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54 **Printing of fabrics.**

57 By using printing pastes containing a high proportion, e.g. 8 to 15% by weight, of a humectant such as urea or glycerol, fabric printing processes may be developed which can be used both on fabric webs and on garments or garment panels with equal ease. Following the application of the printing paste, and before it has materially dried out, the fabric is confined between a pair of impermeable layers and heated to greater than 100° C.

The process is particularly advantageously applied to discharge printing in connection with which it is possible to use discharge printing techniques without the necessity for subsequent washing out and with the production of a visible discharge print immediately after the heat treatment step just noted.

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PRINTING OF FABRICS

This invention relates to the printing of fabrics.

There are many occasions in which it is desired to produce a pattern or design on fabrics other than by weaving or knitting a pattern or design into them by using threads of different colours. The method by which this aim is most often achieved is by the use of a printing process of one kind or another.

5 An important type of textile printing is known as discharge printing in which a dyed fabric is printed with a suitable printing ink which contains chemicals capable of destroying the ground colour of the fabric during heating or steaming treatment. The fabric is then washed off to remove undesirable residues and to give a coloured fabric with a design of substantially uncoloured material. In an important variant of this process, the printing ink contains colouring matters which are resistant to the chemical degradation process of
10 discharging and which are fixed to the fabric during the heating treatments which are involved. In this way, so-called "illuminated" discharge prints may be produced using vat dyes or resin bonded pigments as colouring matters. Even though the colouring matters used for the production of illuminated discharge prints may normally be fixed to the fabric, generally cotton or some other cellulosic or substantially cellulosic material, by colouration processes which do not require washing off, when the colouring matters are used in
15 discharge printing, a washing off stage is involved due to the need to remove the residues of the chemicals involved in the discharge processes.

Discharge pigment printing processes have been described in which a fabric, dyed with a dye or a mixture of dyes susceptible to chemical degradation to produce colourless or virtually colourless products, is printed with an ink containing a discharge agent, finely dispersed pigments in an aqueous medium, a
20 resin binder capable of polymerising to bond the pigment particles to the fabric, and various catalysts etc. to enhance the reactions. The fabric is dried and then steamed for a period of minutes to produce the discharge. The fabric is then baked to polymerise the resin binder and washed off to remove undesirable residues.

A serious disadvantage of these normal procedures of discharge printing is that the results of the
25 process are not apparent for some time, i.e. until after the steaming and washing off processes have been completed. This means that the printer is unable to correct faults during the run of the print and the printed fabric is subject to accidental damage due to, say, unusually damp atmospheres while it is waiting in the factory for the next process. For this reason, discharge printing is subject to a high percentage of rejects as compared with other printing methods in the textile industry.

30 The need to wash off the fabrics is a further disadvantage of existing methods of discharge printing. Washing off creates undesirable effluent requiring processing before disposal and increased production costs due to the expense of drying. Many textile print works are precluded from producing discharge prints because the necessary washing and drying equipment is not available.

Despite these disadvantages, discharge prints have been successfully produced for many years on
35 fabrics in a continuous web. However, discharge printing has not been used for decorating garments, or garment panels from which garments are to be made, because textile materials in such a form cannot be washed off without creating expense as well as inconvenience in later processing. Any decoration process used for such materials thus has to be substantially dry, and various dry processes have indeed been developed for textile printing. A further reason for avoiding wet processing garments or garment panels is
40 that it is essential to maintain the dimensional stability of the material in order to control either the garment size or the fit of the decorated panels with other non-decorated panels in making up the garment. Thus, the opportunities offered by discharge printing have, until now, been wholly unavailable to the printer of garments and garment panels.

We have now found that, by using certain print formations, and a two-stage heat treatment process,
45 improved fabric prints may be obtained. If the print formulation is a discharge print formation, all the above disadvantages and limitations of discharge printing may be avoided, and printing may be carried out on continuous lengths of fabric, garments or garment panels using those formulations and subjecting the print to appropriate dry heat treatment processes. Discharge prints can be obtained without any need for wet processing at any stage after the application of the printing ink and with the discharge effect fully apparent
50 within a very short time after printing.

