Annexe A-II-1.

Liste des demandes de dépôts de brevets européens (European Patents) concernant la pervaporation et la perméation de vapeur pour la période des vingt dernières années (1980 - 1999).

Pervaporation

1. EP 909209A1 :Pervaporization and module for carrying out said process, 1999.
2. EP 944575A1 : Esterification of fermentation-derived acids via pervaporation, 1999.
3. EP 880400A1: Composite membrane with a support membrane made in particular of a microporous material, 1998.
4. EP 765682A1: Apparatus for separating liquid media with two membranes having their primary sides connected by an intermediate space, 1997.
5. EP 811420A1 : Composite membrane for selective separating organic substances by pervaporation, 1997.
6. EP 749351A1 : Device for separating mixtures or for purifying substances by pervaporation, 1996.
7. EP 637990A1: Diaphragm based on graft copolymers, 1995.
8. EP 641593A1 : Pervaporation vessel and method, 1995.
9. EP 652201A1 : Process for the production of concentrated aqueous formaldehyde solutions by pervaporation, 1995.
10. EP 657205A2 : Pervaporation by coutercurrent condensable sweep,1995.
11. EP 669905A1 : Pervaporation separation process of a mixture of methanol and tetrahydofurane, 1995.
12. EP 673671A1: Membrane process for separating fluid mixtures, 1995.
13. EP 674940A2 : Pervaporation membranes and their use, 1995.
14. EP 581831A1 :Control of oxygen level in feed for improved aromatics/non-aromatics pervaporation, 1994.
15. EP 587071A1: Polyelectrolyte membranes, 1994.
16. EP 588840A1: Process for continuously cleaning the auxiliary or working liquid of a compressor, 1994.
17. EP 592706A1: Cellulose ester blend membranes, process for making same and their use, 1994.
18. EP 593011A1: Process for preparing a composite plasma membrane and their use, 1994.
19. EP 610775A1 : Process for separating liquid mixtures having an azeotropic point by combination of pervaporation and distillation, 1994.
20. EP 619756A1 : Pervaporation apparatus and process, 1994.
21. EP 629434A1 : Process for making a microfiltration, ultrafiltration, pervaporation or reverse osmosis membrane for suspensions, emulsions or gas separation, 1994.
22. EP 524242A1 : Membrane separation process for dehydrating a gas or vapour or liquid mixture by pervaporation, vapour permeation or gas separation, 1993.
23. EP 564045A1: Composite membrane, its application and process for the dehydration of organic solvents, 1993.
24. EP 572355A1 : Module for executing the pervaporation of fluids, 1993.
25. EP 484466A1 : Membrane for separating liquid mixtures of substances by pervaporation, 1992.
26. EP 496328A1 : Membrane for a filtration, gas or liquid separation or pervaporation apparatus and method for manufacturing same, 1992.

