[0006] It would be desirable to have an additive which would reduce the TPU polymer melt viscosity, thus allowing fibers to be spun faster and at smaller size while optionally enhancing the physical properties of the fibers in the non-woven fabric.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to provide a non-woven fabric made from TPU which has high tensile strength and is elastic.

[0008] An exemplary non-woven fabric is made by adding a crosslinking agent to the TPU polymer melt. The crosslinking agent is used at a level of from 5 to 20 weight percent based on the total weight of the TPU polymer and the crosslinking agent.

[0009] The crosslinking agent reduces the melt viscosity of the TPU polymer melt allowing the fibers to exit the die at smaller diameters and allowing for greater attenuation.

[0010] In an exemplary embodiment, the non-woven is produced by either a melt blown or spun bond process.

[0011] In another exemplary embodiment, the non-woven fabric is further melt processed to compact the fabric, such that the air passages in the fabric are reduced. The air passages can be reduced to an extent where a membrane is formed.

[0012] In a further exemplary embodiment, the non-woven fabric is calendered into a solid film.

[0013] In another exemplary embodiment, an uncrosslinked TPU non-woven fabric is further melt processed to create a membrane.

In one embodiment, for example, the following items are provided.

(Item 1) A non-woven fabric comprising:

(a) thermoplastic polyurethane polymer; and

(b) crosslinking agent.

(Item 2) The non-woven fabric of item 1, wherein said thermoplastic polyurethane polymer is selected from the group consisting of polyester polyurethane, polyether polyurethane, and polycarbonate polyurethane.

(Item 3) The non-woven fabric of item 2, wherein said thermoplastic polyurethane polymer is a polyester polyurethane.

(Item 4) The non-woven fabric of item 1, wherein said crosslinking agent is present at a level of from 5 to 20 weight percent based on the total weight of said thermoplastic polyurethane polymer and said crosslinking agent.

(Item 5) The non-woven fabric of item 4, wherein said crosslinking agent is present at a level of from 8 to 15 weight percent.

(Item 6) The non-woven fabric of item 4, wherein said crosslinking agent is an isocyanate terminated prepolymer selected from the group consisting of polyether prepolymer and polyester prepolymer.

(Item 7) The non-woven fabric of item 4, wherein said crosslinking agent has a number average molecular weight of from 1,000 to 10,000 Daltons.

(Item 8) The non-woven fabric of item 2, wherein said thermoplastic polyurethane polymer is made by reacting:

(a) at least one hydroxyl terminated intermediate;

(b) at least one glycol chain extender; and

(c) at least one polyisocyanate.

(Item 9) The non-woven fabric of item 8, wherein said polyisocyanate is a diisocyanate.

(Item 10) The non-woven fabric of item 9, wherein said thermoplastic polyurethane has a weight average molecular weight of from 100,000 to 800,000 Daltons.

(Item 11) A process for producing a non-woven fabric comprising the steps of:

(a) adding a preformed thermoplastic polyurethane polymer to an extruder; and

(b) melting said thermoplastic polymer in said extruder to create a polymer melt; and

(c) adding a crosslinking agent to said polymer melt; and

(d) passing said polymer melt mixed with said crosslinking agent through a die having multiple holes from which fibers are formed in a process selected from the group consisting of melt blown process, and spun bond process; and

(e) collecting said fibers in a random alignment to form said non-woven fabric.

(Item 12) The process of item 11, wherein said process is a spun bond process.

(Item 13) The process of item 12, wherein said process is a melt blown process.

(Item 14) The process of item 11, wherein said crosslinking agent is present at a level of from 5 to 20 weight percent, based on the total weight of said preformed thermoplastic polyurethane polymer and said crosslinking agent.

(Item 15) The process of item 14, wherein said crosslinking agent is present at a level of from 8 to 15 weight percent.

(Item 16) The process of item 11, wherein said preformed thermoplastic polyurethane polymer is made by reacting:

(a) at least one hydroxyl terminated intermediate;

(b) at least one glycol chain extender; and

(c) at least one polyisocyanate.

(Item 17) The process of item 16, wherein said preformed thermoplastic polyurethane has a weight average molecular weight of from 100,000 to 800,000 Daltons; and wherein said polyisocyanate is a diisocyanate; and wherein said crosslinking agent has a number average molecular weight of from 1,000 to 10,000.

(Item 18) The process of item 11, wherein said non-woven fabric is passed through a calender operation to compress said non-woven fabric.

(Item 19) An article comprising the non-woven fabric of item 1, wherein said article is selected from the group consisting of consumer apparel, industrial apparel, medical article, sport article, protective article, and filtration membrane.

(Item 20) A porous membrane made from a non-woven thermoplastic polyurethane fabric and having a plurality of pores.

(Item 21) The membrane of item 20 wherein said membrane has a pore size of from 100 nanometers to less than 100 micrometers.

(Item 22) The membrane of item 20 wherein said membrane has an air flow rate through said membrane of from 2 to 500 $ft.^3/min./ft^2$ (0.601 to 152.4 $m^3/min./m^2$) as measured according to ASTM D737-96.

