

System and Method to Seam Seal Textile Products

FIELD OF INVENTION

- 5 Embodiments of the present invention provide a system and method to coat a thread with a material in order to seal the seams of various types of textile products to prevent, for example, water penetration. Embodiments of the present invention may also be used to coat a thread with a material for other uses.

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BACKGROUND

- Various types of textile products are designed to repel water. Such products may include garments designed to be worn by a user, tents, tarpaulins, etc. Waterproof garments have been used for decades to protect people from the elements. Modern
- 15 waterproof garments provide both a moisture barrier and breathability, thus making them comfortable to wear. These garments are sewn together from various pieces of fabric that has been cut to size. Unfortunately, the holes produced by the needle when sewing the garments allow water to leak inside.
- 20 Various methods have been developed to prevent waterproof garments and other textile products from leaking at the seams. For example, waterproof tape may be applied over the seams once the garment has been completed. Laser welding is another process that has been used to produce seam sealed garments.
- 25 These methods have a number of drawbacks. The equipment needed to produce seam sealed products using these methods is very expensive. Additionally, extra time is required to apply seam sealing tape to a product, thus increasing manufacturing costs. The seams may not stay sealed when the product is in use, thus resulting in a product that is not as durable as a user would like. Both laser welding and seam seal tape can
- 30 only be applied to a limited number of fabric types. These methods also limit the design of waterproof garments.

It would therefore be a great improvement in the art if a system or method to seam seal garments could be developed that overcomes one or more of the above disadvantages.

5 SUMMARY

One aspect of the present invention provides a method for producing a waterproof seam in a textile product, the method comprising the steps of: immersing a thread in a polymer solution to soak said thread; sewing a seam in the product with said polymer soaked thread; and curing said seam to form a watertight seal.

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In some embodiments, the immersing step may further include: providing a container containing said polymer solution; and routing said thread over a plurality of pulleys to immerse said thread in said solution. In alternate embodiments, the immersing step may further include: providing a container containing said polymer solution; and routing said thread through a plurality of guides to immerse said thread in said solution.

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The container may be filled with a mixture of at least two components to produce the solution, each of the two components being separately stored adjacent the container. The mixture may be formed from equal parts of each of the components. In alternate embodiments, the mixture includes components A and B of LSR 2010, each component of which has been diluted at a ratio of 3:1 with a solvent prior to mixing in said container.

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The product may be selected from a group consisting of an article of clothing, a tent, and a tarpaulin. The curing step may be accomplished by curing in air. Alternately, the curing step may be accomplished by applying a heat source at a desired temperature for a desired time until said seam is cured.

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An alternate aspect of the present invention provides a system for producing a waterproof seam in a textile product, the system comprising: means for immersing a thread in a polymer solution; means for routing said soaked thread to a sewing machine which sews a seam in said product; and means to cure the seam to
5 provide a waterproof seal in the seam.

In alternate embodiments, the immersing means may include a liquid dispensing system comprising a first container containing a first component, a second container containing a second component, and a third container containing a mixture of said first
10 and second components. The immersing means may further include a plurality of pulleys configured to route said thread into said mixture and to said sewing machine. Alternately, the immersing means may further include a plurality of guides configured to route said thread into said mixture and to said sewing machine.

15 In further embodiments, the polymer solution may be made from components A and B of liquid silicon rubber 2010, each component of which has been diluted at a ratio of 3:1 with a solvent prior to mixing in said third container. The means to cure the seam may be selected from a group consisting of air and a heat source.

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BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only,
25 and in conjunction with the drawings, in which:

Figure 1 illustrates one embodiment of a system to produce a seam sealed textile product according to the present invention;

30 Figure 2 illustrates a top view of a liquid dispenser for use with the embodiment of Figure 1;

Figure 3 illustrates a front perspective view of the dispenser of Figure 2;

Figure 4 illustrates a front view of the dispenser of Figures 2 and 3;

Figure 5 illustrates one embodiment of a support frame for the dispenser of Figures 2-4;

- 5 Figure 6 illustrates a perspective view of a portion of the dispenser of Figures 2-4 connected to the frame of Figure 5;

Figure 7A illustrates a side view of one embodiment of a container that may be used with the dispenser of Figures 2-4 connected to the frame of Figure 5;

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Figure 7B illustrates a partial front view of the frame shown in Figure 7A;

Figure 8 illustrates a perspective view of one embodiment of a thread immersion apparatus used with the system of Figure 1 connected to the frame shown in Figure 5;

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Figure 9 illustrates a front view of the thread immersion apparatus of Figure 8;

Figure 10 illustrates an exploded perspective view of an alternate embodiment of a thread immersion apparatus used with the system of Figure 1;

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Figure 11 illustrates a top view of the thread immersion apparatus of Figure 10;

Figure 12 illustrates a cross-sectional view of the thread immersion apparatus of Figures 10 and 11 taken along the line A-A of Figure 11; and

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Figure 13 is a flow chart illustrating one method of producing a water tight seal for a textile product according to the present invention.