27. EP 500185A1: A semi permeable composite membrane, a process for the manufacture thereof, as well as application of such membranes for the separation of components in an organic liquid phase or in the vapour phase, 1992.
28. EP 512360A1: Selectively-permeable membranes and the use thereof, 1992.
29. EP 423527A1: Device for the separation of mixtures with stacked membranes spaced from each other, 1991.
30. EP 436128A1 : Composite membranes for separating water from organic compounds containing fluids by pervaporation, 1991.
31. EP 446471A1 : Process for making a microfiltration, ultrafiltration, pervaporation or reverse osmosis membrane for suspensions, emulsions or gas separation, 1991.
32. EP 447467A1 : Collagen film for use as a pervaporation membrane, 1991.
33. EP 457981A1 : Multi stage pervaporation process, 1991.
34. EP 317918A3 : Pervaporation process for separating alcohols from ethers, 1990.
35. EP 361377A2 : Pervaporation method of separating liquid organic compound mixture through aromatic imide polymer asymmetric membrane, 1990.
36. EP 380424A1 : Process for the concentration by pervaporation of an aqueous fluid containing volatile or carrier water vapour-distillable organic compounds, 1990.
37. EP 385119A2 : Mixture components separation and recovery process through evaporation, 1990
38. EP 388354A1 : Composite membrane for gas separation and pervaporation, 1990.
39. EP 398508A1 : A separation membrane for use in a pervaporation process and a separation method thereof, 1990.
40. EP 317918A2 : Pervaporation process for separating alcohols from ethers, 1989.
41. EP 338004A1: Polymer with betaine structure, solution diffusion membrane, process for their manufacture and use, 1989.
42. EP 254758A1 : Pervaporation process and membrane, 1988.
43. EP 264113A1 : Pervaporation of phenols, 1988.
44. EP 214496A2 : Apparatus for separating mixtures by pervaporation, 1987.
45. EP 216181A1 : Pervaporation process, 1987.
46. EP 218019A1 : Pervaporation process, 1987.
47. EP 221171A1: Method for producing solution diffusion membranes, 1987.
48. EP 230737A1 : Membrane pervaporation process for obtaining a chlorine dioxide solution, 1987.
49. EP 240803A2: Process for the sepration of the components of a liquid mixture, 1987.
50. EP 181656A1 : Apparatus for separating mixtures by pervaporation, 1986.
51. EP 135419A2 : Method of membrane evaporation and apparatus, 1985.
52. EP 162964A2: Method for the production of an asymmetric membrane, 1985.
53. EP 118760A2 :Device for the separation of solutions by pervaporation, 1984.
54. EP 94543A2 : Process and device for pervaporation, 1983.
55. EP 95583A2: Membrane stack assembly, 1983.
56. EP 96339A2 : Multilayer membrane and its use in the separation of liquids by pervaporation, 1983.
57. EP 96340A2 : Membrane module and its use in the separation of liquids by pervaporation, 1983.

Perméation de vapeur

1. EP 908219A1: Multi-stage process for the separation /recovery of gases, 1999.
2. EP 824034A2 : Vapor permeation system, 1998.

3. EP 752974A1: Method and devices for reducing emissions from storage-tank breather lines, 1997.
4. EP 753337A2 : Hollow fiber vapor permeation membranes and modules, 1997.
5. EP 761715A1 : Copolyether amide and water vapour permeable film made therefrom, 1997.
6. EP 799790A1 : Gasoline dispensing and vapor recovery system and method utilizing a membrane separator, 1997.
7. EP 701856A1 : Organic and inorganic vapor permeation by countercurrent condensable sweep, 1996.
8. EP 701857A1: Membrane dehydration of vaporous feeds by countercurrent condensable sweep, 1996.
9. EP 729773A2: Process for removing organic vapor from air and technical gases, 1996.
10. EP 637987A1 : Process and device for separating gas mixtures formed above liquids, 1995.
11. EP 637990A1 : Diaphragm based on graft copolymers, 1995.
12. EP 674940A1 : Pervaporation membranes and their use, 1995.
13. EP 592706A1 : Cellulose ester blend membranes, process for making same and their use, 1994.
14. EP 521203A1 : Improved process for recovering organic vapors from air, 1993.
15. EP 532368A2 : Membrane-based removal of condensable vapors, 1993.
16. EP 524242A1 : Membrane separation process for dehydrating a gas or vapour or liquid mixture by pervaporation, vapour permeation or gas separation, 1993.
17. EP 535073A1 : Process for carrying out an equilibrium reaction using vapour permeates, 1993.
18. EP 485393A1: Membrane for extracting unsaturated hydrocarbons and process for obtaining it, 1992.
19. EP 500185A1 : A semipermeable composite membrane, a process for the manufacture thereof, as well as application of such membranes for the separation of components in an organic liquid phase or in the vapour phase, 1992.
20. EP 511687A2 : Process for recovering organic vapors from air, 1992.
21. EP 436128A1 : Composite membranes for separating water from organic compounds containing fluids by pervaporation, 1991.
22. EP 456809A1 : Membrane process for removing water vapor from gas, 1991.
23. EP 308002A1 : Method and membrane for the removal of water vapour from a gas/vapour mixture by means of vapour permeation, 1989.
24. EP 326083A2: Vapor permselective membrane, 1989.
25. EP 329962A2 : Method of separating organic compounds from air/permanent gas mixtures, 1989.
26. EP 291679A1: Method and production of an asymmetric membrane, 1988.
27. EP 171879A2: Process for recovering vapors from air, 1986.
28. EP 50288A1: Process for changing the water content of water absorbing or releasing materials, 1982.

