SYSTEM AND METHOD FOR SIMULTANEOUS SUBLIMATION PRINTING ON BOTH SIDES OF A SINGLE LAYER OF FABRIC AND DOUBLE-SIDED GARMENT PRODUCED THEREBY

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ABSTRACT

This invention relates to a method and system for simultaneously sublimating two or more sublimation dyes on the opposite sides of a single-layer fabric and a single layer, double-side garment produced thereby. The method and system includes the preparation of compatible top and bottom sublimation transfer sheets, as well as the use and selection of varying temperatures for the top and bottom panels of a double-sided sublimation printing machine. The product produced by this method and system is a double-sided, single layer garment which is light weight, extremely versatile, aesthetically appealing and less costly to manufacture than other double-sided garments.

Related U.S. Application Data
- Provisional application No. 60/753,855, filed on Dec. 23, 2005.
FIG. 4
FIG. 7
SYSTEM AND METHOD FOR SIMULTANEOUS SUBLIMATION PRINTING ON BOTH SIDES OF A SINGLE LAYER OF FABRIC AND DOUBLE-SIDED GARMENT PRODUCED THEREBY

BACKGROUND OF THE INVENTION

[0001] 1. Field of Invention

[0002] This invention relates to a system and method for printing on fabric and, more particularly, the invention relates to a system and method for achieving high quality simultaneous double-sided sublimation printing on a single-layer of fabric.

[0003] 2. Background

[0004] For decades, a variety of well-known techniques have been used to print on fabrics. These printing techniques include screen printing, dyeing, flexographic printing, and sublimation printing. Sublimation printing techniques have been used in the manufacture of fabrics and clothing for decades. U.S. Pat. No. 4,242,092 and U.S. Pat. No. 6,698,958 each disclose systems and methods for sublimation printing.

[0005] Generally, sublimation printing involves the creation of a mirror image of a desired design and color scheme on a paper backing sheet known as a transfer sheet. Sublimation inks are deposited on one side of the transfer sheet. With the sublimation inks in a solid state, the transfer papers are then placed with their ink side in contact with the fabric that is to be printed on. The transfer sheet and fabric are placed in a sublimation printing machine which employs heat and pressure so as to cause the sublimation inks to change from a solid state to a gaseous state. The gaseous sublimation inks chemically react with the fibers of the cloth and are effectively transferred from the transfer sheets to the cloth itself in a mirror image of the design on the transfer sheet.

[0006] Traditionally, sublimation-printing machines are "single-sided." Such printing machines typically have a moveable upper side with a heating element and a lower side with a device that applies pressure upward, against the fabric, the transfer sheet and the upper side of the printing machine. Since at least 2000, however, Monti Antonio SPA of Italy has manufactured a sublimation printing machine which has heating elements on the top and bottom panels of the machine and a mechanism so as to allow the application of pressure. (See, FIG. 6) This design provides for the application of heat on both sides of a fabric at the same time.

[0007] Traditionally, the technique of sublimation printing has only been employed successfully on one side of a single-layer of fabric. (See, U.S. Pat. Nos. 6,811,840 B1; 6,698,958 B2; 5,246,518; and 4,058,644.) As described above, the sublimation printing technique involves the impregnation of the fibers of a fabric with sublimation inks in their gaseous state. (See, U.S. Pat. Nos. 4,107,365; and 4,021,591.) Accordingly, when sublimation printing was attempted on both sides of a single-layer fabric at the same time, or on one side at a time, the colors and designs impregnated on one side of the fabric would be blurred or changed by the design and colors of the sublimation ink applied to the opposite side of the fabric. These attempts left very unsatisfactory results.

