solution.

12. The system of claim 1, wherein the plurality of membranes are hydrophobic and the module is operable at a temperature of 120ºF – 150ºF.

13. A system for recovering ammonia from an aqueous solution, comprising:

a plurality of rows arranged in parallel, each row comprising a plurality of modules arranged in series, each module comprising a plurality of membranes, each membrane having a lumen side and a shell side,

each lead module of the row having a shell inlet fluidly connected to a source of the aqueous solution comprising ammonia, a lumen inlet, a shell outlet, and a lumen outlet,

each end module of the row having a lumen inlet fluidly connected to a source of an acidic solution, a lumen outlet fluidly connected to the lumen inlet of the corresponding lead module, a shell inlet fluidly connected to the shell outlet of the corresponding lead module, and a shell outlet,

the lumen outlet of each lead module being fluidly connected to the source of the acidic solution by a return conduit.

14. The system of claim 13, wherein each row further comprises at least one intermediate module having a shell inlet, a shell outlet, a lumen inlet, and a lumen outlet, the shell inlet of the intermediate module being fluidly connected to the shell outlet of the corresponding lead module, the shell outlet of the intermediate module being fluidly connected to the shell inlet of the corresponding end module, the lumen inlet of the intermediate module being fluidly connected to the lumen outlet of the corresponding end module, and the lumen outlet of the intermediate module being fluidly connected to the lumen inlet of the corresponding lead module.

15. The system of claim 13, further comprising a pH control subsystem configured to control pH of the acidic solution.

16. The system of claim 13, further comprising at least one flow control subsystem configured to control flow rate of the acidic solution and/or the source of the aqueous solution.

17. The system of claim 13, further comprising a temperature control subsystem configured to control temperature of the aqueous solution.