Annexe A-II-2.

Liste des brevets européens (European Patents) sur la pervaporation et la perméation de vapeur pour la période des vingt dernières années (1980 – 1999).

Pervaporation

1. EP 673671B1: Membrane process for separating fluid mixtures, Deutsche Carbone, 1999.
2. EP 587071B1: Process for the preparation of a polyelectrolyte composite membrane, GKSS, 1998.
3. EP 96339B2 : Use of a multilayer membrane in the separation of liquids by pervaporation, Deutsche Carbone, 1998.
4. EP 593011B1: Process for the separation of C1-C3 alcohols from mixtures of these alcohols from other organic liquids, Deutsche Carbone, 1997.
5. EP 657205B1 : Pervaporation by coutercurrent condensable sweep, Bend Research, 1997.
6. EP 674940B1 : Use of a membrane for pervaporation or vapour permeation, Deutsche Carbone, 1997.
7. EP 592706B1: Use of cellulose ester blend membranes, Deutsche Carbone, 1997.
8. EP 423527B1: Device for the separation of mixtures with stacked membranes spaced from each other, GKSS, 1996.
9. EP 564045B1: Composite membrane and its use for the dehydratation of organic solvents or concentrated acetic acid solutions, Deutsche Carbone, 1996.
10. EP 572355B1 : Module for executing the pervaporation of fluids, Krebs & Co., 1996.
11. EP 637990B1: Membrane based on graft copolymers, GKSS, 1996.
12. EP 361377B1 : Pervaporation method of separating liquid organic compound mixture through aromatic imide membrane, Ube Industries, 1995.
13. EP 436128B1 : Composite membranes for separating water from organic compounds containing fluids, Deutsche Carbone, 1995.
14. EP 446471B1 : Process for making a microfiltration, ultrafiltration, pervaporation or reverse osmosis membrane for suspensions, emulsions or gas separation, Altenburger Electronic, 1995.
15. EP 484466B1 : Membrane for separating liquid mixtures of substances by pervaporation, GKSS, 1995.
16. EP 500185B1: A semipermeable composite membrane, a process for the manufacture thereof, as application of such membranes for the separation of components in an organic liquid phase or in a vapour phase, X Flow, 1995.
17. EP 512360B1 : Method for pervaporation by a membrane comprising starch and a synthetic thermoplastic polymer, Novamont, 1995.
18. EP 240803B1: Process for the separation of the components of a liquid-mixture, GKSS, 1994.
19. EP 385119B1 : Mixture components separation and recovery process through evaporation, GKSS, 1994.
20. EP391699B1 : Pervaporation method of selectively separating water from an organic material aqueous solution through aromatic imide polymer asymmetric membrane, Ube Industries, 1994.
21. EP 524242B1 : Membrane separation process for dehydrating a gas or vapour or liquid mixture by pervaporation or vapour permeation, TNO, 1994.

