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PROCESS FOR DEVELOPING FABRICS PRINTED WITH VAT DYESTUFFS

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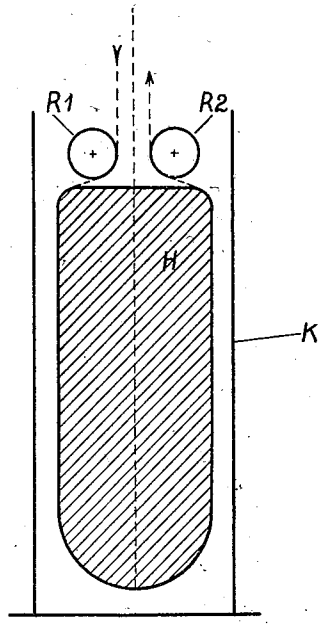
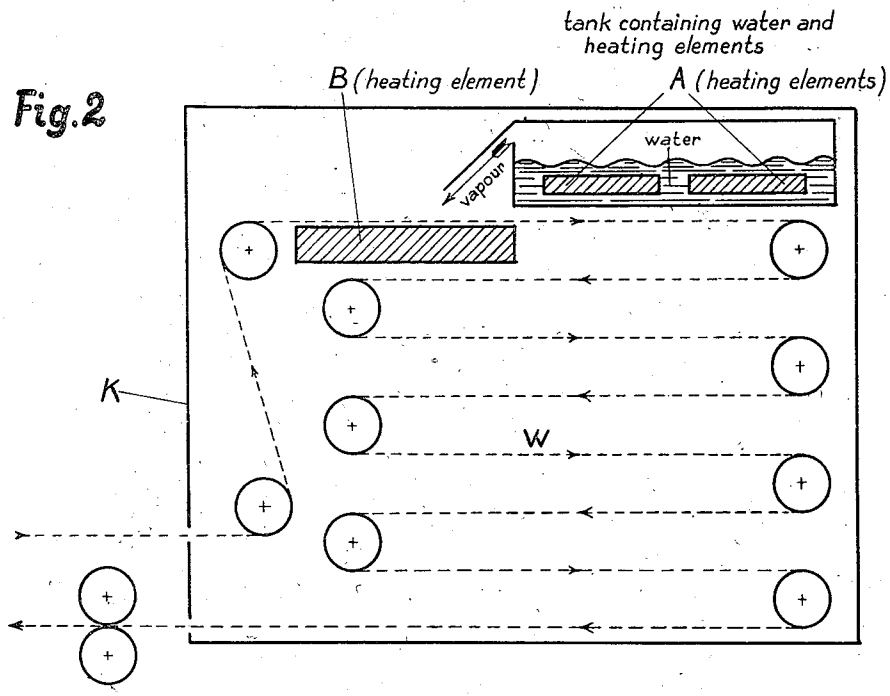


Fig. 1

Fig. 2



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PROCESS FOR DEVELOPING FABRICS PRINTED WITH VAT DYESTUFFS

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2 Claims. (Cl. 8—5)

The present invention relates to a process of developing fabrics printed with vat-dyestuffs.

As is known, fabrics which have been printed with vat-dyestuffs and on which there are present besides the dye-stuff and a thickening agent an alkali and hydrosulfite or a derivative thereof, are developed in a double-walled steaming device in which the goods are subjected to the action of steam at a temperature between about 100° C. and about 120° C., with exclusion of air. In these rather complicated devices the dyestuff is reduced and the leuco compound is fixed on the goods at the same temperature. The fabric thus prepared is then further treated in order to cause oxidation of the leuco-compound.

I have found that the development of moist printed goods of the above described kind is simplified and at the same time better prints are obtained with a more advantageous utilization of the dyestuff, by effecting the reduction of the vat-dyestuff on the moist goods instantaneously, that is to say, as rapidly as possible by means of heat, advantageously at temperatures below 100° C., for instance at about 70° C. to about 80° C., namely by exposing the goods in a moist atmosphere to a source of heat having a temperature exceeding that to which the goods are to be heated and removing them from the influence of the said source as soon as they have attained the desired temperature, so that their temperature then falls and the leuco-vat-dyestuff is fixed on the fiber at a temperature below the temperature to which the goods were heated for reduction. The exclusion of air during the reduction and fixation of the dyestuff is not necessary but advantageous in some cases.

