Claims

What is claimed is:

1. A composite membrane comprising:
a first porous polymeric layer; and
a second porous polymeric layer laminated with the first porous polymeric layer,
wherein the composite membrane is free of an adhesive.

~~2. The composite membrane of claim 1, wherein the first porous polymeric layer, the second porous polymeric layer, or both are selected from the group consisting of a polyamide, a polysulfone, a polyether sulfone, and a polyolefin, and wherein the first porous polymeric layer and the second porous polymeric layer are different.~~

~~3~~2. The composite membrane of claim 1 ~~or 2~~, wherein the first porous polymeric layer has a thickness of less than 20 µm.

~~4~~3. The composite membrane of claim ~~3~~2, wherein the first porous polymeric layer is a stretched polyethylene layer.

~~5~~4. The composite membrane of ~~any preceding~~ claim 1, wherein the second porous polymeric layer is a polyolefin layer having a thickness of from about 50 µm to about 200 µm.

~~6~~5. The composite membrane of claim ~~5~~4, wherein the polyolefin layer is an ultra-high molecular weight polyethylene (UHMWPE) layer.

~~7. The composite membrane of any preceding claim, wherein the composite membrane has a flow rate that is greater than or equal to 90% of a flow rate of a non-laminated composite of the first porous polymer layer and the second porous polymeric layer.~~

~~8. The composite membrane of any preceding claim, wherein the composite membrane has a flow time increase that is less than or equal to 20% of a flow time of a non-laminated composite of the first porous polymer layer and the second porous polymeric layer.~~

~~9. The composite membrane of any preceding claim, wherein the first porous polymeric layer has a first bubble point, the second porous polymeric layer has a second bubble point, and the first bubble point is greater than the second bubble point, and wherein the composite membrane has a bubble point that is greater than or equal to 90% of the first bubble point of the first porous polymeric layer.~~

~~10~~6. A composite membrane, comprising:

a first region comprising a first porous polymer and having a thickness of less than about 20 µm and

a second region comprising a second porous polymer and having a thickness of from about 50 µm to about 200 µm,

wherein the second porous polymer is different from the first porous polymer, and

wherein there is no interlayer region between the first region and the second region.

~~11~~7. The composite membrane of claim ~~10~~6, wherein the first region, the second region, or both the first region and the second region comprise a porous compression region.

~~12. The composite membrane of claim 10 or 11, wherein the first porous polymer is a stretched polyethylene.~~

~~13. The composite membrane of any of claims 10-12, wherein the second porous polymer is a polyolefin.~~

~~14~~8. A method of forming a composite membrane comprising:

i) providing a first porous polymeric layer and a second porous polymeric layer in a laminator;

ii) heating the first porous polymeric layer and the second porous polymeric layer to a lamination temperature in the laminator; and

iii) laminating the heated first porous polymeric layer and the heated second polymeric layer together without an adhesive to form the composite membrane.

~~15. The method of claim 14, further comprising compressing the composite membrane during or after laminating.~~

~~16. The method of claim 14 or 15, wherein the first porous polymeric layer is an ultra-thin porous polymeric layer having a thickness of less than 20 µm.~~

~~17. The method of claim 16, wherein the ultra-thin porous polymeric layer is a stretched polyethylene layer.~~

~~18. The method of any of claims 14 to 17, wherein the second porous polymeric layer is a polyolefin layer having a thickness of from about 50 µm to about 200 µm.~~

~~19. The method of claim 18, wherein the polyolefin layer is an ultra-high molecular weight polyethylene (UHMWPE) layer.~~

~~20~~9. The method of ~~any of~~ claim~~s 14-19~~ 8, wherein the first porous polymeric layer has a first melting temperature and wherein the first porous polymeric layer is heated to a temperature that is between 5ºC and 20ºC below the first melting temperature.

~~21~~10. The method of ~~any of~~ claim~~s 14-20~~ 8, wherein the second porous polymeric layer has a second melting temperature, and wherein the second porous polymeric layer is heated to a temperature that is between 5ºC and 20ºC below the second melting temperature.

~~22. The method of any of claims 14-21, wherein the composite membrane has a flow rate that is greater than or equal to 90% of a flow rate of a non-laminated composite of the first porous polymeric layer and the second porous polymeric layer.~~

~~23~~11. A filter comprising the composite membrane of ~~any of~~ claim~~s~~ 1~~-13~~ or claim 6.