22. EP 588840B1: Apparatus for continuously cleaning the auxiliary or working liquid of a compressor, GKSS, 1994.
23. EP 214496B1 : Apparatus for separating mixtures by pervaporation, Deutsche Carbone, 1993.
24. EP 317918B1 : Pervaporation process for separating alcohols from ethers, Hoechst Celanese Corporation, 1993.
25. EP 338004B1: Polymer with betaine structure, solution diffusion membrane, process for their manufacture and use, GFT, 1993.
26. EP 447467B1 : Collagen film for use as a pervaporation membrane, Naturin GmbH, 1993.
27. EP 254758B1 : Pervaporation process and membrane, GFT, 1991.
28. EP 118760B1 : Device for the separation of solutions by pervaporation, GKSS, 1990.
29. EP 162964B1: Method for the production of an asymmetric membrane, GKSS, 1990
30. EP 221171B1: The use of diffusion membranes, GFT, 1990.
31. EP 216181B1 : Pervaporation process, Starcosa GmbH, 1989.
32. EP 230737B1 : Membrane pervaporation process for obtaining a chlorine dioxide solution, Tenneco Canada, 1989.
33. EP 96339B1 : Multilayer membrane and its use in the separation of liquids by pervaporation, GFT, 1988.
34. EP 181656B1 : Apparatus for separating liquid mixture by pervaporation, Metallgesellschaft, 1988.
35. EP 95583B1: Membrane stack assembly, GKSS, 1987.
36. EP 96340B1 : Membrane module and its use in the separation of liquids by pervaporation, GFT, 1987.
37. EP 94543B1 : Process and device for pervaporation, Akzo GmbH, 1986.

Perméation de vapeur

1. EP 752974B1 : Method and devices for reducing emissions from storage-tank breather lines, GKSS, 1999.
2. EP 908219B1 : Multi-stage process for the separation /recovery of gases, GKSS, 1999.
3. EP 637987B1 : Process and device for separating gas mixtures formed above liquids, GKSS, 1998.
4. EP 592706B1: Use of cellulose ester blend membranes, Deutsche Carbone, 1997.
5. EP674940B1 : Use of a membrane for pervaporation or vapour permeation, Deutsche Carbone, 1997.
6. EP 637990B1: Membrane based on graft copolymers, GKSS, 1996.
7. EP 485393B1 : Membrane for extracting unsaturated hydrocarbons and process for obtaining it, GKSS, 1996.
8. EP 436128B1: Composite membranes for separating water from organic compounds containing fluids, Deutsche Carbone, 1995.
9. EP 500185B1: A semipermeable composite membrane, a process for the manufacture thereof, as application of such membranes for the separation of components in an organic liquid phase or in a vapour phase, X Flow, 1995.
10. EP 535073B1 : Process for carrying out an equilibrium reaction using vapour permeation, Henkel, 1995.
11. EP 326083B1: Vapopermselective membrane, Asahi Glass Company, 1994.
12. EP 329962B1: Method of separating organic compounds from air/permanent gas mixtures, GKSS, 1994.

13. EP 524242B1 : Membrane separation process for dehydrating a gas or vapour or liquid mixture by pervaporation or vapour permeation, TNO, 1994.
14. EP 171879: Process for recovering organic vapors from air, Membrane Technology and Research, 1993.
15. EP 291679B1: Method and production of an asymmetric membrane, GKSS, 1993.
16. EP 308002B1 : Method and membrane for the removal of water vapour from a gas/vapour mixture by means of vapour permeation, TNO, 1992.
17. EP 50288B1 : Use of water vapour permeable polyvinylalcohol sheets, Hoechst, 1985.

Annexe A-II-3.

Liste des brevets américains par les acteurs principaux en pervaporation pour la période des vingt dernières années (1980 – 1999).

