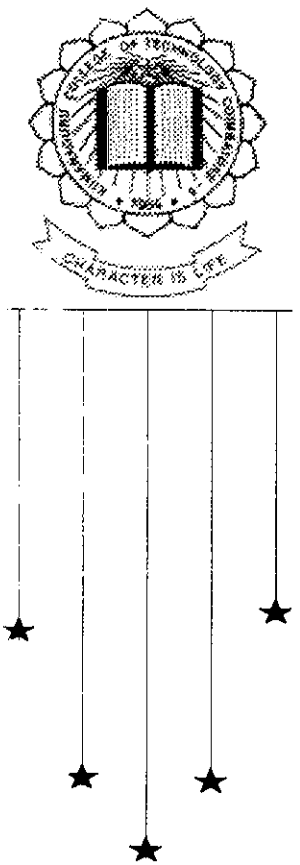
INFLUENCE OF MERCERIZATION ON DYEING OF KNITTED FABRICS



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PROJECT REPORT

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In partial fulfillment of the requirements
for the award of the degree of
BACHELOR OF TECHNOLOGY IN
TEXTILE TECHNOLOGY
of the Bharathiar University, Coimbatore.

Department of Textile Technology

Kumaraguru College of Technology

COIMBATORE- 641 006.

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Coimbatore-641 006

Department of Textile Technology

Certificate

This is to certify that this project entitled

INFLUENCE OF MERCERISATION ON
DYEING OF KNITTED FABRICS

has been submitted by

Mr. _____

In partial fulfillment of the requirements for the award of degree of Bachelor of Technology in the Textile Technology branch of the Bharathiar University, Coimbatore – 641 046 during the academic year 2000-2001.

Guide ***Head of the Department***

Certified that the candidate was examined by us in the project work.

Viva-voice Examination held on 28/3/2001

University Register Number

Internal Examiner ***External Examiner***

Dedicated
to our
beloved Parents

Acknowledgement

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Synopsis

SYNOPSIS

Mercerization is the process of treating cotton yarn or fabric with caustic soda of 52° - 56 ° Tw for a small time and then removing as much caustic soda as possible from the fabric under tension. It has been found that a part of the caustic soda is taken out by the material which cannot be removed by washing and neutralization. Due to the physical changes brought about by the absorbed caustic soda several desired properties are achieved by the mercerized material such as increase in lusture, increased dye ability, better dimensional stability, better reactivity.

Several authors have found out the increasing dye affinity of mercerized cotton using various class of colours. Irrespective of the class of colour used for dyeing there is a substantial improvement in the dye ability of cotton when mercerized. In the present study a comparison of dye uptake has been made using three direct colours, two vat colours and two reactive colours on mercerized as well as unmercerised cotton fabric. Dyeings were carried out by the recommended procedure for exhaust dyeing in all cases, results show that in case of vat and direct colours that increase in dye up take obtained on mercerized cotton in any case is not more than 40% of the colour taken up by the unmercerised fabric. In case of reactive colours in most of the cases there is nearly 100% increase in dye exhaustion. This is very remarkable to consider the fact that reactive dyes on the whole have poor affinity for both unmercerized and mercerized cotton in the absence of salt. The trend seen in case of padding is seen in exhaust dyeing also. It is very essential to use mercerized fabrics only for dyeing of reactive as lot of

colour will be wasted if application of colour is done by exhaust method. Reflectance tests showed changes in lusture properties for the above mentioned dyes. Relative colour strength of mercerized and unmercerised samples were also found.

Introduction

INTRODUCTION

Mercerization is a process of treating vegetable fibre, yarn or fabric with caustic soda of a strength varying 52 - 56° Tw at a temperature of 15° C. the process of mercerization was invented by John Mercer. When he was filtering a solution of caustic soda of 60° Tw through a filter made of cotton fabrics he observed that the filter cloth had undergone some peculiar change. The portions where caustic soda came into contact with the fabric were found to be semi transparent and contracted both in length and breadth and due to this became thick. Mercer conducted several experiments with caustic soda of mercerizing strength and in all cases he observed the same type of changes. This experiment gave conclusion that caustic soda of a strength 52 - 56° Tw is able to bring about some attractive changes on cellulosic fibres. Later on , it was found that if the temperature is sufficiently low and the treatment is done under tension cotton attain several more desirable characteristics. Due to the preferential absorption of caustic soda the strength of caustic soda solution decreases considerably and hence a more concentrated solution of caustic soda should be fed in the treating both so as to maintain the strength of the solution more or less constant in continuous mercerisation process. Later on, it was found that some of the caustic soda is firmly retained by the cotton which cannot be removed at all, even by neutralization with acid at high temperature. Hence, it was thought that caustic soda of mercerizing strength combines with cellulose to form a product which has all the properties observed by Mercer and later experiments of mercerization.

Effect of temperature on mercerization shows that as the temperature of alkali used for mercerization increases the mercerizing action is getting diminished. The suitable temperature was found to be nearly 15° . However , it will be costly to cool the caustic dye bath so that mercerization is done now-a-days at room temperature.

Mercer observed the following properties in a fabric which has been treated with caustic soda of the desired concentration.

1. Shrinkage in the area of cloth and the length of the yarn.
2. Increase in tensile strength.
3. Increased hygroscopicity.
4. Increased capacity for absorbing dye stuff.
5. Preferential absorption of sodium hydroxide during the process.
6. Increased action at lower temperature.
7. Possible compound formation, namely, soda-cellulose.

When cotton yarn or fabric is treated with caustic soda of mercerizing strength , it was found to shrink considerably. If this shrinkage is avoided by mercerizing under tension or by mercerizing in slack form and stretching to the original dimensions before caustic soda is fully washed the material attains a good lusture. Study of microscopial cross section shows that the bean shaped cross section of the original fibre slowly changes to a round form.

We consider a material bright and lustrous if the light falling on it is fully reflected and sent to our eyes. Bean shaped cross section helps in the scattering of light where as more or less circular cross section will not scatter away light in various direction and due to that it will appear more bright lustrous. Deconvolution and conversion of the original cross section to more or less circular shape are the reasons for attaining lusture in mercerized cotton, increases in lusture can be identified visually or better still by using a reflectometer as designed by Adderley.