[0008] At the same time, and in the area of sporting attire for example, there has been a need for clothing which is double-sided; i.e., clothing with different colors or designs on the inside and outside of the clothing. This type of apparel is also known as "reversible" clothing. In 1959, Levi was issued U.S. Pat. No. 2,890,460 on a "REVERSIBLE GARMENT AND METHOD FOR MAKING THE SAME." There, a reversible garment was made by sewing two different pieces of fabric together such that a "double layered" article of apparel was manufactured. U.S. Pat. Nos. 4,078,265, 4,277,848, 4,296,498 and 4,453,274 achieve similar results. That is, a double-sided or reversible garment made of two layers of fabric. The deficiencies associated with double layered reversible garments include added weight, cost and time of manufacture, and different arts and colors on each side of the fabric.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0009] It is a primary object of the invention to provide an improved system and method for simultaneously sublimating two or more sublimation dyes on the opposite sides of a single layered fabric. The final intent of this invention is to provide the wearer with the garment having a single layer of fabric with two distinctive and different arts and colors on each side of the fabric. Previous single-layer dyed garments with different colors required each side of the fabric to be made from different yarn types such as polyester on the first side and nylon on the reverse side. This required a dye process that will only be accepted by the polyester yarn and a second dye process that will only be accepted by the nylon yarn.

[0010] A preferred embodiment of a garment manufactured pursuant to this invention represents a game jersey for use in a sporting event which has a player's home colors on one side and the player's away colors on the reverse side using only a single layer of fabric. Before this invention, either two separate home and away jerseys were required or a double fabric layer sewn together after printing two fronts and backs was required. The benefits of a single layer garment include a lightweight garment and double usage. Other benefits include providing the wearer with the comfort of moisture wicking, anti-microbial, ultraviolet protection, as well as any other enhancement available using the performance polyester and polyester blend fabrics (see, U.S. Patent Application US 2005/0112976 A1 and U.S. Pat. No. 6,006,550) which can be decorated using the invention. The invention is not limited to any particular warp knit, circular knit, woven, single face or double face fabric.
the base pigments which are common to the dyes on both sides of the fabric. For example, if the upper transfer paper includes a green sublimation dye made of yellow and blue base pigments and the lower transfer paper contains purple sublimation dye made of red and blue base pigments, then the formulation of the lighter shade color (green) must be adjusted by reducing or eliminating the pigment in common to both purple and green (i.e., the blue base pigment).

[0013] In addition, the temperature and pressure settings applied by the double-sided sublimation printing machine are also critical components to a preferred embodiment of the invention. Double-sided sublimation machines are made up of a top element and a bottom element. A preferred embodiment of the invention includes a temperature setting of the top element which is approximately ten to twenty degrees Celsius less than the temperature setting for the bottom element of the printing machine. Yet another preferred embodiment of the invention includes setting the temperature of the top element at 200 degrees Celsius and the bottom element of the machine at 215 degrees Celsius.

[0014] Pressure of 5-8 bar (i.e., one bar equals 29.54 inches of Mercury) is applied for approximately 30-50 seconds at the temperatures set forth above. This temperature differential at a constant increased pressure and time allows the sublimation dyes on the bottom element (which are exposed to a higher temperature) to sublimate faster than the sublimation dyes attached to the top transfer sheet. Together with the selective elimination or reduction in base pigments in the top transfer sheet sublimation dyes, this temperature differential has achieved the unique and unexpected result of clear, uniform colors on both sides of the garment without the bleeding associated with prior attempts to print by sublimation on both sides of a single layer of fabric.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. 1 is two perspective views of a double sided simultaneous sublimation printing machine in accordance with one embodiment of the invention, showing an upper heating side (20) and a lower heating side (21), an upper or top sublimation dye and design transfer sheet (11), a single layered fabric (14) and a lower or bottom sublimation dye and transfer sheet (12);

[0016] FIG. 2 depicts two examples of a potential upper transfer sheet (11) and a potential lower transfer sheet (12) according to one embodiment of the invention;

[0017] FIG. 3 is a perspective view of a double sided simultaneous sublimation printing machine showing an upper transfer sheet (11), a blank single layered fabric (13) and a potential lower transfer sheet (12) according to one embodiment of the invention;