It is observed that throughout this specification the term "colouring materials" is used to indicate a pigment or a dyestuff or a mixture of both which will give a coloured effect, and the term is used to include both black and white, as well as spectral colours.

According generally to the present invention, there is provided a process of decorating fabric which comprises printing desired image areas forming a design on the fabric using a printing paste, and

subjecting the fabric so printed to a heat treatment prior to drying the paste to fix the printed design in the fabric, wherein the printing paste contains water, a substantial proportion of humectant, colouring materials and/or decolouring materials, and the heat treatment includes a stage at a temperature greater than 100 °C during which the fabric is confined between a pair of impermeable layers.

5 The fabric may then be subjected to a second heat treatment, the conditions of which are designed to fix any colouring materials in the printing paste to the fabric to give a fast to washing result. Alternatively, discharge printed or decolourised areas may be overprinted with colouring material to produce a design in a second printing step.

10 When the fabric to be decorated is dyed and it is desired to produce a discharge effect, the paste needs to contain at least one reagent capable of reacting with the dye in the fabric at least substantially to destroy its colour (i.e. a discharge agent) together with agents assisting the reaction such as acids, alkalies, reduction catalysts and the like.

15 Preferably, during the first heat treatment, or part thereof, the fabric is subject to pressure, e.g. by being passed through a roller nip while being confined between two impermeable layers or by being held between two heated plates coated with impermeable material for an appropriate period of time.

The first heat treatment referred to above needs to be carried out for only a relatively short period of time and, immediately thereafter, if the discharge printing process is being used, the discharge process is complete. Thus, the printer may judge more accurately, and at an early stage in the printing operation, whether the print is satisfactory. The exact time necessary for the first heat treatment stage will vary with 20 the fabric, the quantity of discharge ink applied and if the discharge printing process is being used the nature of the dyestuff applied to the fabric and which it is necessary to discharge, but using appropriate temperatures and apparatus it can be as low as 10 seconds. Usually 20 to 30 seconds is convenient, though longer treatment times, e.g. up to 60 seconds, can be used if desired.

25 It is important to subject the fabric to the heat treatment before the print on it has dried. Because of the high concentration of humectant in the printing paste, however, the heat treatment does not have to be carried out immediately and a delay between printing and heating of more than a minute can, under appropriate circumstances, be allowed without detriment. The heat treatment should, however, be carried out before the print paste has materially dried out on the fabric.

A variety of humectants may be used of which the following are particularly suitable:

30 Urea
Glycerol
Polyethylene Glycols
Thiodiglycol
Ethoxylated esters

35 Such humectants are known to be used in textile printing to prevent inks drying on the silk screens used in printing. Normally for this purpose they are present in relatively low concentration in the printing ink, i.e. 3-4%. In the inks of the present invention they are required to constitute at least 8-9% of the ink formulation, preferably 12-15%.

40 A particular advantage of the printing process of the present invention is the soft handle conferred by the heat treatment especially when the ink incorporates pigments and binders to produce a coloured discharge.

The precise mechanism by which the improvements in discharge printing processes which can be obtained using the method of the present invention are achieved is not known. It is thought that during the heat treatment, while the temperature of the fabric is raised to more than 100 °C under light pressure, the 45 superheated steam atmosphere that results causes the discharging agent or agents present to react vigorously and completely with the dye on the fabric leading to the destruction of the chromophoric system and, when suitable dyes are selected for the dyeing, the production of substantially uncoloured products. The role of the humectant during this process is thought to be to extend the time during which the fabric is effectively moist beyond that which would apply if it were not present, thus allowing a longer and more 50 useful reaction time and ensuring that the reactions are complete during the short treatment time involved. A further benefit which is observed when the pigments and pigment binders are incorporated into the printing ink is that excellent penetration and a soft handle are obtained due, it is believed, to the combined assistance to penetration given by the humectant and the superheated steam.