There is an increase in moisture absorption, barium hydroxide absorption by cotton after mercerization. Caustic soda bring about the swelling of cotton where by the sites where previously not accessible to the above compounds will not become available to them and due this reason only mercerized cotton shows better reactivity. There will be parallelisation of cellulose chain molecules after mercerization due to which mechanical properties such as tensile strength , tear strength etc., are improved.

Increase in dye affinity due to mercerization was noticed by Minajeff and Schaposchnikoff, who carried out a number of quantitative experiments on dye absorption by mercerized and unmercerised cotton. Studies conducted using indigo and diamine blue 3B showed a n increase in dye uptake of 30% and 40% respectively. In case of Immedial blue C mercerized cotton was found to show 40% more dye uptake than ordinary cotton. Chemicals like tannin also taken to higher extent by mercerized cotton. These experiments were all conducted using cotton mercerized without tension.

Economy in dyeing is achieved due to better exhaustion of dye stuff on mercerized cotton HUBNER. HUBNER felt even though the same percentage shade is obtained on mercerized, and unmercerised cotton taking equal amounts of them and dyeing with the same amount of colour. There is a remarkable difference in the depth of colour obtained on both the fibre. HUBNER and POPE carried out several experiments to correlate colour uptake with strength of caustic liquor used for mercerizing. Bleached yarn was mercerized without tension , washed and then dyed without drying in a bath of 0.25% benzopurpurin 4B for half an hour at boil. The various banks were then washed and dried and the depth of shade estimated by visual examination. The colour uptake was found to increase continuously from the unmercerised yarn to the yarn mercerized with 25% sodium hydroxide solution. There after there was only a very little change up to 31.5% of sodium hydroxide . when the alkali concentration was increased more than 36.5% of caustic soda the depth of shade decreased.. the maximum dyeing effect was at 25% - 31.5% caustic soda does not show a sharp maximum for alkali concentration. Due to the fact that during washing of cotton after mercerizing the more concentrated solution must momentarily except the effect of a more dilute solution. It can be concluded that if mercerization is done to increase dye uptake only concentration of caustic soda used can be anything between 25% and 31.5%.

KNECHET measured the absorption of benzopurpurin 4B from a boiling dye bath by Egyptian cotton yarn which had been pre-wetted with boiling water, mercerized under tension with varying concentration of caustic soda solutions and finally dried. The dye bath contain 3% benzopurpurin 4B , 5% sodium carbonate and 10% common salt and an

m:l ratio 1:20 was used. The colour taken up by the mercerized yarn was found by quantitative estimating using titanous chloride . The weight of the absorbed dye was found to increase with concentration of mercerizing alkali but the increase is less rapid as the concentration of sodium hydroxide exceed 13.5%

KNECHT has investigated the effect of drying on mercerized yarn and correlated with dye absorption. Bleached American yarn was mercerized in 20%sodium hydroxide solution. Washed, acidified and washed again till neutral. One portion was dried for one hour between 100°C and 110°C while the other remain wet. Both were died together for 15 minutes in the boiling bath of benzopurpurin solution. The up take of colour on mercerized dried and dyed to be 1.16% was mercerized and dyed without drying was 1.74% Hence it can be concluded that the drying of yarn after mercerizing brings about a decrease in affinity for direct dyes and this decrease is greater if the temperature of dyeing is higher. Similar experiments were carried out with unmercerised cotton for comparison purpose, but no appreciable effect in colour uptake was observed by the wetting and drying operation. Knecht has also showed that a 25% of glycerine thickened with British gum can conserve the moisture in the printed portions.

Study of the absorption of chlorozal sky Blue FF by cotton fabric mercerized without tension was done by Hobson, Neale and String Fellow. The increase in colour uptake by the mercerized fabric was found to be almost independent of the amount of salt used for exhausting the dye bath. The ratio of dye uptake of unmercerised to mercerized

cotton was found to be 1:1.6 which is very similar to the ratio found in case of, water vapour by Urquhart and Williams.

Lindermann has studied the absorption of iodine and direct dyes with mercerized and unmercerised cotton and arrived at a method for distinguishing between mercerized and unmercerised cottons by means of affinity diagrams.

Boulton and Mortan have studied the relative speed of dyeing mercerized and unmercerised American cotton using 0.12% chlorizol Sky Blue FF and 50% sodium chloride at 90° using an m:l ratio of 1:40. the time of half absorption was found to be 0.35 minutes in case of mercerized cotton where as it was 1.4 minutes in case of unmercerised cotton.

The dye absorption work done by several research workers employed only direct dyes and there is enough scope for conducting further research with colours belonging to other classes and which have low affinity values as compared to direct dyes.

Scope of the Present Investigation

SCOPE OF THE PRESENT INVESTIGATION

A survey of literature shows that much work has been done in the assessing the increased dye uptake of mercerized cotton using direct, vat and azoic colours . Very less work is done using reactive colours and a correlation between different reactive system and dye uptake on mercerized fabric is not studied. In the present investigation we have given importance to the reflectance values and the relative colour strength of different dyes . Also a comparative study is made in dyeing of mercerized and unmercerised knitted fabrics. The results are tabulated and recorded.

Summary of Results

SUMMARY OF THE RESULTS

1. Irrespective of the class of colour studied mercerized fabric takes up a very good amount of colour as compared to the unmercerised fabric due to the increase in affinity imparted by the mercerization process.
2. The increase in dye uptake is very high almost 100% in case of all the reactive colours studied.
3. As the percentage of shade dyed increases there is a decrease in the percentage exhaustion in both mercerized and unmercerised cloth. When a graph is plotted with percentage shade against exhaustion nearly parallel curves are obtained for mercerized and unmercerised fabric.
4. If percentage exhaustion is plotted against initial dye bath concentration of a particular dye, incase of unmercerised and mercerized cotton nearly parallel curves may be obtained.
5. If percentage exhaustion is plotted against final dye bath concentration of a particular dye, in case of unmercerised and mercerized cotton sample nearly parallel curves may be obtained.
6. Direct colours were found to have better affinity for cotton when compared to vat colours. Reactive colours have very poor affinity among all the three classes studied.
7. As far as exhaustion is considered there is no appreciable difference in case of reactive dyes having different reactive colours.
8. Improvement in lusture properties was found as indicated by the reflectance tests.