[0018] FIG. 4 is another perspective view of a double sided simultaneous sublimation printing machine depicting the placement of said blank single layered fabric (13) on top of the lower transfer sheet (12) with the upper transfer sheet (11) being placed on top of said blank single layered fabric (13) according to one embodiment of the invention;

[0019] FIG. 5 is another perspective view of said double sided simultaneous sublimation printing machine depicting a potential control panel (23) which controls the application of heat and pressure over specified time periods to upper heating side (20) and lower heating side (21) and the placement of upper transfer sheet (11) on top of lower transfer sheet (12), according to one embodiment of the invention;

[0020] FIG. 6 is a perspective view of a double sided simultaneous sublimation printing machine after the sublimation process has taken place, depicting the transfer of the design and colors from the upper transfer sheet (11) to the top side of the now dyed single lay of fabric (13) and the transfer of the colors and design from the lower transfer sheet (12) to the lower side of the now dyed single layered fabric (13);

[0021] FIG. 7 depicts four examples of top and bottom sides of single layer of fabrics simultaneously printed by sublimation (14), pursuant to one embodiment of the invention;

[0022] FIG. 8 is front and back perspective views of the inside and outside of a single layered garment produced pursuant to one embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] Referring initially to FIG. 1, there is shown open and closed perspective views of a double sided simultaneous sublimation printing machine pursuant to one embodiment of the invention. The embodiment in FIG. 1, as well as those found in FIGS. 3, 4, 5 and 6 provide separate heating controls for their upper (20) and lower (21) heating elements. Dual heating surfaces with independent heating capabilities are necessary for at least one of the preferred embodiments of the invention so as to allow one skilled in the art to reduce the heat of the upper element to increase the desirability of the resulting simultaneous color and design transfer. Since at least 2000, Monti Antonio S.B.A. of Italy has manufactured a sublimation printing machine which has independent heating elements on the top and bottom panels of the machine and a mechanism so as to allow the application of pressure.

[0024] Referring to FIG. 2, there is shown two examples of potentially compatible upper (11) and lower (12) transfer sheets prepared according to one embodiment of the invention. As depicted herein, as is generally the case when printing on both sides of a single layer of fabric, the design and color pattern to be used on one side of the fabric will be of a lighter shade than the design and color pattern to be printed on the other side of the fabric. When selecting which transfer sheet is to be used on top of the blank fabric, pursuant to one embodiment of the invention a printer would select the lighter shaded transfer sheet to be placed on the top side of the blank single layered fabric and the darker shade to be placed on the lower sublimation dye and design transfer sheet (12). Those skilled in the art will recognize that sublimation dyes range in color from violet to blue to green to yellow to orange and finally to red with many shades in between. Colors in the violet side of the spectrum are considered to be darker than the lighter colors on the red and of the spectrum. Those skilled in the art will also be familiar with the Cyan, Magenta, Yellow and Key (CMYK) subtractive color model used in color printing wherein three colored substrates are mixed to create various color shades. In CMYK, Magenta plus Yellow produces Red, Magenta
plus Cyan makes Blue and Cyan plus Yellow generates Green. Cyan, Magenta and Yellow printed together on white result in black.

[0026] The combination of these properly formulated colors, the elected positioning of the transfer sheets in the machine, and differing degrees of heat applied simultaneously under a constant pressure to a single layered fabric has yielded surprisingly different results from earlier attempts to print on both sides of a single layered fabric. The product produced by this method and system is a double sided, single layered garment which is light weight, extremely versatile, aesthetically appealing and less costly to manufacture than other double-sided garments.

[0027] While the method herein described, and the form of apparatus for carrying this method in to effect, constitute preferred embodiments of this invention, together with the garment produced thereby, it is understood that the invention is not limited to these precise methods, form of apparatus and garments, and that changes may be made in either without departing from the scope of the invention, which is defined in the appended claims.

