CLAIMS

1. Method for preparing an acid block anion selective polymeric membrane having a woven or non-woven cloth reinforcing structure, the polymer of said membrane prepared by the process comprising copolymerizing components (I) an ethylenically unsaturated aliphatic or aromatic tertiary or quaternary amine monomer, (II) a cross linking monomer, and (III) vinylbenzyl chloride, in the presence of a free radical polymerization initiator.

2. Method as recited in claim 1 wherein the molar ratio of components I:I:III is from about 20-60:30-70:1-19 with said I, II and III equating 100 molar percent.

3. Method as recited in claim 2 wherein the molar ratio of components I:II:III is from about 35-45:45-55:10-15.

4. Method as recited in claim 1 said copolymerization is conducted in the absence of non-polymerizable solvent.

5. Method as recited in claim 1 wherein said component (I) comprises an ethylenically unsaturated aliphatic tertiary amine.

6. Method as recited in claim 1 wherein said component (I) comprises an ethylenically unsaturated aromatic tertiary amine.

7. Method as recited in claim 5 wherein said component I comprises a member selected from the group consisting of DMAEMA and DMAPMA.

8. Method as recited in claim 6 wherein said component I is vinyl pyridine.

9. Method as recited in claim 7 wherein said initiator (IV) comprises a peroxide initiator.

10. Method as recited in claim 7 wherein said cross linking monomer comprises a member selected from the group consisting of DVB and EGDM.

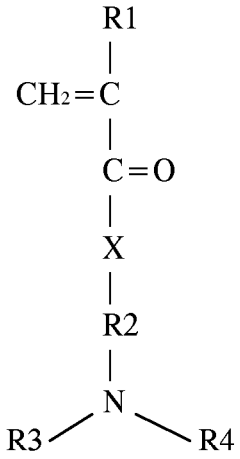
11. Method as recited in claim 10 wherein said cloth comprises a member selected from the group consisting of polypropylene woven cloth, polyester woven cloth and polyacrylic woven cloth, said membrane having a water content % of from about 12-20 wt% and a resistance R ohm- cm^2 of about 50-100 measured in 0.01N NaCl solution at 1,000 Hz.

12. Method as recited in claim 10 wherein said cloth comprises a member selected from the group consisting of polypropylene woven cloth, polyester woven cloth, polyester woven cloth, and polyacrylic woven cloth, and modacrylic woven cloth, said membrane exhibiting a current efficiency of greater than about 93%.

13. An anionic exchange membrane of the type used in an electrodialysis apparatus, comprising a woven or non-woven cloth, said cloth impregnated with a copolymer comprising the reaction product of components (I), (II), and (III) wherein (I) is an ethylenically unsaturated aliphatic or aromatic tertiary or quaternary amine monomer, (II) a cross linking monomer, and (III) vinyl benzyl chloride.

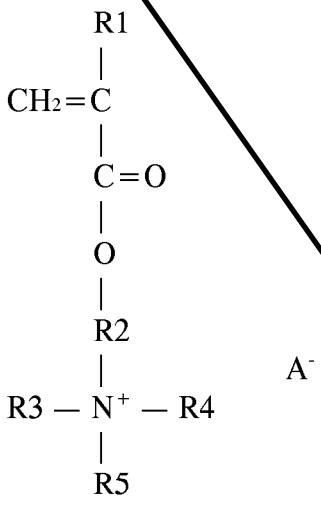
14. Anionic exchange membrane as recited in claim 13 wherein said component (I) is chosen from the Formula A-D wherein

Formula A - aliphatic tert-amine



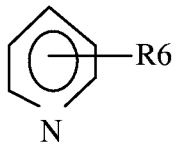
wherein R1 is H or CH_3, X is O or NH_2, R2 is lower alkyl (C_1-C_6) alkylene and R3 and R4 are independently chosen from lower (C_1-C_6) alkyl.

Formula B – aliphatic quaternary amine



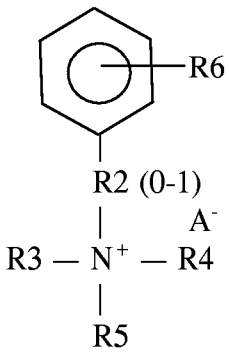
wherein R1, R2, R3, and R4 are as defined in Formula A; R5 is chosen from lower (C_1-C_6) alkyl, and A is an anion chosen from halo and $MeSO_4^-$.