Exxon Research and Engineering

1. US 5871650 : Supported zeolite membranes with controlled crystal width and preferred orientation grown on a growth enhancing layer, 1999.
2. US 5849980 : Low alkaline inverted in-situ crystallized zeolite membrane, 1998.
3. US 5756643 : Polyimide copolymers containing polycarbonate soft segments, 1998.
4. US 5670052 : Separating aromatics from non-aromatics by polyimide-polyester membrane, 1997.
5. US 5643442 : Membrane process for enhanced distillate or hydrotreated distillate aromatics reduction, 1997.
6. US 5635055 : Membrane process for increasing conversion of catalytic cracking or thermal cracking units (LAW011), 1997.
7. US 5550199 : Diepoxide crosslinked/esterified polyimide-aliphatic polyester copolymers, 1996.
8. US 5430224 : Supercritical perstraction process, 1995.
9. US 5416259 : Feed pretreatment for pervaporation process, 1995.
10. US 5401891 : Production of polymerization grade dicyclopentadiene, 1995.
11. US 5396019 : Fluorinated polyolefin membranes for aromatics/saturates separation, 1995.
12. US 5302750 : Method for producing n-octadienol from butadiene, 1994.
13. US 5298669 : Perstraction sweep stream for a membrane reactor, 1994.
14. US 5290452 : Crosslinked polyester amide membranes and their use for organic separations, 1994.
15. US 5288818 : Method for separating a water soluble noble metal catalyst from a noble metal catalysed hydroformylation reaction, 1994.
16. US 5288712 : Pervaporation process employing permeate recycle, 1994.
17. US 5275726 : Spiral wound element for separation, 1994 .
18. US 5294344 : Separation of alcohol from alcohol/ether/olefin/non-linear hydrocarbon mixtures using polyester or polyester copolymer membranes, 1994.
19. US 5241039 : Polyimide/aliphatic polyester copolymers without pendent carboxylic acid groups (C-2662), 1993.
20. US 5177296 : Saturated polyesters and crosslinked membranes therefrom for aromatics/saturates separation, 1993.
21. US 5180496 : Unsaturated polyesters and crosslinked membranes therefrom for aromatics/saturates separation, 1993.
22. US 5254795 : Removal of 2-ring aromatics from low boiling streams containing low concentrations of same using membranes, 1993.
23. US 5230801 : Recovery of alcohols from n-paraffins by pervaporation, 1993.
24. US 5221481: Multi-block polymer comprising an ester prepolymer, made by combining epoxy with polyester, chain extended with a compatible second prepolymer, the membrane made therefrom and its use for separations, 1993.
25. US 5215667 : Method for separating water soluble noble metal catalyst from a noble metal catalysed hydroformylation reaction, 1993.
26. US 5207909 : Plasma polymer membrane (C-2564), 1993.

27. US 5138023 : Unsaturated polyesters and crosslinked membranes therefrom for aromatics/saturates separation, 1992.
28. US 5130017: Multi-block polymer comprising a first amide acid prepolymer, chain extended with a compatible second prepolymer, the membrane made therefrom and its use in separations, 1992.
29. US 5096592 : Multi-block polymer comprising an ester prepolymer, chain extended with a compatible second prepolymer, the membrane made therefrom and its use in separations, 1992.
30. US 5093003 : Halogenated polyurethanes, 1992.
31. US 5128439 : Saturated polyester and crosslinked membranes therefrom for aromatics/saturates separation, 1992.
32. US 5159130 : Polysulfone membranes for aromatics/sturated separation, 1992.
33. US 5104532 : Flat stack permeator, 1992.
34. US 5146009 : Process for the recovery of alcohols using an organic acid-modified polymer membrane, 1992.
35. US 5098570 : Multi-block polymer comprising a urea prepolymer chain extended with a compatible second prepolymer, the membrane made therefrom and its use for separations, 1992.
36. US 5095171 : Control of oxygen level in feed for improved aromatics/non-aromatics pervaporation (OP-3602), 1992.
37. US 5028685 : Halogenated polyurethanes, 1991.
38. US 5075006 : Isocyanurate crosslinked polyurethane membranes and their use for the separation of aromatics from non aromatics, 1991.
39. US 4983338 : Isocyanurate crosslinked polyurethane membranes and their use for the separation of aromatics from non aromatics, 1991.
40. US 5039418: Membrane made from a multi-block polymer comprising an oxazolidone prepolymer extended with a compatible second prepolymer and its use in separations, 1991.
41. US 5039417: Membrane made from a multi-block polymer comprising an imide or amide-acid prepolymer chain extended with a compatible second prepolymer and its use in separations, 1991.
42. US 5019666 : Non porous polycarbonate membranes for separation of aromatics from saturates, 1991.
43. US 4990275 : Polyimide/Aliphatic polyester copolymers,1991.
44. US 4997906 : Crosslinked copolymers of aliphatic polyester diols and dianhydrides, 1991.
45. US 5063186 : Highly aromatic polyurea/urethane membranes and their use of the separation of aromatics from non-aromatics, 1991 .
46. US 5055632 : Highly aromatic polyurea/urethane membranes and their use of the separation of aromatics from non-aromatics, 1991 .
47. US 5055631 : Sulfonated polysulfone membranes for aromatics/saturates separation, 1991.
48. US 5049281 : Multi-block polymer comprising a first prepolymer, made by combining epoxy with diamine, chain extended with a compatible second prepolymer, the membrane made therefrom and its use in separations, 1991.
49. US 5039422 : Multiblock polymer comprising a urea prepolymer chain extended with a compatible second prepolymer, the membrane made there from and its use in separations, 1991.
50. US 5012036 : Polyarylate membranes for aromatics/saturates separation, 1991.