(Item 23) The membrane of item 20 wherein said thermoplastic polyurethane fabric is made using a crosslinking agent.

(Item 24) The membrane of item 22 wherein said membrane has an air flow rate through said membrane of from 5 to 10 $ft^3/min./ft^2$ (1.524 to 3.048 $m^3/min./m^2$).

BRIEF DESCRIPTION OF THE DRAWING

[0014] Fig. 1 shows a graph of die head pressure (psi) as the Y axis vs. weight percent of crosslinking agent as the X axis.

DETAILED DESCRIPTION OF THE INVENTION

[0015] The non-woven fabric of this invention is made from a thermoplastic polyurethane polymer (TPU).

[0016] The TPU polymer type used in this invention can be any conventional TPU polymer that is known to the art and in the literature as long as the TPU polymer has adequate molecular weight. The TPU polymer is generally prepared by reacting a polyisocyanate with an intermediate such as a hydroxyl terminated polyester, a hydroxyl

What is claimed is:

1. A non-woven fabric comprising a fiber wherein said fiber consists of:

(a) thermoplastic polyurethane polymer; ~~and~~

(b) crosslinking agent; and

(c) optionally one or more additives selected from the list consisting of opacifying pigments, colorants, stabilizers, lubricants, UV absorbers, processing aids, plasticizers, and flame retardants;

wherein said thermoplastic polyurethane polymer has a weight average molecular weight of from 100,000 to 800,000 Daltons and wherein said thermoplastic polyurethane polymer is the derived from diphenyl methane-4, 4'-diisocyanate, a hydroxyl terminated polyester, and a glycol having from 2 to 10 carbon atoms; and wherein said crosslinking agent comprises a pre-polymer of a hydroxyl terminated intermediate that is a polyether reacted with diphenyl methane-4, 4'-diisocyanate.

2. ~~The non-woven fabric of claim 1, wherein said thermoplastic polyurethane polymer is selected from the group consisting of polyester polyurethane, polyether polyurethane, and polycarbonate polyurethane.~~

~~3.~~ The non-woven fabric of claim 1, wherein said crosslinking agent is present at a level of from 5 to 20 weight percent based on the total weight of said thermoplastic polyurethane polymer and said crosslinking agent.

~~4. The non-woven fabric of claim 3, wherein said crosslinking agent is an isocyanate terminated prepolymer selected from the group consisting of polyether prepolymer and polyester prepolymer.~~

~~5~~3. The non-woven fabric of claim 3, wherein said crosslinking agent has a number average molecular weight of from 1,000 to 10,000 Daltons.

~~6. The non-woven fabric of claim 2, wherein said thermoplastic polyurethane polymer is made by reacting:~~

~~(a) at least one hydroxyl terminated intermediate;~~

~~(b) at least one glycol chain extender; and~~

~~(c) at least one polyisocyanate.~~

~~7. The non-woven fabric of claim 8, wherein said thermoplastic polyurethane has a weight average molecular weight of from 100,000 to 800,000 Daltons.~~

~~8~~4. A ~~process~~ method for producing a non-woven fabric comprising the steps of:

(a) adding a preformed thermoplastic polyurethane polymer to an extruder; and

(b) melting said thermoplastic polymer in said extruder to create a polymer melt; and

(c) adding a crosslinking agent to said polymer melt; and

(d) passing said polymer melt mixed with said crosslinking agent through a die having multiple holes from which fibers are formed in a process selected from the group consisting of melt blown process, and spun bond process; and

(e) collecting said fibers in a random alignment to form said non-woven fabric;

wherein said thermoplastic polyurethane polymer has a weight average molecular weight of from 100,000 to 800,000 Daltons and wherein said thermoplastic polyurethane polymer is the derived from diphenyl methane-4, 4'-diisocyanate, a hydroxyl terminated polyester, and a glycol having from 2 to 10 carbon atoms; and wherein said crosslinking agent comprises a pre-polymer of a hydroxyl terminated intermediate that is a polyether reacted with diphenyl methane-4, 4'-diisocyanate.

5~~9~~. The ~~process~~ method of claim ~~8~~4, wherein said process is a spun bond process.

6~~10~~. The ~~process~~ method of claim ~~9~~4, wherein said process is a melt blown process.

~~11~~7. An article comprising the non-woven fabric of claim 1, wherein said article is selected from the group consisting of consumer apparel, industrial apparel, medical article, sport article, protective article, and filtration membrane.

~~12~~8. A porous membrane made from a non-woven of claim 1 ~~thermoplastic polyurethane~~ fabric and having a plurality of pores.

~~13~~9. The membrane of claim ~~12~~8 wherein said membrane has a pore size of from 100 nanometers to less than 100 micrometers.

1~~4~~0. The membrane of claim ~~12~~8 wherein said membrane has an air flow rate through said membrane of from 2 to 500 $ft.^3/min./ft^2$ (0.601 to 152.4 $m^3/min./m^2$) as measured according to ASTM D737-96.

~~15. The membrane of claim 12 wherein said thermoplastic polyurethane fabric is made using a crosslinking agent.~~