Materials and General Procedures

MATERIALS AND GENERAL PROCEDURES

FABRIC PARTICULARS :

For both mercerized and unmercerised samples -

Count – 30s

Fabric - single jersey / plain

Name of the machine – FALMAC

Gauge - 24

Diameter – 26 inches

GSM - 140

DYEING WITH DIRECT DYES :

MATERIALS USED :

a. FABRIC

   i. mercerized fabric

   ii. unmercerized fabric

b. DIRECT DYES

   i. Royal blue

   ii. Red

   iii. Bordo

All dyes used are of commercial quality and dyed samples are prepared on mercerized and unmercerised fabric at room temperature. Percentage exhaustion is

assessed based on colorimetric examination of the dye bath after dyeing and wavelength of the light absorbed by each colour to get maximum optical density as follows.

CHEMICALS :

1. soda ash	-	commercial quality for enhancing the dissolution of direct dyes.
2. sodium chloride	-	for exhaustion (commercial quality)

EQUIPMENTS :

1. Aluminium dye bath of 2 litres capacity for carrying out dyeing.
2. Spectrophotometer manufactured by MINOLTA CO. Ltd.

PROCEDURE FOR DYEING DIRECT DYES :

The colour is mixed with little amount of soda ash and pasted with cold water. Then hot water is added for dissolving the colour. The cold water is added to make up the volume.

The mercerized and unmercerised fabrics are weighed accurately. The M:L ratio used is 1 : 20. the mercerized and unmercerised fabrics are dyed with 1% , 2% and 4% shades.

Before dyeing the initial strength of all the dye baths are found out using spectrophotometer.

The dyeing was started at room temperature and dyeing is done at 65 - 70°C for one hour. 10% of sodium chloride is added for the exhaustion of the dye bath. The dyeing is continued for another one hour. Then the fabric is washed and dried.

The colour left out in the bath after dyeing is estimated by determining the optical density of 1 ml of solution. After diluting it suitably, optical density measurement is carried at the particular wavelength on which the percentage transmission is minimum. Dye bath exhaustion is calculated in case of all dyes and compared . visual examination is also carried in case of all colours.

Standard graph is plotted with optical density in Y-axis and concentration in X-axis. The concentration is directly read out from the optical density shown by the solution multiplying this with the dilution factors given and final dye bath concentration in mg/l.

DYEING WITH VAT DYES

MATERIALS USED :

a. FABRIC
   1. mercerized fabric
   2. unmercerised fabric

b. VAT DYES
   1. Gold
   2. orange

c. CHEMICALS
   1. Caustic soda 72° Tw
   2. Turkey Red Oil
   3. Sodium hydro sulphite
   4. Sodium Chloride

PROCEDURE FOR DYEING OF VAT DYES :

IN CLASS OF DYES :

The dye stuff is pasted with required amount of wetting agent and little hot water followed by further hot water to make up the volume. Now sodium hydroxide of 72°Tw and sodium hydro sulphite at 50 - 55°C is added , now vatting is done for 15 minutes.

The mercerized and unmercerised fabrics are weighed accurately. M : L ratio used is 1 : 20. the mercerized and unmercerised fabrics are dyed with 1%, 2% and 4% shades. Before dyeing the initial strength of all the dye baths are found by using spectrophotometer.

Now the dye bath is set with colour and little amount of sodium hydroxide and sodium hydrosulphite. The dye bath is set at a temperature of 55 – 60 °C. dyeing is carried out for 45 minutes. The presence of excess of sodium hydro sulphite is tested with vat paper (yellow to blue) and for sodium hydroxide with phenolphthalein paper (colourless to violet) during dyeing. If it is found low required amount is added. After dyeing the fabric is squeezed and oxidized by stirring for 5 minutes and washed with water, soaped with 0.2% soap at boil for 10 minutes and dried.

The colour left out in the bath after dyeing is estimated by determining the optical density of 1 ml of the solution after diluting it suitably. Optical density measurement is carried out at the particular wave length on which the percentage transmittance is minimum. Dye bath exhaustion is calculated in case of all dyes and compared . visual examination is also carried out in case of all colours.

IW CLASS OF DYES :

The dye stuff is pasted with required amount of wetting agent and little hot water followed by further hot water to make up the volume. Now , sodium hydroxide of 72°Tw and sodium hydro sulphite at 50°C is added. Now, vatting is done for 15 minutes.

The mercerized and unmercerised fabrics are weighed accurately. M : L ratio is 1:20. the mercerized and unmercerised fabrics are dyed with 1%, 2% and 4% shades. Before dyeing the initial strength of all the dye baths are found out by using spectrophotometer.

Now the dye bath is set with colour and little amount of sodium hydroxide and sodium hydro sulphite. The dyeing is done at 50°C for 15 minutes. Then 10% common salt is added for exhaustion. Dyeing is continued for another 30 minutes. The presence of excess of sodium hydro sulphite is tested with vat paper (yellow to blue) and for sodium hydroxide with phenolphthalein paper (colourless to violet) during dyeing. If it is found low, required amount is added, After dyeing the fabric is squeezed and oxidized by airing for 5 minutes and washed with water, soaped with 0.2% soap at boil for 10 minutes and dried.

The colour left out in the dye bath after dyeing is estimated by determining the optical density of 1 ml of dye solution after diluting it suitably. Optical density is carried out at the particular wavelength on which the percentage transmittance is minimum. Dye

bath exhaustion is calculated in case of all dyes and compared . visual examination is also carried out in case of all colours.

DYEING WITH REACTIVE DYES

MATERIALS USED :

d. FABRIC

1. Mercerised fabric
2. Unmercerised fabric

e. DYES

Cold brand colours

1. Green
2. Violet

f. CHEMICALS

1. urea
2. sodium bicarbonate
3. tri sodium phosphate
4. sodium silicate

PROCEDURE FOR DYEING COTTON FABRIC WITH COLD BRAND REACTIVE DYES

The dye stuff is pasted with cold water and then cold water is added to make up the volume. The cloth is padded through a solution containing the following recipies.

	1% Shade	2% Shade	4% Shade
Colour	10 gpl	20 gpl	50 gpl
Urea	100 gpl	150 gpl	200gpl
Sodium bi carbonate	10 gpl	10gpl	10 gpl

After padding , the cloth is dried and cured at 150°C for 4 – 5 minutes. Then it is washed, soaped , hot washed and cold washed and then dried. Before padding, the dye is taken and its strength in mg/l is found out. Then the cloth is padded and the strength of the liquor after padding is found out in mg/l using spectrophotometer. From that the percentage exhaustion of mercerized and unmercerised fabrics are dyed with 70% expression. Bowl pressure is maintained at 20lb carefully.