51. US 5012035 : Polyphtalatecarbonate membranes for aromatics/saturates separation,1991.
52. US 5030355 : Thin film composite membrane prepared by suspension deposition, 1991
53. US 4944880 : Polyimide/Aliphatic polyester copolymers,1990.
54. US 4946594 : Crosslinked copolymers of aliphatic polyester diols and dianhydrides, 1990.
55. US 4976868 : Polyester membranes for aromatics/saturates separation, 1990.
56. US 4962271 : Selective separation of multi-ring aromatic hydrocarbons from distillates by perstraction, 1990.
57. US 4962270 : Multi-stage pervaporation process run at progressively higher vacuum, higher temperature or both at each successive retentate stage, 1990.
58. US 4929358: Polyurethane-imide membranes and their use for the separation of aromatics from non-aromatics, 1990.
59. US 4929357 : Isocyanurate crosslinked polyurethane membranes and their use for the separation of aromatics from non aromatics, 1990.
60. US 4914064 : Highly aromatic polyurea/urethane membranes and their use of the separation of aromatics from non-aromatics, 1990.
61. US 4978454 : Membrane assisted settling process, 1990.
62. US 4921611 : Thin film composite membrane prepared by deposition from a solution, 1990.
63. US 4828773 : Highly aromatic polyurea/urethane membranes and their use of the separation of aromatics from non-aromatics, 1989.
64. US 4885096 : Aromatics-non-aromatics separation by permeation through thermally crosslinked nitrile rubber membranes, 1989.
65. US 4879044 : Higly aromatic anisotropic polyurea/urethane membranes and their use for the separation of aromatics from non aromatics, 1989.
66. US 4861628 : Thin film composite membrane prepared by suspension deposition, 1989.
67. US 4876403 : Process for the recovery of alcohols using a perfluorinated ionomer membrane, 1989.
68. US 4837054 : Thin film composite membrane prepared by deposition from a solution, 1989.
69. US 4802987 : Selective permeation of aromatic hydrocarbons through polyethylene glycol impregnated regenerated cellulose or cellulose acetate membranes, 1989.

Texaco

1. US 5445731 : Pervaporation vessel, 1995.
2. US 5456839 : Method of dehydrating organic oxygenates, 1995.
3. US 5281337 : Membrane separation process, 1994.
4. US 5182022 : Dewatering of concentrated aqueous solutions by pervaporation, 1993.
5. US 5238573 : Separation of organic liquids, 1993.
6. US 5192445 : Membrane suitable for the dehydration of organic oxygenates, 1993.
7. US 5126503 : Membrane process for dewatering lube oil dewaxing solvents, 1992.
8. US 5139677 : Membrane separation method, 1992.
9. US 5141649 : Novel membrane and method of separation, 1992.
10. US 5152898 : Separation of organic oxygenates, 1992.
11. US 5160046 : Membrane separation process, 1992.
12. US 5171449 : Membrane and method of separation, 1992.
13. US 5143620 : Membrane separation process, 1992.
14. US 5147549 : Membrane separation process, 1992.