What is claimed is:

1. A system and method for simultaneously sublimating two or more sublimation dyes on the opposite sides of a single layered fabric, which comprises the steps of:
   - preparation of compatible top and bottom sublimation transfer sheets;
   - placement of said sublimation transfer sheets on opposite sides of said single layered fabric;
   - moving said transfer sheets and said fabric into a double-sided sublimation printing machine;
   - raising the temperature and pressure on both sides of said double-sided sublimation printing machine to appropriate levels for an appropriate period of time; and
   - removal of said transfer sheets and said fabric from said printing machine and removal of said transfer sheets from said single layered fabric.

2. The system and method of simultaneously sublimating two or more sublimation dyes on the opposite sides of a single layered fabric set forth in claim 1,

   wherein said step of producing compatible top and bottom sublimation transfer sheets is comprised of selecting specific pigments and their percentages in the color formulation for said transfer sheets which do not interact with each other when simultaneously sublimated on opposite sides of said single layered fabric.

3. The system and method of simultaneously sublimating two or more sublimation dyes on the opposite sides of a single layered fabric set forth in claim 2,

   wherein said step of selecting said colored dyes for the top and bottom transfer sheet is comprised of a top transfer sheet which contains colors of a lighter shade than the color shades of the bottom transfer sheet.

4. The system and method for simultaneously sublimating two or more sublimation dyes on the opposite sides of a single layered fabric as defined by claim 1,

   wherein said step of preparing compatible top and bottom sublimation transfer sheets is also comprised of identifying the base pigments that the colored dyes on the top and bottom transfer sheets share, and reducing or eliminating the shared base pigments in the dyes to be used on the top side of the fabric.

5. The system and method for simultaneously sublimating two or more sublimation dyes on the opposite sides of a single layered fabric as defined by claim 1,

   wherein said step of preparing compatible top and bottom transfer sheets is comprised of selecting dyes for the top transfer sheet which are lighter in shade than those used on the bottom transfer sheet and where the common base pigments in the top transfer sheet are reduced or eliminated as compared to the bottom transfer sheet.

6. The system and method for simultaneously sublimating two or more sublimation dyes on the opposite sides of a single layered fabric as defined by claim 1,

   wherein said step of raising the temperatures of the top and bottom panels of said double-sided sublimation printing machine is further comprised of raising the temperature of the top panel of said printing machine to approximately 190-200 degrees Celsius and the temperature of the bottom panel of said printing machine to approximately 200-215 degrees Celsius.

7. The system and method for simultaneously sublimating two or more sublimation dyes on the opposite sides of a single layer of fabric as defined in claim 1,

   wherein said step of raising the pressure applied by said double-sided sublimation printing machine is further comprised of raising the pressure to approximately 5-8 bar for approximately 30-55 seconds.

8. The system and method for simultaneously sublimating two or more sublimation dyes on the opposite sides of a single layered fabric as defined by claim 1,

   wherein said step of raising the temperatures of the top and bottom panels of said double-sided sublimation printing machine is further comprised of raising the temperature of the top panel of said printing machine to approximately 190-200 degrees Celsius and the temperature of the bottom panel of said printing machine to approximately 200-215 degrees Celsius; and

   wherein said step of raising the pressure applied by said double-sided sublimation printing machine is further comprised of raising the pressure to approximately 5-8 bar for approximately 30-55 seconds.

9. The double-sided, single layer fabric produced by the system and method of claim 1.

10. The double-sided, single layer fabric produced by the system and method of claim 2.

11. The double-sided, single layer fabric produced by the system and method of claim 3.
12. The double-sided, single layer fabric produced by the system and method of claim 4.
13. The double-sided, single layer fabric produced by the system and method of claim 5.
14. The double-sided, single layer fabric produced by the system and method of claim 6.
15. The double-sided, single layer fabric produced by the system and method of claim 7.
16. The double-sided, single layer fabric produced by the system and method of claim 8.

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