REFLECTANCE TESTS

An object absorbs part of the light from the light source and reflects the remaining light. This reflected light enters the human eye, and the resulting stimulation of the retina is recognized as the object's colour by the brain. Each object absorbs and reflects light from different portions of the spectrum and in different amounts; these differences in absorptance and reflectance are what make the colours of different objects different.

If we use a spectrophotometer for measurements, not only can we obtain the numerical data, but we can also see the spectral reflectance graph for that colour. Further, with its high-precision sensor and the inclusion of data for a variety of illuminant conditions, the spectrophotometer can provide higher accuracy than that obtainable with a tristimulus colorimeter. Reflectance tests were carried out for mercerized and unmercerised dyed samples for 2% shade in each dye.

Experimental Results

EXPERIMENTAL RESULTS

DIRECT DYES

COLOUR : Royal blue

SHADE : 1%

Fabric	**Time of dyeing (Hrs)**	**Temperature °c**	**Initial conc. Of dye bath Mg/l**	**Final conc. Of dye bath Mg/l**	**Exhaustion of dye bath %**
Unmercerised	2	65 – 70	500	184.705	63.1
Mercerized	2	65 – 70	500	137.409	72.5

Shade : 2%

Unmercerised	2	65 – 70	1000	468.72	53.13
Mercerized	2	65 – 70	1000	384.7	61.53

Shade : 4%

Unmercerised	2	65 – 70	2000	1249.6	37.6
Mercerized	2	65 – 70	2000	1015	49.3

Colour : Red

Shade : 1%

Fabric	Time of dyeing (Hrs)	Temperature °C	Initial conc. Of dye bath mg/l	Final conc. Of dye bath mg/l	Exhaustion of dye bath %
Unmercerised	2	65 - 70	500	66.4	86.7
Mercerised	2	65 – 70	500	22.3	95.54

Shade 2%

Unmercerised	2	65 – 70	1000	179.9	82.01
Mercerised	2	65 – 70	1000	89.9	91.00

Shade 4%

Unmercerised	2	65 – 70	2000	446.3	77.6
Mercerised	2	65 - 70	2000	268.2	86.6

Colour : Bordo

Shade : 1%

Fabric	Time of dyeing (Hrs)	Temperature °C	Initial conc. Of dye bath mg/l	Final conc. Of dye bath mg/l	Exhaustion of dye bath %
Unmercerised	2	65 – 70	500	240.37	52
Mercerised	2	65 – 70	500	204.3	59.2

Shade 2%

Unmercerised	2	65 – 70	1000	515.5	48.4
Mercerised	2	65 - 70	1000	444.68	55.5

Shade 4%

Unmercerised	2	65 – 70	2000	1072.64	46.37
Mercerised	2	65 - 70	2000	946.5	52.7

VAT DYES

Colour : Gold

Shade : 1%

Fabric	Time of dyeing (Min)	Temperature °C	Initial conc. Of dye bath mg/l	Final conc. Of dye bath mg/l	Exhaustion of dye bath %
Unmercerised	45	55 – 60	500	296.8	40.7
Mercerised	45	55 - 60	500	250	50.0

Shade 2%

Unmercerised	45	55 – 60	1000	671.87	32.8
Mercerised	45	55 - 60	1000	587.5	41.25

Shade 4%

Unmercerised	45	55 – 60	2000	1508.1	24.6
Mercerised	45	55 - 60	2000	1331.9	33.4

Colour : Orange

Shade : 1%

Fabric	Time of dyeing (Min)	Temperature °C	Initial conc. Of dye bath mg/l	Final conc. Of dye bath mg/l	Exhaustion of dye bath %
Unmercerised	45	55 – 60	500	354	29.2
Mercerised	45	55 – 60	500	302	39.6

Shade 2%

Unmercerised	45	55 – 60	1000	763.0	23.7
Mercerised	45	55 – 60	1000	671.2	32.9

Shade 4%

Unmercerised	45	55 – 60	2000	1636	18.2
Mercerised	45	55 – 60	2000	1466	26.7

REACTIVE DYES

Colour : Green

Shade : 1%

Fabric	Time of dyeing (Hrs)	Temperature °C	Initial conc. Of dye bath mg/l	Final conc. Of dye bath mg/l	Exhaustion of dye bath %
Unmercerised	1	Room temp.	500	479.16	4.17
Mercerised	1	Room temp.	500	450.33	8.4

Shade 2%

Unmercerised	1	Room temp.	1000	968.7	3.13
Mercerised	1	Room temp.	1000	949.3	5.07

Shade 4%

Unmercerised	1	Room temp.	2000	1962.5	1.87
Mercerised	1	Room temp.	2000	1950	2.5

Colour : Violet

Shade : 1%

Fabric	Expression percentage	Pressure lb	Initial conc. Of dye bath mg/l	Final conc. Of dye bath mg/l	Exhaustion of dye bath %
Unmercerised	70	20	10000	9375	6.25
Mercerised	70	20	10000	8806.8	11.93

Shade 2%

Unmercerised	70	20	20000	19318.18	3.41
Mercerised	70	20	20000	18522..73	7.39

Shade 4%

Unmercerised	70	20	50000	48863.64	2.27
Mercerised	70	20	50000	47727.27	4.55

When present exhaustion is plotted against final dye bath concentration of particular dye, incase of unmercerised and mercerized cotton, nearly parallel curves are obtained. In this case the curve obtained is similar to the previous curve there is no change in the cotton trend after dyeing.

Irrespective of the nature of the fibre (mercerized or unmercerised) a reactive colour is exhausted better by the padding method when compared to exhaust dyeing without salt. This is expected because the colour as such has got very poor affinity for cotton and hence increase in time cannot bring about an increase in dye bath exhaustion. Only a driving force in the form of mechanical pressure or in the form of exhausting agent can bring about a better penetration and better uptake of colour by fibre. Since mechanical pressure is used in padding gives better result. However no study was possible to assess the effect of salt in bringing about the enhanced dye bath exhaustion due to lack of time.