The invention is based on the following observations:

It has been found that the reduction of practically all vat-dyestuffs to the leuco-form by means of suitable hydrosulfite concentrations occurs at about 70° C. to about 80° C. almost instantaneously, so that the application of higher temperatures and the prolongation of the time of reduction to half a minute or more, as is customary with the known devices, is not necessary.

It has also been found that hydrosulfite decomposes the more easily the longer it is exposed to heat and the higher the temperature, so that it is not advantageous to heat goods containing hydrosulfite for a longer time and to a higher temperature than is necessary. By developing in the known steaming devices under the usual conditions under which the hydrosulfite or its derivative is heated for about ½ to about 5 minutes at about 100° C. to about 120° C., decomposition of the hydrosulfite generally occurs too quickly. It is true that also under these unfavorable conditions the dyestuff is completely transformed into the leuco-form, but it is very important that the hydrosulfite which has been used in excess is not decomposed completely and that the necessary excess of reducing agent is always present, in order that the dyestuff may be retained on the goods in its leuco-form until it is finally fixed. By developing the goods in the known devices, the leuco-dyestuffs, in spite of the exclusion of air, are often decomposed, probably owing to lack of a reducing agent, and therefore, cannot be completely utilized. Only if the fixation process is so conducted that the conditions which cause the hydrosulphite to decompose are adapted as much as possible to the fixation process, is an almost complete utilization of the dyestuff guaranteed.

Furthermore, it has been found that the leuco-vat dyestuffs are best fixed on the goods at temperatures which are below those required for the most rapid reduction of the dyestuffs; the members of the group of dyestuffs which dye at a raised temperature are advantageously fixed at a temperature between about 50° C. and about 60° C. and those of the group of dyestuffs which dye in the cold are best fixed at room temperature.

The present process, in contradistinction to the processes hitherto known, offers the possibility of observing the above described favorable conditions of reduction and fixation of the vat dyestuffs and thus allows of obtaining the most favorable printing results.

The practically instantaneous heating of the moist goods, as is required according to the present invention, to the temperature which is the most favorable for the reduction of the dyestuff, for instance to about 70° C. to about 80° C., may be effected, for instance, by passing the moist goods through a short distance over heating elements which can be regulated, for instance, electric heating plates or resistance heating bodies with directed heat rays, the radiating thermal energy being adjusted according to the quality of the goods (for instance, thick or thin fabrics) and their content of moisture.

The quantity of radiated heat may advantageously be regulated by means of some known thermostatic device; thus, for instance, part of the current to be regulated may be conducted over a contact which is in as complete a vacuum

as practicable, the circuit being opened and closed by the expansion and contraction of a thin metal rod.

For dyestuffs which are advantageously fixed at room temperature, a simple device may be used, such as is shown diagrammatically in Fig. 1 of the accompanying drawing. The moist printed goods are conducted at as high a speed as possible over a roller R_1 alongside and round a body H which is heated to a suitable temperature and is contained in an open tank K, and then over the roller R_2 but so that the dyestuff on the goods is completely reduced. The dyestuff is advantageously fixed on the goods by a subsequent passage through the air, the temperature falling rapidly to room temperature.

For other dyestuffs which are best fixed at about 50° C. to about 60° C., a device such as is diagrammatically shown in Fig. 2 may be used. The chamber K which may have the shape of a box or a drum or the like and contains the heating element B is in this case so large that the goods after having passed the heating element have to travel along a path W before leaving the chamber K. Consequently, the temperature drop is not so rapid and the fixing may occur, for instance, at a temperature of 50° C. to 60° C.

Since it is necessary for the development of the dyestuffs that the goods should have a certain humidity and, on the other hand, a thin material when heated easily loses its relatively small quantity of humidity, it is advantageous to combine the developing devices according to the present invention with a humidifier as diagrammatically shown in Fig. 2. Such a humidifier may be constructed in a simple manner, for instance by a heating element A which can be regulated and is placed in water, which is thereby evaporated in the required quantity.