55 In one form of the present invention, the printing ink incorporates a pigment or a mixture of pigments which are chemically stable to the discharge agent and a pigment binder or mixture of binders together with any desired catalysts which will promote the curing of the binder or binders in a second heat treatment following the first discharging heat treatment. Agents enhancing softness of handle or any other desired effect may also be included as required. Suitable pigment binders are well known in the general field of

pigment printing textiles but due to the special conditions associated with the production of the colour discharge, not all of the binders which are used under normal circumstances will give a fully satisfactory result due to discolouration or other degradation reactions which may occur. The printer should therefore select suitable binders by experiment.

5 Another kind of pigment dispersion which may be used in this form of the invention is that known as water based or water compatible plastisol inks. These may be mixed with the discharge agent and the humectant and printed in the usual way. The fabric is then heat treated to produce the discharge effect using heating between impermeable blankets as described. Due to the thermoplasticity of plastisol inks, it can be advantageous to cover the print with a sheet of release paper to prevent adhesion to the
10 impermeable blankets during this stage of the process. After the discharge is complete, the print is fully cured by passage through a hot oven in the usual way for such inks. This procedure offers considerable advantage over the simple application of these inks on to dyed materials since discharging the colour makes it unnecessary to have sufficient ink present to mask the ground shade and consequently softer, better defined prints with a more attractive handle can be obtained.

15 A special advantage of the present invention is the rapidity with which the full discharge effect becomes apparent. This enables the discharged area of a final print to be produced in the course of a sequence of application of different inks to the fabric to produce a final design. Thus, the whole area to be decorated may be printed with a colourless binder free discharge ink constituted in accordance with the present invention and the printed fabric heated between hot plates for a short period or a succession of short
20 periods, e.g. two times 5 seconds at 160 ° C. The discharge printed area may then be printed with a variety of white or coloured inks without the requirement that the colouring matters be stable to the discharge reaction. It is thus possible to combine discharge printing with the application of reactive dyes in a way which cannot be achieved except with very considerable inconvenience by conventional discharge printing because of the time lag noted above between printing and the production of the discharge. Similarly,
25 pigments may be selected when this form of the invention is employed which are unstable to discharging. So-called expanding inks which increase in volume on heating may also be employed as well as adhesives for the subsequent application of metallic or other decorative effects to the fabric. This variant is of particular value in the printing of both regular and water based plastisol inks on to coloured grounds since the discharge removes the need to apply sufficient ink to mask the ground colour so the less ink can be
30 applied with consequent better design definition, economy and handle.

The following Examples will serve to illustrate the invention.

Example 1

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A printing ink is prepared containing the following (% by weight):

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Imperon Binder 506	10.6%
Alcoprint PHL	17.6%
Water	45.5%
Titanium Dioxide (as a 50% aqueous dispersion)	13.6%
Diammonium Hydrogen Phosphate	3.3%
Viscalex HV30	2.8%
Zinc Formaldehyde Sulphoxylate	6.6%
Imperon Binder 506 is an aqueous emulsion of acrylic polymers manufactured by Hoechst UK Ltd.	
Alcoprint PHL is a mixture of organic salts and ethoxylated esters manufactured by Allied Colloids Ltd.	
Viscalex HV30 is a mixture of polyacrylic acid derivatives manufactured by Allied Colloids Ltd.	

55 Using this ink, a design is printed by silk screen on to a cotton fabric dyed to a full red shade using Remazol Brilliant Red F3B (Hoechst UK Ltd). The printed fabric is then passed into a hot oven at 180 ° C between two continuous impermeable blankets held together to prevent drying for 30 seconds. The blankets are so arranged that, before emerging from the oven, the fabric passes between pressure rollers. It can be

seen that, as the fabric emerges from the oven, the red dye is discharged in the printed areas to give a white design. The fabric is then passed through a hot oven at 180°C for 1 minute to complete polymerisation of the binder and fixation of the white pigment. The design produced in this manner is fast to washing at 60°C, to wet or dry rubbing and to light.