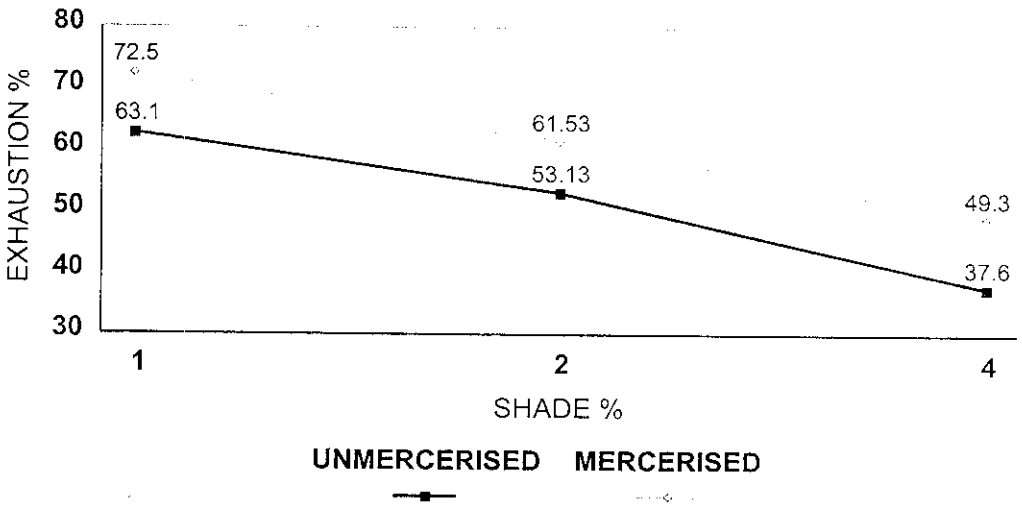
Direct colours found to have better affinity of cotton when compared to vat colours. Reactive colours have very poor affinity among all the three classes studied . this may be due to the bulky complicated structure of vat colours as compared with the more or less the plain structure of direct colours. Direct colours are found to move faster and occupy less space as compared to vat dye molecules which resulted in a better exhaustion of the former colours. Reactive colours even though they are similar to direct colours due to lack of fibre affinity giving groups the impinging molecules cannot be held firmly at the hydroxyl groups of cellulose before the chemical bond formation process.

As far as exhaustion is concerned there is no appreciable difference in case of reactive dyes having different reactive groups. This clearly show that reactive groups don't have any saying in the affinity of reactive dyes. The group present in the main chromogen determine the affinity of all brands of reactive colours. Their function is to form a co – valent bond with the fibre and they control only the stability of the bond. They can fix colour with the fibre in the presence of alkali but they cannot influence at all. The dye uptake bringing about a substantial colour yield.

Reflectance values and relative colour strength values were found for different wave lengths under standard lighting conditions in the spectrophotometer. From these values we find lusture effect in mercerized and unmercerised dyed samples.

Our studies show that mercerization is very essential for cotton fabrics if they are to be dyed with reactive dyes since the increase in dye uptake obtained in case of reactive colours due to mercerization is very high as compared with direct and vat colours. Since dye exhaustion is very low it is very essential that an efficient exhaustion agent should be used in reactive colour dyeing by the exhaust dyeing method so as to minimize colour wastage.

ROYAL BLUE



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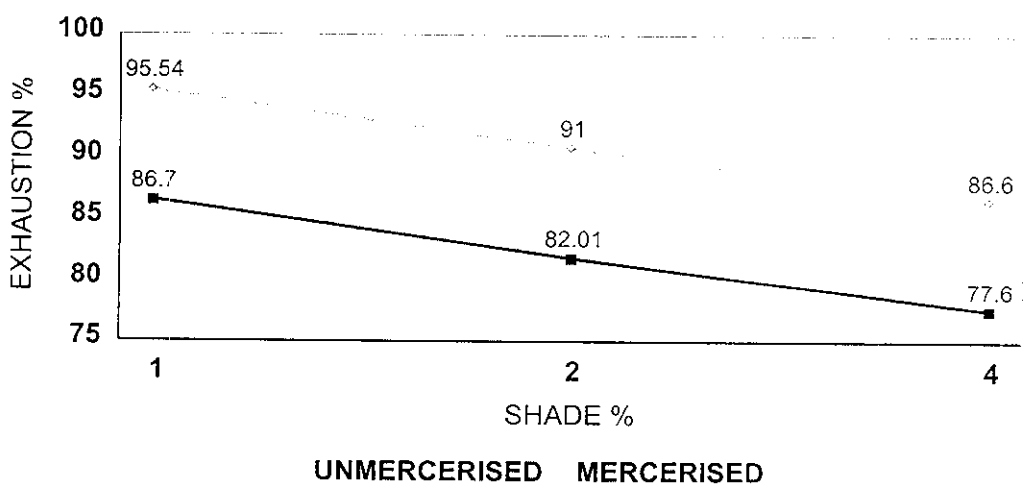
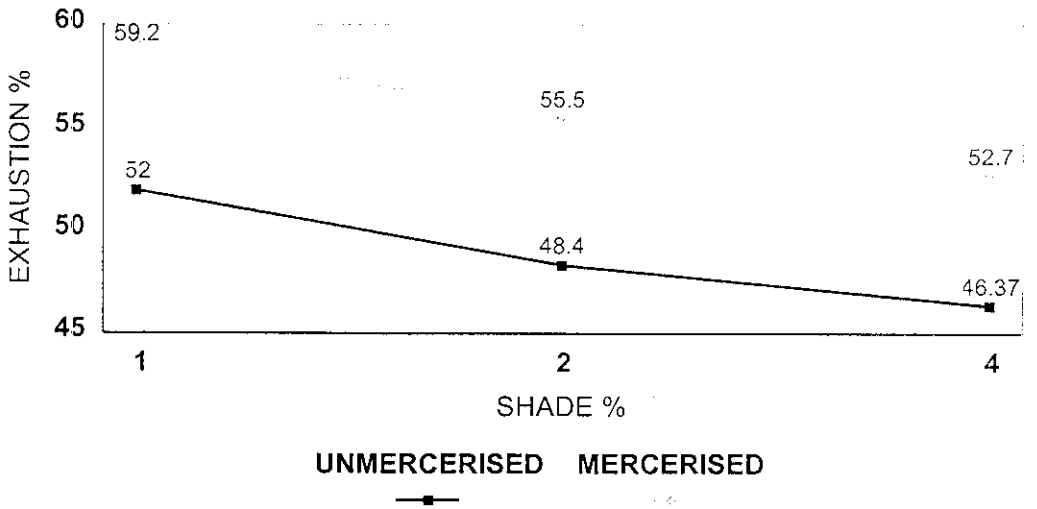
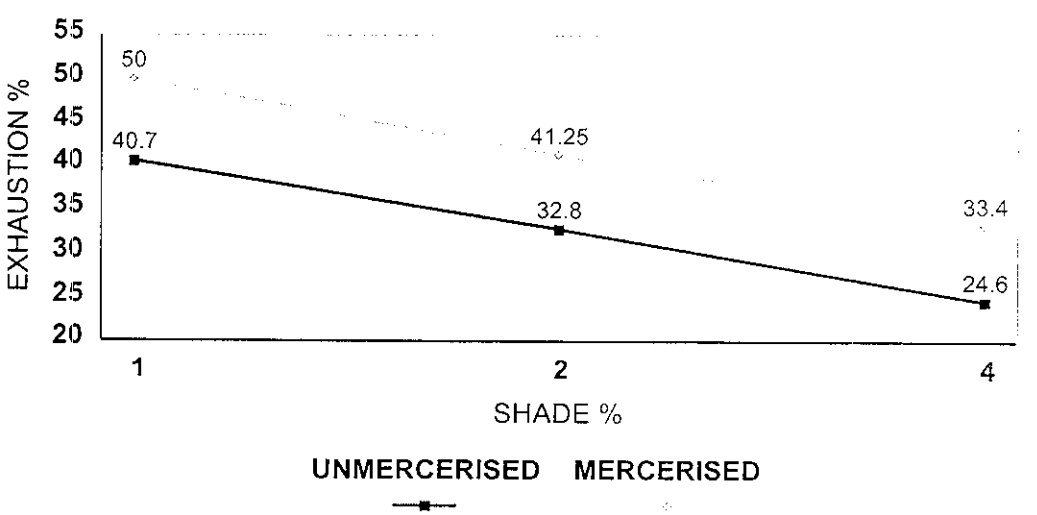