The humidifier may be controlled, for instance, on the principle of a hygrometer or by conducting the grid circuit of a tube electrode over two condenser plates which are placed in the chamber. According to the amount of humidity the dielectric constant varies and therefore also the resistance between the condenser plates. In this manner the humidifier also may be controlled.

By such a control of the humidity the goods are provided with the quantity of humidity which is the most advantageous and the arrangement is distinguished from the known developing devices especially by the fact that a deficiency or a detrimental excess of humidity is avoided. The steaming devices hitherto known have the drawback that the goods, in certain circumstances when introduced in a moist condition, take up a considerable quantity of condensation water which easily causes the dyestuff to bleed.

As thickening agents for the printing pastes there may be used those usually applied. It is not to be feared that the prints will bleed on the fabric since the printed goods, after drying, are passed only for a very short time through the bath containing an alkali and a reducing agent and also during the reduction are exposed only for a very short time to the action of heat. The cellulose derivatives known as useful for the purpose in question have proved to be the most advantageous thickening agents.

The invention is applicable not only to goods which have been printed with a dyestuff and a thickening agent, dried and then padded for a short time in a bath containing an alkali and a reducing agent, but also to goods which have been printed with a paste containing the dyestuff, an alkali, a reducing agent and a thickening agent, dried and moistened for a short time.

Hydrosulfite may advantageously be used as reducing agent in the present process; with a slight modification, however, the process is also operative if derivatives of hydrosulfite, such as formaldehyde sulfoxylates are used. In this case it is only necessary to start with a higher temperature of the heating device or to heat the goods at first to a higher temperature, for instance to 100° C., until the sulfoxylate has been decomposed and hydrosulfite has been formed, whereupon the process may be carried through practically in the manner described for the use of hydrosulfite.

If dyestuffs are used which are known to fix best on the goods in the cold, it has been found to be important to use the the optimum alkali concentration for the fixing process. This is practically attained by padding in a bath which contains, as far as possible, 1 molecular proportion of hydrosulfite for about 2 molecular proportions of caustic soda in solution so that, the hydrosulfite being nearly completely consumed, the caustic soda solution is neutralized to the most favorable extent.

The following examples serve to illustrate the invention, but they are not intended to limit it thereto,

(1) A paste is prepared from
75 grams of a 25.8 per cent. paste of the commercial dyestuff No. 1229 of Schultz, Farbstofftabellen 1931 (N-dihydro-1.2.1'.2'-anthraquinoneazine),
200 grams of water,
60 grams of thiodiethyleneglycol and
665 grams of starch tragacanth thickening (60 grams of tragacanth and 100 grams of starch per liter).

This printing color is printed on a fabric of vegetable nature, which is then dried and passed through a padding bath of 50° C. which contains
100 grams of hydrosulfite and
100 cc. of caustic soda solution of 40° Bé. per liter.
From this bath the moist goods are conducted into a tank (box) which contains electric heating elements. These elements heat the fabric as quickly as possible (in about 10 seconds) to 80° C. For about a further 50 seconds the goods travel through the box and cool, by radiation or dissipation of heat, to about 65° C. The goods thus treated are finished as usual (rinsed, oxidized, rinsed, soaped). There are obtained vivid blue patterns of good properties of fastness.

(2) An artificial silk fabric is printed with the following printing color:

200 grams of a 12 per cent. paste of the dyestuff obtainable by carbazolation of α-α-trianthrimide (according to U. S. Patent No. 1,900,350) are made into a paste with
800 grams of methyl-cellulose-thickening (100 in 1000).

The goods thus printed are passed through a bath at 40° C. containing
50 cc. of caustic soda solution of 40° Bé.
50 grams of hydrosulfite and
200 grams of Glauber's salt
} per liter

The well squeezed goods travel through the apparatus described in Example 1 and are subse-

quently passed through the air whereby they are cooled to about 40° C.

Thereupon, the goods are finished as usual (rinsed, oxidized, rinsed, soaped). There are obtained very fast yellow prints.