Formula C – aromatic tertiary amine



wherein R6 is vinyl.

Formula D



wherein R6 is the same as in Formula C, R2, when present, is the same as in Formula A; R3, R4, and R5 are the same as in Formula B and A^- is the same as defined in Formula B.

15. Anionic exchange membrane as recited in claim 14 wherein the molar ratio of components I:II:III is from about 20-60:30-70:1-19% with the foregoing percentages adding up to 100%.

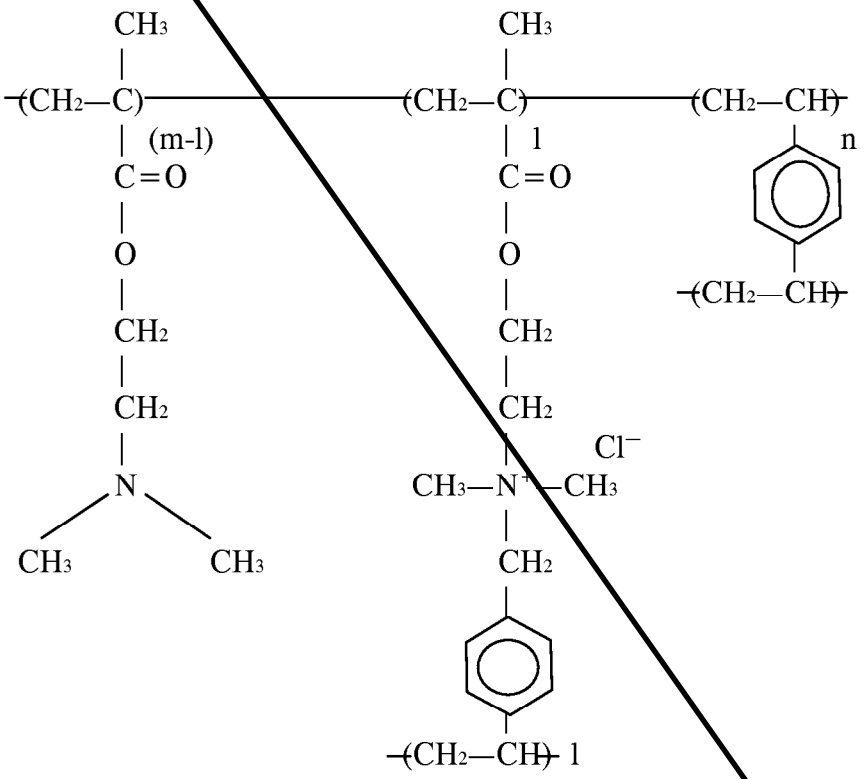
16. Anionic exchange membrane as recited in claim 15 wherein the molar ratio of components I:II:III is from about 35-45:45-55%:10-15%.

17. Anionic exchange membrane as recited in claim 15 wherein the molar ratio of components I:II:III is about 37-40%, 48-50%, 12-13%.

18. Anionic exchange membrane as recited in claim 16 wherein said component (I) comprises a member selected from the group consisting of DMAEMA and DMAPMA, said membrane characterized by having a current efficiency of greater than 93%.

19. Anionic exchange membrane as recited in claim 18 wherein cross linking monomer component (II) is a member selected from the group consisting of DVB and EGDM.

20. Anionic exchange membrane comprising a polymer reinforced fabric, said polymer having the structure:



CLAIMS

The invention claimed is:

1. Method for preparing an acid block anion selective polymeric membrane having a woven or non-woven cloth reinforcing structure, the polymer of said membrane prepared by the process comprising copolymerizing components (I) an ethylenically unsaturated aliphatic or aromatic tertiary amine monomer, (II) a cross linking monomer, and (III) vinylbenzyl chloride, in the presence of a free radical polymerization initiator, said polymer having a tertiary amine:quaternary amine ratio in meq./per dry gram resin in the range of 1.41-2.86:1, and said membrane having a current efficiency of 93% and greater.

2. Method as recited in claim **1** wherein the molar ratio of components I:II:III is in the ranges of 20-60:30-70:1-19 with said I, II and III equating 100 molar percent.