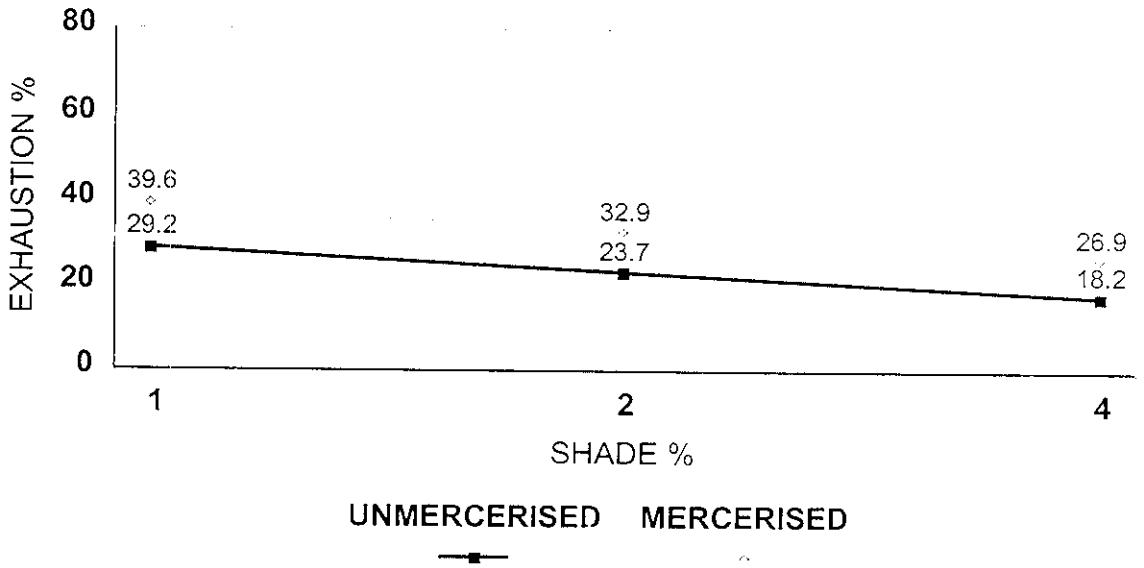
BORDO


60
55
50
45
EXHAUSTION %
59.2
55.5
52
52.7
48.4
46.37
1
2
4
SHADE %
UNMERCERISED
MERCERISED

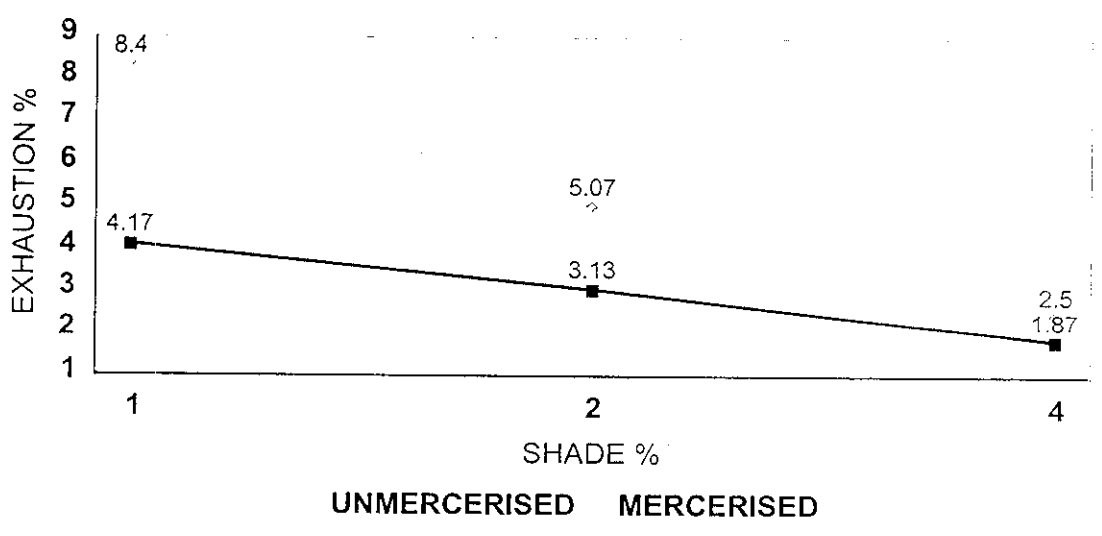
GOLD

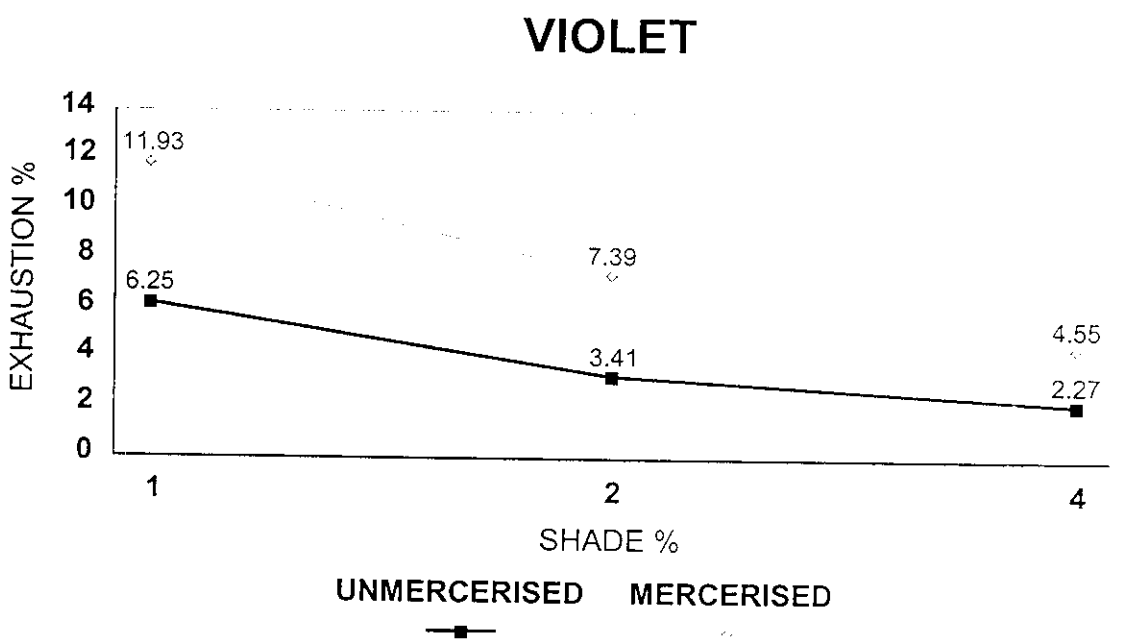

55
50
45
40
35
30
25
20
EXHAUSTION %
50
41.25
40.7
32.8
33.4
24.6
1
2
4
SHADE %
UNMERCERISED
MERCERISED

ORANGE



GREEN




VIOLET
EXHAUSTION %
14
12
10
8
6
4
2
0
11.93
6.25
7.39
3.41
4.55
2.27
1
2
4
SHADE %
UNMERCERISED
MERCERISED

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Annexure

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027

Ref. Dir. : VICTUS\003\O\
Reference : A736/10 UNMERCERISED ROYAL

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
300										
400	25.61	29.29	32.95	35.43	36.26	35.78	34.54	32.59	30.11	27.60
500	24.65	21.45	18.18	15.03	12.39	10.24	8.43	6.92	5.68	4.85
600	4.39	4.07	3.79	3.53	3.37	3.41	3.73	4.53	6.07	8.72
700	13.00	18.69	24.92	30.45	34.16					

D65/10 x = 0.1836 y = 0.2137 Y = 12.77
L* = 42.41 a* = -8.13 b* = -38.25 C* = 39.11 h½ = 258.00

F11/10 x = 0.2405 y = 0.2734 Y = 9.95