30 **DETAILED DESCRIPTION**

Figure 1 illustrates one embodiment of a system 100 to produce a waterproof seal in a textile product according to the present invention. The system 100 may include a liquid dispenser 200, a container 110 for receiving a dispensed liquid 112, a spool of thread

102, a sewing machine 150, and a product that is being sewn 104 to produce a seam. In some embodiments, the system 100 may also include a curing apparatus (not shown that may be used to cure the seam once the textile product has been sewn. The liquid dispenser 200 may be coupled to a frame structure 160 that may be attached to a table
5 or other surface 106 proximate the sewing machine 150.

It is understood that the textile product may be any type of textile that requires sewing. By way of example and not limitation, the product may be clothing intended to be worn by a user, a tent, a tarpaulin, or any other textile product. In a preferred embodiment,
10 the product may be made from a waterproof material that requires the waterproof seams provided by embodiments of the present invention. Similarly, the thread may be any type of thread that is commercially available.

The curing apparatus may be a standard iron, a commercial iron, or any other device
15 capable of providing a desired level of heat to the product for a desired amount of time. In some embodiments, the seam may be cured in air. It is understood that specific curing times and temperatures may vary depending on the type of fabric used in the product and the specific polymer solution that is used to coat the thread 102.

20 It is also understood that, while the system 100 illustrated in Figure 1 includes a hand operated sewing machine 150, other systems, including but not limited to automated systems, may also be used with embodiments of the present invention.

Figure 2 illustrates a top view of the liquid dispenser 200 that may be used with the
25 system 100 of Figure 1. Figure 3 illustrates a front view of the dispenser 200 of Figure 2. Figure 4 illustrates a side view of the dispenser 200 of Figures 2 and 3. Figure 5 illustrates a side view of the support frame 160 for the dispenser 200 of Figures 2-4. Figure 6 illustrates a perspective view of a portion of the dispenser 200 of Figures 2-4 connected to the frame 160 of Figure 5. Figure 7A illustrates a side view of one
30 embodiment of a container 110 that may be used with the dispenser 200 of Figures 2-4 connected to the frame 160 of Figure 5. Figure 7B illustrates a partial rear view of the frame 160 shown in Figure 7A. Figure 8 illustrates a perspective view of one embodiment of the thread immersion apparatus 120 connected to the frame 160 shown

in Figure 5. Figure 9 illustrates a front view of the thread immersion apparatus 120 of Figure 7.

With reference to Figures 2-9, the dispenser 200 dispenses a solution into the container 110. In a preferred embodiment, the solution is a polymer solution. The thread immersion apparatus 120 can then be used to route the thread 102 through the dispensed polymer solution to coat the thread 102 with the solution. The thread 102 is then used to sew a seam in the textile product 104.

10 In a preferred embodiment, the dispenser 200 holds two components "A" and "B", which are combined in the container 110 to form the polymer solution. In this embodiment, the dispenser 200 includes a first container 210 holding component "A" of the polymer solution and a second container 220 holding component "B" of the polymer solution. A dual plunger 250 may be used to force each of the components "A" and "B" through
15 corresponding openings 234 in container 210 and 236 in container 220 that feed a nozzle 230 having an opening 232. The components "A" and "B" exit the opening 232 in the nozzle 230 and enter an opening 242 in a mixer 240. The mixer 240 may include a plurality of notches 246 that mix the two components "A" and "B". The mixed solution then exits the mixer 240 through opening 244 and into the container 110.

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The dual plunger 250 may include a handle 251 that engages first and second push components 252, 254. Each of the first and second push components is connected to a corresponding plunger portion 256, 258 in containers 220, 210, respectively. Applying a downward force on the plunger 250 thus pushes equal portions of the components "A" and "B" through the nozzle 230 and mixer 240 to provide the solution in the container 110.