(3) Cotton fabric is printed with the following printing color:

150 grams of a 20 per cent. paste of 3.4.8.9-dibenzpyrene-5.10-quinone are made into a paste with
850 grams of methylcellulose-thickening (1:10).

The printed goods are then passed through a bath containing per liter:

100 grams of hydrosulfite
50 cc. of caustic soda solution of 40° Bé. and
120 grams of Glauber's salt.

The goods are squeezed to 100 per cent moisture and conducted for about 10 seconds over a plate heated by steam which heats the goods in the time specified to 70° C. Thereupon, the goods are passed through the air for about 60 seconds and are rinsed, oxidized, rinsed and soaped. There are obtained vivid yellow-orange prints.

(4) Linen fabric is printed with the following printing color:

150 grams of a 20 per cent paste of the commercial dyestuff No. 1269 of Schultz, Farbstofftabellen 1931 (dimethoxy-dihydrodibenzanthrone),
760 grams of methylcellulose-starch-thickening, (100 grams of methyl cellulose, 40 grams of starch for 1 kilo of thickening)
90 grams of water.

The goods thus printed are padded with a solution prepared from

100 grams of formaldehyde sulfoxylate
100 grams of potassium carbonate
75 grams of thiodiethylene glycol
50 grams of Glauber's salt
3 grams of a wetting agent
672 grams of water

and squeezed to 100 per cent humidity. Thereupon, the moist goods are introduced into the above described apparatus as shown in Figure 2 wherein they are heated in 2 minutes to about 100° C. by means of resistance heating devices. The goods then travel for a further 2 minutes through the apparatus in which they are cooled by radiation or dissipation of heat of the box to about 60° C. to about 70° C. The goods are then finished as usual. There are obtained vivid very fast green prints.

(5) The operations are as described in Example 1. There are used fabrics of different weight and different content of moisture, for instance, heavy cloth, light voile. During the passage of these kinds of cloth essentially different in weight and moisture, the moisture in the fixing apparatus is controlled by means of a device that controls the humidity. At the same time, the temperature of the goods is regulated by an automatic electric temperature-regulator.

(6) A mixed cotton viscose fabric is printed with the following printing color:

200 grams of a 23 per cent paste of the commercial dyestuff No. 1265 of Schultz, Farbstofftabellen 1931 (dichloro-isoviolanthrone),
500 grams of starch-tragacanth (40 grams of tragacanth, 80 grams of starch per kilo of printing paste) are made into a paste with
120 grams of potassium carbonate
100 grams of formaldehyde-sulfoxylate
80 grams of glycerine.

The goods thus printed are conducted through the apparatus referred to in Example 4, which contains also the humidifier described above. The humidifier imparts to the goods the necessary moisture. There are obtained deep black prints of good fastness properties.

(7) The operation is as described in Example 4 with the exception that the goods, which have been printed with vat-dyestuffs and on which there are present a thickening agent, and alkali and hydrosulfite or a derivative thereof, are dried and only immediately before they are introduced into the box, are moistened with water by padding them according to one of the usual methods.

I claim:

1. A process of developing moist fabrics which have been printed with vat-dyestuffs and on which there are present, besides the dyestuff and a thickening agent, an alkali and a reducing agent of the group consisting of hydrosulfite and the formaldehyde derivative thereof, wherein for reducing the dyestuff the goods are heated rapidly to a temperature below 100° C. by exposing them in a moist atmosphere to a locally limited source of heat, removing them from the influence of the said source of heat as soon as the dyestuff is reduced and fixing the dyestuff in the reduced state on the fiber at a temperature lower than that to which the goods were heated for reduction.

2. A process of developing moist fabrics which have been printed with vat-dyestuffs and on which there are present, besides the dyestuff and a thickening agent, an alkali and a reducing agent of the group consisting of hydrosulfite and the formaldehyde derivative thereof, wherein for reducing the dyestuff the goods are heated rapidly to a temperature of about 70° C. to about 80° by exposing them in a moist atmosphere to a locally limited source of heat, removing them from the influence of the said source of heat as soon as the dyestuff is reduced and fixing the dyestuff in the reduced state on the fiber at a temperature lower than that to which the goods were heated for reduction.

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