L* = 37.75 a* = -13.80 b* = -46.83 C* = 48.82 h½ = 253.57

A/10 x = 0.2664 y = 0.3332 Y = 9.62
L* = 37.16 a* = -23.78 b* = -46.34 C* = 52.09 h½ = 242.83

Sample: MERCERISED ROYAL, A720/10

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
300										
400	20.77	23.79	26.74	28.77	29.55	29.24	28.31	26.82	24.77	22.74
500	20.35	17.75	14.99	12.38	10.14	8.26	6.78	5.51	4.53	3.89
600	3.51	3.28	3.05	2.84	2.72	2.72	3.00	3.56	4.72	6.68
700	9.70	13.17	16.08	17.77	18.29					

D65/10 x = 0.1826 y = 0.2139 Y = 10.44
L* = 38.61 a* = -8.09 b* = -35.78 C* = 36.68 h½ = 257.26

F11/10 x = 0.2392 y = 0.2731 Y = 8.09
L* = 34.18 a* = -13.15 b* = -43.92 C* = 45.85 h½ = 253.33

A/10 x = 0.2642 y = 0.3332 Y = 7.83
L* = 33.63 a* = -22.73 b* = -43.50 C* = 49.08 h½ = 242.42

D65/10 dx = -0.001 dy = 0.0002 dY = -2.33
dL*= -3.80 da*= 0.04 db*= 2.47 dC*= -2.42 dH*= -0.49

F11/10 dx = -0.001 dy = -0.000 dY = -1.85
dL*= -3.57 da*= 0.65 db*= 2.91 dC*= -2.98 dH*= -0.20

A/10 dx = -0.002 dy = -0.000 dY = -1.79
dL*= -3.53 da*= 1.06 db*= 2.84 dC*= -3.01 dH*= -0.36