3. Method as recited in claim **1** said copolymerization is conducted in the absence of non-polymerizable solvent.

4. Method as recited in claim **1** wherein said component (I) consists essentially of an ethylenically unsaturated aliphatic tertiary amine.

5. Method as recited in claim **1** wherein said component (I) consists essentially of an ethylenically unsaturated aromatic tertiary amine.

6. Method as recited in claim **4** wherein said component I comprises a member selected from the group consisting of DMAEMA and DMAPMA.

7. Method as recited in claim **5** wherein said component I is vinyl pyridine.

8. Method as recited in claim **6** wherein said cross linking monomer comprises a member selected from the group consisting of DVB and EGDM.

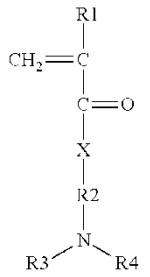
9. Method as recited in claim **8** wherein said cloth comprises a member selected from the group consisting of polypropylene woven cloth, polyester woven cloth and polyacrylic woven cloth, said membrane having a water content % of from about 12-20 wt % and a resistance R of about 50-100 ohm-cm^2 measured in 0.01N NaCl solution at 1,000 Hz.

10. Method as recited in claim **8** wherein said cloth comprises a member selected from the group consisting of polypropylene woven cloth, polyester woven cloth, polyacrylic woven cloth, and modacrylic woven cloth.

11. An anionic exchange membrane used in an electrodialysis apparatus, comprising a woven or non-woven cloth, said cloth impregnated with a copolymer comprising the reaction product of components (I), (II), and (III) wherein (I) is an ethylenically unsaturated aliphatic or aromatic tertiary amine monomer, (II) a cross linking monomer, and (III) vinyl benzyl chloride, said copolymer having a tertiary amine:quaternary amine ratio in meq./per dry gram resin in the range of 1.41-2.86:1, and said membrane having a current efficiency of 93% and greater.

12. Anionic exchange membrane as recited in claim **11** wherein said component (I) is a member selected from the group consisting of Formula A and C

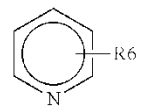
Formula A



aliphatic tert-amine

wherein R1 is H or CH_3, X is O or NH, R2 is lower alkyl (C_1-C_6) alkylene and R3 and R4 are independently chosen from lower (C_1-C_6) alkyl

Formula C



aromatic tertiary amine

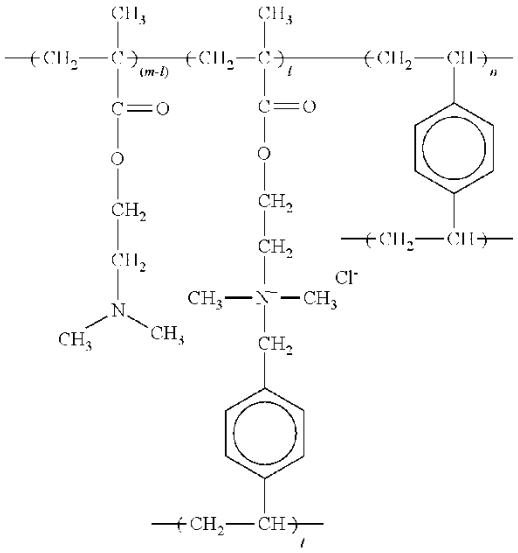
wherein R6 is vinyl.

13. Anionic exchange membrane as recited in claim **12** wherein the molar ratio of components I:II:III is in the ranges of 20-60:30-70:1-19% with the foregoing percentages adding up to 100%.

14. Anionic exchange membrane as recited in claim **13** wherein said component (I) comprises a member selected from the group consisting of DMAEMA and DMAPMA.

15. Anionic exchange membrane as recited in claim **14** wherein cross linking monomer component (II) is a member selected from the group consisting of DVB and EGDM.

16. Anionic exchange membrane comprising a polymer reinforced fabric, said polymer having the structure:



wherein the ratio of (m−1):1 in meq./per dry gram resin is in the range of 1.41-2.86:1.

17. Anion exchange membrane as recited in claim **16** wherein said membrane has a current efficiency of 93% and greater.