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In a preferred embodiment, the two components "A" and "B" may be a commercially available two-component liquid silicone rubber compound. By way of example and not
30 limitation, the polymer solution may be Baysilone® LSR 2010, manufactured by the General Electric Company and available, for example, through Momentive performance materials. Baysilone® LSR 2010 is a 10 shore standard two-component liquid silicone rubber used, for example, for injection molding processes. In a further preferred embodiment, each of the components "A" and "B" of the LSR 2010 product may be

diluted with an appropriate solvent, including, but not limited to, isopropyl alcohol. In some embodiments, the two components "A" and "B" are diluted at a ratio of 3:1 with isopropyl alcohol. It is understood that other types of polymer solutions, and/or other dilution ratios may also be used.

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In some embodiments, it is desired to use a polymer solution having particular viscosity and other chemical characteristics in order to achieve correct saturation of the thread 102. Other consideration may include the shelf life of the polymer, the finishing process required to achieve a final desired performance (i.e. Curing), and the usability of the polymer in contact with air at room temperature (to avoid loss of absorbency, curability etc.).

For example, in a preferred embodiment, the polymer solution may have the following properties:

15	Viscosity in Pas gamma = 10s at 20°C	300-400 range
	Density in gr/cm ³	1000-1130 range
	Tensile strength in N/mm ²	3.9 minimum
	Elongation at break point in %	300 minimum
	Tear Strength in N/mm	5.0 minimum
20	Hardness Shore A	40-45 range

Prior to mixing into container 110, the silicone polymer will not start curing at room temperature in the first 24 hrs. This allows a user to purchase and store a desired quantity of the product for up to a year.

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In alternate embodiments, different types of solutions may be used on the thread 102 in order to achieve a desired outcome. By way of example and not limitation, the thread 102 may be immersed in a hi-visibility dye to provide added visibility to the textile product. In other applications, the thread 102 may be immersed in an electro-conductive polymer to provide a continuous antenna that may form part of the product. In other applications, the thread 102 may be immersed in a silicon polymer solution containing silver to activate an antibacterial property of the solution. It is understood that these embodiments may be used as part of or separately from the seam sealing embodiment described above.

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The silicone polymer applied to the thread 102 closes up the needle holes in the textile product 104, and helps prevent the thread 102 from absorbing moisture. In this embodiment, silicone polymer treated thread 102 is used for every single stitch in the textile product. In some embodiments, the finished seams may be subjected to a curing process, which may include, but is not limited to air curing or heat treatment. In one preferred embodiment, the seams may be ironed with hot iron, e.g. 170°C, to cure the silicone polymer into a water resilient, colorless synthetic rubber. It is understood that the temperature of the curing apparatus and the time that heat is applied to the seam may vary depending the type of material being sewn. In other preferred embodiments, the treated seams will provide rain proofing according to various national and/or international standards. By way of example and not limitation, the standard may be European standard BS EN 14360:2004, Protective clothing against rain; Test method for ready made garments; Impact from above with high energy droplets. It is understood that other standards may also be used.

Figure 5 illustrates one embodiment of a support frame 160 that may be used with the dispenser 200 and thread immersion/routing apparatus 120 of the present invention. The support frame may include a first elongated section 162 connected to a second elongated section 164 via a plurality of connectors 166. A lower portion 168 of the second section 164 may be inserted into a corresponding opening in a mounting apparatus (not shown) that could be attached adjacent the sewing machine 150. The dispenser 200, thread immersion/routing apparatus 120, and container 110 may be attached to the frame as described below. Alternately, the components may be attached to each other, and the assembled system attached to the frame 160. It is understood that any type of support frame capable of supporting the components of the system 100 may be used with the embodiments of the system 100. The support frame 160 may be attached to a table 106 (Figure 1) that also supports the sewing machine 150. In alternate embodiments, the support frame 160 may be free standing and located adjacent the sewing machine 150.

Figure 6 illustrates a perspective view of a portion 220 of the dispenser 200 of Figures 2-4 connected to the frame 160 of Figure 5. In this embodiment, the container 220 is shown attached to the frame 160 by means of a spring clip 170 attached to the front

portion 162 of the frame 160 using a screw 172. A support shelf 174 may also be provided under the dispenser 200 to provide further support. It is understood that there are many ways to effect the connection of the various components. All such connections are considered to fall within the scope of the present embodiments.

