

## UNITED STATES PATENT OFFICE

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## VAT DYEING

No Drawing.

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This invention relates to a process of applying vat colors to materials such as cotton piece goods. More particularly it relates to a special method of developing the color on the goods.

In the usual art of vat dyeing, particularly with heavy shades, it has been practically impossible satisfactorily to pad the material being dyed without supplementing the padding operation by passing the fabric through a jigger. The dyestuff in the unreduced form is padded on the fabric, and the penetration of the dye into the fibres of the fabric is expedited by thereafter passing the padded fabric through a jigger in which is maintained a reducing bath. Even for light shades it has been found convenient to pad the fabric with the reduced dyestuff and then subject the padded fabric to a jigger, in which is maintained a reducing bath. The reduced dyestuff in either case is thereafter developed by oxidation in the usual manner. The two steps of padding and jiggering have heretofore been necessary because without them it has been impossible to obtain a proper penetration of the fibres of the fabric. When the attempt has been made to dye the fabric in a single stage process, the fabric has not been uniformly dyed.

It is one object of this invention to carry out a process of vat color printing or dyeing in a single step in place of the two steps heretofore used. It is a further object to permit single step dyeing with vat colors in heavy as well as light shades. It is a further object of the invention to carry out the dyeing in such a way as to develop the color on the goods and obtain dyes which are faster to soaping and rubbing than are the dyes of previous processes. It is a still further object to carry out the dyeing process in a way more economical than has heretofore been possible. Further objects will be apparent from the description.

The above objects are attained by reducing the vat color to its leuco-compound and applying the leuco-compound directly to the goods, at the same time retarding the oxidation of the leuco-compound sufficiently to

allow penetration of the dye into the fiber of the goods.

As a specific example, given by way of illustration and not in limitation, the vat color is reduced to its leuco-compound in the usual manner in a vat containing caustic soda, glue and hydrosulfite. Specifically 160 gallons of pad liquor are prepared by adding the following ingredients to a sufficient quantity of water:

10 lbs Ponsol blue GD double paste  
(Schultz No. 842)  
8 lbs. of sodium hydroxide  
8 lbs. of sodium hydrosulfite  
8 lbs. animal glue

To this liquor is added one quart of an anthraquinone solution prepared by dissolving in three parts of water the following ingredients:

1 part of anthraquinone  
 $\frac{1}{8}$  part of sodium hydroxide  
 $\frac{1}{4}$  part of sodium hydrosulfite

The goods to be dyed are padded or passed through this combined solution and from this padding the goods are passed directly to a suitable squeeze roll, the color being forced into the goods by squeezing. The color is then developed with steam by running the wet goods from the squeeze rolls directly on hot cans (which are merely cylindrical drums, the interiors of which are steam heated) before the color is oxidized to its insoluble state. The goods are then soaped at the boil in the usual way to remove any loose dyestuff which may be deposited on the surface of the goods.

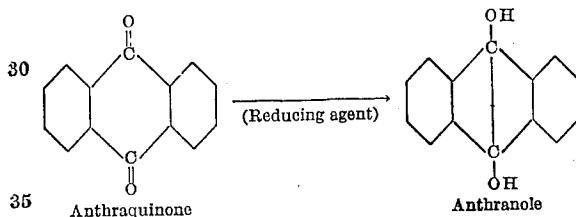
This method is more economical than previous methods in that it combines in one step the impregnation of the goods and reduction of the dye. The resultant dyeings obtained are faster to soaping and running than those previously obtained by the usual methods. In the usual pad-jig method, the dyestuff is padded or applied to the goods in unreduced form and thereafter penetration of the dyestuff is expedited by the use of a reducing bath in a jigger. The use of the jig method entails the passage of the goods

back and forth through the dye bath for some time to obtain the desired results. The dyeings obtained by the present method are remarkably good and are superior for vat colors in both light and heavy shades.

Anthraquinone has been used in textile printing previously but it has always been used to render the discharge whiter. It has not served in any way to produce a colored textile. However, where in the past anthraquinone has been used to remove color, the present method entails the use of anthraquinone in a dyeing process.

The method described is applicable to substantially all vat colors but its principal importance lies in connection with the anthraquinone vats, since these are characterized by the fact that they oxidize very rapidly.

Various modifications may be made in the details of the process. It will be apparent that other alkalis may be used in place of caustic soda and other suitable reducing agents may be used in place of sodium hydrosulfite, if desired. The reducing bath to which the anthraquinone is added apparently reduces the anthraquinone to anthranole, as shown in the following formulæ:



The anthranole appears to be active as a negative catalyst or oxidation inhibitor in the present process, so I do not wish to be limited to any definite theory of operation. Anthranole is quite unstable when in contact with air, and its positive identification in a reaction mixture such as I employ entails considerable difficulty. It is, therefore, to be understood that by the expression "anthranole" is meant those derivatives of anthraquinone obtained by subjecting anthraquinone to a reducing bath of the type described above. Substituted anthraquinones, such as anthraquinone sulphonic acid or amino anthraquinone sulphonic acid, may be employed in lieu of the unsubstituted anthraquinone. Such compounds give, upon reduction, substituted anthranoles, such as amino anthranole sulfonic acid. The proportions of the materials used may be varied within wide limits appropriate to the particular vat color and the depth of shade required, as is well understood in the dyeing art.

Suitable changes may be made in the method described without departing from the spirit and scope of the invention.

I claim:

1. In a process of vat color printing vegetable fibres the step which comprises adding

an oxidation inhibitor to retard the oxidation of the leuco-compound of the vat dye sufficiently to allow penetration of the dye into the fiber of the material being dyed.

2. The process which comprises reducing a vat color to its leuco-compound, padding goods composed of vegetable fibres in a solution of such compound, passing the goods through squeeze rolls and developing the dye with steam, the oxidation of the leuco-compound being retarded sufficiently by the addition of an oxidation inhibitor to allow the penetration of the dye into the fiber of the goods.

3. The process which comprises preparing a solution of alkali, anthraquinone, hydrosulfite and a vat color, padding vegetable fibre goods to be dyed in said solution, squeezing the dyed goods and developing the color on the goods with steam.

4. In the process of coloring vegetable fibres with vat colors, the step which comprises padding the material to be dyed in a reduced dye solution which contains anthraquinone, alkali hydrosulfite and alkali hydroxide.

5. In the process of coloring vegetable fibres with vat colors, the step which comprises padding the material to be dyed in a reduced dye solution containing anthraquinone, sodium hydrosulfite and sodium hydroxide.

6. In the process of coloring vegetable fibres with vat colors, the step which comprises padding the material to be dyed in a reduced dye solution containing in solution an oxidation inhibitor composed of approximately 8 parts of anthraquinone, 2 parts of sodium hydrosulfite, and 1 part of sodium hydroxide.

In testimony whereof, I affix my signature.

FRANK L. REMLEIN.