- 5 If the printing is repeated without the use of the impermeable blanket, it is found that the discharge effect is only partially produced, is not stable to light, and the printed fabric has a much harsher less desirable handle.

10 Example 2

A printing ink is prepared containing the following (% by weight):

15	Acramine Binder SLN	11.1%
	Glycerol	19.1%
	Titanium Dioxide (as a 50% aqueous dispersion)	13.1%
	Copper Phthalocyanine as an aqueous dispersion)	5.0%
	Water	34.4%
20	Isopropanolamine	3.5%
	Viscalex V30	6.8%
	Formamidine Sulphinic Acid	7.0%
25	Acramine Binder SLN is an aqueous emulsion of acrylic polymers manufactured by Bayer.	

Using this ink, a design is printed by silk screen on to a cotton fabric dyed to a yellow shade by the pad-batch (cold) process using Remazol Brilliant Yellow 4GL (Hoechst UK Ltd). The printed fabric is then heated for 25 seconds in a book press at 175°C between impermeable felts. On removal of the fabric from the press, it is seen that it is printed with a bright blue design on a yellow ground. The fabric is then passed through a hot oven for 2 minutes at 185°C to complete fixation of the white and blue pigments. The design produced in this way is fast to washing at 60°C, to wet and dry rubbing and to light. It possesses a soft attractive handle.

35 Example 3

A printing ink is prepared containing the following (% by weight):

40	Hydroxymethyl cellulose	5.0%
	Alcoprint PHL	12.5%
	Monoethanolamine	3.5%
45	Formamidine Sulphinic Acid	7.0%
	Water	72.0%

A cotton garment panel dyed to a violet shade with Remazol Violet 5R (Hoechst UK Ltd) is mounted on a carrier board in a multicolour screen printing unit and printed with a design using the above ink. The mounted panel is then moved to the second station on the machine where it is pressed between heated plates at 165°C for 5 seconds. It is then moved to the third station where it is pressed between plates as before. At this point, it can be seen that the panel has a white discharged design in the printed areas.

Printing may then be continued using the fourth and subsequent printing stations to apply any desired coloured ink containing dyes or pigments as required. These may be fixed by any appropriate method to produce their normal fastness but with their normal shade due to their having been printed on a white ground as results of the discharge produced.

Claims

1. A process of decorating fabrics which comprises printing desired image areas forming a design on the fabric using a printing paste and subjecting the fabric so printed to a heat treatment prior to drying the
5 paste to fix the printed design in the fabric, wherein the printing paste contains water, a substantial proportion of humectant, colouring materials and/or decolouring materials, and wherein the heat treatment includes a stage at a temperature greater than 100 °C during which the fabric is confined between a pair of impermeable layers.
2. A process according to Claim 1, wherein the fabric to be decorated is dyed fabric and the printing paste
10 contains at least one reagent capable of reacting with the dye in the fabric at least substantially to destroy its colour and agents assisting the colour destroying reaction.
3. A process according to Claim 1 or 2, wherein the printing paste contains colouring materials and means to fix the colouring materials in the fabric and wherein the process comprises a further heat treatment under
15 conditions of time and temperature adapted to fix such colouring materials in the fabric to render them wash fast.
4. A process according to any one of Claims 1 to 3, wherein, subsequent to the application of the printing paste and heat treatment step(s), the fabric is overprinted with a colouring material to produce a design in a second printing step.
5. A process according to any one of Claims 1 to 4, wherein the printing paste contains at least 8% by
20 weight of humectant.
6. A process according to Claim 5, wherein the printing paste contains at least 12% by weight humectant.
7. A process according to any one of Claims 1 to 6, wherein the humectant is one or more of urea, glycerol, polyethylene glycol, thiodiglycol and ethoxylated esters.
8. A process according to any one of the preceding Claims, wherein the printing paste contains plastisol ink
25 components and the printed face of the fabric is covered during the heat treatment step(s) with a release paper.

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