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Figure 7A illustrates a close-up side view of the container 110 connected to the front portion 162 of the frame 160. Figure 7B illustrates a front view of the front portion 162 of the frame 160. A screw or other fastener 114 may be attached to the container 110. The screw 114 may then be inserted into a corresponding groove 178 of the front
10 portion 162 of the frame 160. The container 110 may be any type of container capable of holding the mixed polymer solution provided from the dispenser 200. The container 110 may include a spout 112 for receiving the dispensed polymer solution from the mixer 240. It is understood that various container configurations known to those of skill in the art may be used with the embodiments of the present invention. Similarly,
15 various connections means may be employed to attach the container 110 to the frame 160.

Figures 8 and 9 illustrate one embodiment of a means 120 for immersing the thread 102 into the polymer solution in container 110, and onto the sewing machine 150. In
20 this embodiment, the immersion/routing means 120 may include a frame 122, and a plurality of pulleys 124. As shown the frame 122 may include a horizontal section 122a that separates input pulley 124a and output pulley 124b. The frame 122 may further include a vertical section 122b having a mixing pulley 124c coupled thereto. Additionally, the frame 120 may include connecting sections 122c and 122d that
25 attaché the frame 120 to the front section 162 of the frame 160 at connections points 161. In this embodiment, the thread 122 is run over the input pulley 124a, across the mixing pulley 124c, and back to the sewing machine 150 via the output pulley 124b. It is understood that other configurations for routing the thread 102 through the polymer solution and to the sewing machine 150 may also be used without departing from the
30 scope of the present invention as defined by the appended claims.

Figure 10 illustrates an exploded perspective view of an alternate embodiment of a thread immersion apparatus 300 and container 350 used with the system 100 of Figure 1. Figure 11 illustrates a top view of the thread immersion apparatus 300 and container

350 of Figure 10. Figure 12 illustrates a cross-sectional view of the thread immersion apparatus 300 and container 350 of Figures 10 and 11 taken along the line A-A of Figure 11.

- 5 In this embodiment, the thread immersion apparatus 300 provides another example of a means for immersion the thread 102 into the polymer solution held in the container 350. The apparatus 300 may include a support portion 310, an anchor portion 320 coupled to a distal side 306 of the support portion 310, and a thread routing portion 330 coupled to a proximal side 308 of the support portion 310. It is understood that the support
10 portion 310, the anchor portion 320, and the thread routing portion 330 may be made from a single piece of, for example, plastic. Other materials may also be used. In alternate embodiments, the three portions may be coupled to each other using, for example, adhesives.
- 15 In a preferred embodiment, the support portion 310 includes an upper section 311 having a plurality of protrusions 312 which define a pair of semicircular thread guides 314a, 314b. The thread routing portion 330 may include a protrusion 332 which defines a lower semi-circular thread guide 334. The thread guides 314a, 314b, and 334 route the thread 102 from the sewing machine 150, into the polymer solution, and to the
20 garment for sewing. In alternate embodiments, the thread guides 314a, 314b and 334 may be circular apertures used to guide the thread 102.

- In this embodiment, the container 350 includes a circular wall portion 352, a rear wall 354, and a bottom portion 356 which provide the means for holding the polymer solution
25 used to coat the thread 102. An upper lip 355 extends around the circumference of the circular wall portion 352 and the rear wall portion 354 of the container 350. The rear wall portion 354 may also include a "T" shaped bracket 358 for receiving and securing the thread immersion apparatus 300. The container 350 may also include a base 360 used to support the container 350. The base 360 may include one or more holes 362
30 which may be used to secure the container 350 to, for example, the table 106 using one or more bolts or screws 364. It is understood that the container 350 may also be secured to the frame 160 or to any other support surface as desired.

In some embodiments, the container 350 and base 360 may be made from a unitary plastic compound. As with the container 110 discussed above, it is understood that various types of containers having various configurations and being made from various materials may be used with the embodiments as described.

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In a preferred embodiment, the anchor portion 320 of the thread immersion apparatus 300 may include a pair of hooks 322, 324 which may be configured to couple the immersion apparatus 300 to the "T" bracket 358 in the rear wall 354 of the container 350. It is understood that various configurations and attachment mechanisms may be used to secure the thread immersion apparatus 300 to the container 350. The upper section 311 of the thread immersion apparatus 300 may extend above the upper lip 355 of the container 350. In this embodiment, the thread guides 314a, 314b are located above the upper lip 350 to provide an unobstructed path for the thread 102. The support portion 310 may rest at an angle with respect to the container 350 to provide for the smooth routing of the thread 102 during operation. It is understood that, given the teachings of the present disclosure, various configurations for the thread immersion apparatus 300 and container 350 may be provided as desired.