15. US 5006576 : Ion exchange membrane, 1991.
16. US 5032278 : Process for dehydration of organic oxygenates, 1991.
17. US 5009783 : Separation of compositions containing water and organic oxygenates, 1991.
18. US 5004861 : Process for pervaporization using membrane separating means, 1991.
19. US 4992176 : Dehydration of organic oxygenates, 1991.
20. US 4898674 : Solvent dewaxing process, 1990.
21. US 4935144 : Concentration of water-ketone compositions, 1990.
22. US 4910344 : Treatment of compositions containing water and organic oxygenates, 1990.
23. US 4961855 : Dehydration of organic oxygenates, 1990.
24. US 4971699 : Separation of compositions containing water and organic oxygenates, 1990.
25. US 4960519 : Membrane process for separation of organic liquids, 1990.
26. US 4952318 : Separation of oxygenates, 1990.
27. US 4802988 : Dehydration of glycols, 1989.
28. US 4798674: Separation of organic liquids, 1989.
29. US 4877529 : Separation of organic liquids, 1989.

Membrane Technology and Research (MTR)

1. US 5711882 : Gas separation membrane module and process, 1998.
2. US 5538640 : Pervaporation apparatus and process, 1996.
3. US 5417847 : Pervaporation apparatus and process, 1995.
4. US 5294345 : Membrane module assembly, 1994.
5. US 5350519 : Pervaporation process and use in treating waste stream from glycol dehydrator, 1994.
6. US 5256295 : Two-stage membrane process and apparatus, 1993.
7. US 5266206 : Process for recovering organic components from liquid streams, 1993.
8. US 5147550 : Membrane process and apparatus for removing a component from a fluid stream, 1992.
9. US 5169533 : Process for recovering organic components from liquid streams, 1992.
10. US 4990255 : Composite membranes for fluid separations, 1991.
11. US 5030356 : Process for recovering organic components from liquid streams, 1991.
12. US 5049167 : Multilayer interfacial composite membrane, 1991.
13. US 5069793 : Membrane module, 1991.
14. US 4952751 : Treatment of evaporator condensates by pervaporation, 1990.
15. US 4963165 : Composite membrane, method of preparation and use, 1990.

Bend Research

1. US 5725769 : Solvent-resistant microporous polyimide membranes, 1998.
2. US 5753008 : Solvent resistant hollow fiber vapor permeation membranes and modules, 1998.
3. US 5464540 : Pervaporation by countercurrent condensable sweep, 1995.
4. US 4944882 : Hybrid membrane separation systems, 1990.
5. US 4806245 : Pervaporation of phenols, 1989.

GFT et associés

1. US 5700374 : Pervaporation process and use thereof, 1997.
2. US 5512179 : Membrane process for separation of fluid mixtures, 1996.
3. US 5558776 : Process for the manufacture of a composite plasma membrane and use thereof, 1996.
4. US 5385647 : Process for the reduction of the alcohol content of alcoholic beverages, 1995.
5. US 5437796 : Plate module and its use for separating fluid mixtures, 1995.
6. US 5334314 : Composition membrane for separating water from fluids containing organic components by means of pervaporation, 1994.
7. US 5180459 : Process for producing sealing components from all-carbon composite material, 1993.
8. US 5156740 : Multi-layer membrane and the use thereof for the separation of liquid mixtures according to the pervaporation process, 1992.
9. US 5164424 : Polymer having a betaine structure, solution diffusion membrane, process for producing same and use thereof, 1992.
10. US 4925562 : Pervaporation process and membrane, 1990.
11. US 4915834 : Multi-layer membrane and the use thereof for the separation of liquid mixtures according to the pervaporation process, 1990.
12. US 4865743 : Method of production of solution-diffusion membranes and their application for pervaporation, 1989.
13. US 4755299 : Multi-layer membrane and the use thereof for the separation of liquid mixtures according to the pervaporation process, 1988.
14. US 4789480 : Membrane module and the use thereof for the separation of liquids according to the pervaporation process, 1988.