Figure 13 illustrates one method, designated generally with reference numeral 400, for producing a waterproof seam in a textile product. The method 400 may include a first step of immersing a thread 102 in a polymer solution to soak said thread, as shown with reference numeral 402. The method 400 may further include steps for sewing a seam in the product with said polymer soaked thread, as shown with reference numeral 404, and curing said seam to form a watertight seal, as shown with reference numeral 406.

In some embodiments of the method 400, the immersing step 402 may further include providing a container 110, containing the polymer solution; and routing the thread over a plurality of pulleys 124 to immerse the thread 102 in the solution. Alternately, the thread 102 may be routed over or through the thread guides 314a, 314b, 334 into the container 350. The container 110, 350 may be filled with a mixture of at least two components to produce the solution, each of the two components being separately stored adjacent the container 110, 350. In some embodiments, the mixture may include equal parts of each of the components.

In one preferred embodiment of the method 400, the solution includes components A and B of LSR 2010, each component of which has been diluted at a ratio of 3:1 with a solvent prior to mixing in said container. As previously discussed, the solvent may
5 be isopropyl alcohol, or any other appropriate solvent.

In alternate embodiments of the method 400, the curing step 406 may be accomplished by curing in air. Alternately, the curing step 406 may be accomplished by applying a heat source at a temperature of 170° C until the seam
10 is cured.

Embodiments of the present invention provide several advantages over the prior art. The equipment needed to produce seam sealed products using the embodiments of the present invention is reasonably inexpensive. The system and method greatly reduce
15 the amount of time necessary to produce a seam sealed product, as additional sealing steps are not required. The system and method may be used for any type of material, and allow for a wide variety of clothing or other product designs as compared to the prior art.

20 It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

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CLAIMS

1. A method for producing a waterproof seam in a textile product, the method comprising the steps of:
 - 5 immersing a thread in a polymer solution to soak said thread;
sewing a seam in the product with said polymer soaked thread; and
curing said seam to form a watertight seal.
2. The method of claim 1 wherein said immersing step further comprises:
 - 10 providing a container containing said polymer solution; and
routing said thread over a plurality of pulleys to immerse said thread in said solution.
3. The method of claim 1, wherein said immersing step further comprises:
 - 15 providing a container containing said polymer solution; and
routing said thread through a plurality of guides to immerse said thread in said solution.
4. The method of claims 2 or 3, wherein said container is filled with a mixture of
 - 20 at least two components to produce said solution, each of said two components being separately stored adjacent said container.
5. The method of claim 4 wherein said mixture comprises equal parts of each of said components.
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6. The method of any one of claims 4 or 5, wherein said solution comprises components A and B of LSR 2010, each component of which has been diluted at a ratio of 3:1 with a solvent prior to mixing in said container.
7. The method of any one of the previous claims, wherein said product is selected from a group consisting of an article of clothing, a tent, and a tarpaulin.
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8. The method of any one of the previous claims, wherein said curing step is accomplished by curing in air.

9. The method of any one of claims 1-7, wherein said curing step is accomplished by applying a heat source at a desired temperature for a desired time until said seam is cured.

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10. A system for producing a waterproof seam in a textile product, the system comprising:

means for immersing a thread in a polymer solution;

means for routing said soaked thread to a sewing machine which sews a

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seam in said product; and

means to cure said seam to provide a waterproof seal in said seam.

11. The system of claim 10, wherein said immersing means comprises:

a liquid dispensing system comprising a first container containing a first

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component, a second container containing a second component, and a third container containing a mixture of said first and second components.

12. The system of claim 11, wherein said immersing means further comprises a plurality of pulleys configured to route said thread into said mixture and to said sewing
20 machine.

13. The system of claim 11, wherein said immersing means further comprises a plurality of guides configured to route said thread into said mixture and to said sewing
25 machine.

14. The system of any one of claims 10-13, wherein said polymer solution comprises components A and B of liquid silicon rubber 2010, each component of which has been diluted at a ratio of 3:1 with a solvent prior to mixing in said third
30 container.

15. The system of any one of claims 10-14, wherein said means to cure said seam is selected from a group consisting of air and a heat source.