GKSS

1. US 5456827 : Compressor system having a device for continuous cleaning of the auxiliary working fluid, 1995.
2. US 5254251 : Membrane for the separation of liquid mixtures by pervaporation, 1993.
3. US 5203969 : Method of separating and recovering component of mixtures via pervaporization, 1993.
4. US 5108549: Method of separating and recovering components of mixtures via pervaporization, 1992.
5. US 5076923: Apparatus for separating mixtures by spaced stacked membrane elements, 1991.
6. US 4818452: Method of manufacturing an integral asymmetrical membrane, 1989.
7. US 4650574: Apparatus for the separation of solutions by pervaporation, 1987.

Annexe A-II-4.

Liste des brevets américains par les acteurs principaux en perméation de vapeur pour la période des vingt dernières années (1980 – 1999).

Membrane Technology and Research

1. US 5861049 : Chlorine separation process combining condensation, membrane separation and flash evaporation, 1999.
2. US 5964923 : Natural gas treatment train , 1999.
3. US 5779763 : Process for recovering semiconductor industry cleaning compounds, 1998.
4. US 5772734 : Membrane hybrid process for treating low-organic-concentration gas streams, 1998.
5. US 5769927 : Monomer recovery process, 1998.
6. US 5755855 : Separation process combining condensation, membrane separation and flash evaporation, 1998.
7. US 5611841 : Vapor recovery process using bafled membrane module, 1997.
8. US 5670051 : Olefin separation membrane and process, 1997.
9. US 5538535 : Membrane process for treatment of chlorine containing gas streams, 1997.
10. US 5688307 : Separation of low-boiling gases using super-glassy membranes, 1997.
11. US 5501722 : Natural gas treatment process using PTMSP membrane, 1996.
12. US 5389126 : Process for removal of components from liquids in batch mode, 1995.
13. US 5374300 : Process for removing condensable components from gas streams, 1994.
14. US 5205843 : Process for removing condensable components from gas streams, 1993.
15. US 5199962 : Process for removing condensable components from gas streams, 1993.
16. US 5273572 : Process for removing an organic compound from water, 1993.
17. US 5089033 : Process for removing condensable components from gas streams, 1992.
18. US 5127926 : Membrane process for treating pump exhausts, 1992.
19. US 5069686 : Process for reducing emissions from industrial sterilizers, 1991.
20. US 5044166 : Refrigeration process with purge and recovery of refrigerant, 1991.

American Air Liquide ou L'Air Liquide

1. US 5919285: Process and system for separation and recovery of perfluorocompound gases, 1999.
2. US 5858065: Process and system for separation and recovery of perfluorocompound gases, 1999.
3. US 5855647: Process for recovering SF6 from a gas, 1999.
4. US 5785741: Process and system for separation and recovery of perfluorocompound gases, 1998.
5. US 5759237: Process and system for selective abatement of reactive gases and recovery of perfluorocompound gases, 1998.

Gilbarco

1. US 5843212 : Fuel tank ullage pressure reduction, 1998.
2. US 5626649 : Volatile organic chemical tank ullage pressure reduction, 1997.
3. US 5571310 : Volatile organic chemical tank ullage pressure reduction, 1996.
4. US 5464466 : Fuel storage tank vent filter system, 1995.

GKSS

1. US 5595658: Membrane based on graft copolymers, 1997.
2. US 5537911: Method and device for separating gas mixtures formed above liquids, 1996.
3. US 4994094: Method for removing organic compounds from air/permanent gas mixtures, 1991.
4. US 4933085: Method of manufacturing an integral asymmetrical membrane, 1990.

Bend Research

1. US 5843209 : Vapor permeation system, 1998.
2. US 5753008 : Solvent resistant hollow fiber vapor permeation membranes and modules, 1998.
3. US 5611842: Organic and inorganic vapor permeation by countercurrent sweep, 1997.
4. US 5236474: Membrane-based removal of condensable vapors, 1993.

Annexe A-II-5.

International survey on pervaporation and vapour permeation industrialisation : questionnaire envoyé à tous les équipementiers ou fournisseurs de membranes référencés.