D65/10 dE*= 4.54
F11/10 dE*= 4.65
A/10 dE*= 4.65

Met D65/10:F11/10 = 0.25 <-
D65/10:A/10 = 0.21 <-
F11/10:A/10 = 0.29 <-

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027
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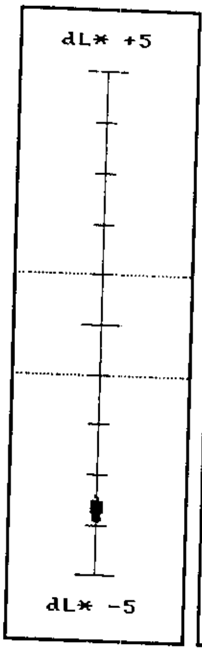
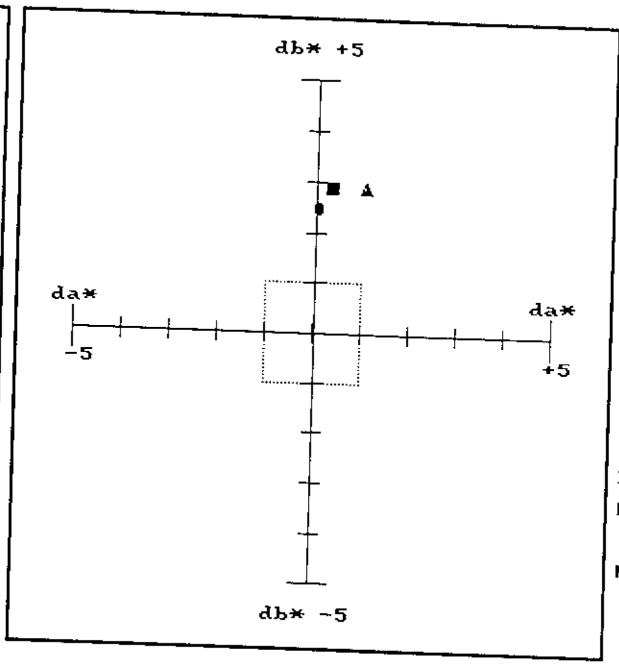
STD. DIR. VICTUS\003\O\
STANDARD A736/10 UNMERCERISED ROYAL
SAMPLE A720/10 MERCERISED ROYAL





DIFFERENCE

Ill.	D65/10	TL84/10
	●	■
dL*	-3.80	-3.62
da*	0.04	0.36
db*	2.47	2.88
dC*	-2.42	-2.89
dH*	-0.49	-0.24
dE*	4.54	4.64
Lightn.	+dark	+dark
Purity	-sat	-sat
Hue	+green	+green

Metamerism D65/10:TL84/10
D65/10:A/10
TL84/10:A/10

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027

Relative Color strength

Substrate 1: OO1 SINGLE JERSEY

Sample 1 : A736/10 UNMERCERISED ROYAL Conc: 100.00 %

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
400	25.61	29.29	32.95	35.43	36.26	35.78	34.54	32.59	30.11	27.60
500	24.65	21.45	18.18	15.03	12.39	10.24	8.43	6.92	5.68	4.85
600	4.39	4.07	3.79	3.53	3.37	3.41	3.73	4.53	6.07	8.72
700	13.00									

Substrate 2: 002 SINGLE JERSEY

Sample 2 : A720/10 MERCERISED ROYAL Conc: 100.00 %

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
400	20.77	23.79	26.74	28.77	29.55	29.24	28.31	26.82	24.77	22.74
500	20.35	17.75	14.99	12.38	10.14	8.26	6.78	5.51	4.53	3.89
600	3.51	3.28	3.05	2.84	2.72	2.72	3.00	3.56	4.72	6.68
700	9.70									

	K/S weighting	Best Curve Fit
Relative color strength	125.97 %	126.82 %
Part of dye value	0.7938	0.7886

Color diff.			Remaining color diff.			Remaining color diff.		
	D65/10	F11/10	A/10	D65/10	F11/10	A/10	D65/10	F11/10	A/10
dL*	-3.80	-3.57	-3.53	0.11	0.04	0.02	0.19	0.13	0.11
da*	0.04	0.65	1.06	1.00	0.61	0.20	0.95	0.57	0.17
db*	2.47	2.91	2.84	-1.30	-1.42	-1.31	-1.29	-1.40	-1.30
dC*	-2.42	-2.98	-3.01	1.09	1.20	1.08	1.08	1.19	1.08
dH*	-0.49	-0.20	-0.36	1.23	0.98	0.77	1.18	0.94	0.74
dE*	4.54	4.65	4.65	1.64	1.54	1.33	1.62	1.52	1.32

Activity Protocol

12-3-2001 11:03

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027

Ref. Dir. : VICTUS\003\O\
Reference : A736/7 UNMERCERISED RED

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
300										
400	6.74	6.32	6.01	5.88	5.69	5.28	8.94	7.89	7.37	7.12
500	2.58	2.43	2.40	2.42	2.49	2.74	4.66	4.00	3.40	2.92
600	31.62	44.22	56.14	65.83	72.73	77.43	3.59	5.81	10.79	19.71
700	85.49	85.99	86.35	86.65	86.89		80.40	82.35	83.65	84.64

D65/10	x = 0.5574	y = 0.3135	Y = 12.83			
	L* = 42.50	a* = 58.85	b* = 27.58	C* = 64.99	h½ = 25.11	
F11/10	x = 0.6113	y = 0.3376	Y = 16.96			
	L* = 48.20	a* = 54.32	b* = 37.38	C* = 65.94	h½ = 34.53	
A/10	x = 0.6385	y = 0.3333	Y = 19.41			
	L* = 51.17	a* = 57.67	b* = 43.81	C* = 72.43	h½ = 37.22	

Sample: MERCERISED RED, A720/7

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
300										
400	4.59	4.35	4.21	4.11	3.96	3.73	6.16	5.40	5.03	4.86
500	1.94	1.85	1.85	1.86	1.88	2.02	3.27	2.83	2.42	2.14
600	28.28	41.30	52.91	61.23	66.55	69.96	2.53	4.02	8.05	16.33
700	77.46	78.35	79.05	79.65	80.23		72.17	73.89	75.24	76.46

D65/10	x = 0.5775	y = 0.3168	Y = 11.13			
	L* = 39.80	a* = 58.61	b* = 31.04	C* = 66.32	h½ = 27.91	
F11/10	x = 0.6221	y = 0.3378	Y = 15.21			
	L* = 45.92	a* = 54.22	b* = 41.56	C* = 68.32	h½ = 37.47	
A/10	x = 0.6464	y = 0.3313	Y = 17.20			
	L* = 48.51	a* = 57.45	b* = 47.13	C* = 74.31	h½ = 39.36	

D65/10	dx = 0.0201	dy = 0.0033	dY = -1.70			
	dL*= -2.70	da*= -0.24	db*= 3.46	dC*= 1.33	dH*= 3.20	
F11/10	dx = 0.0109	dy = 0.0002	dY = -1.75			
	dL*= -2.29	da*= -0.10	db*= 4.18	dC*= 2.38	dH*= 3.44	
A/10	dx = 0.0079	dy = -0.002	dY = -2.22			
	dL*= -2.66	da*= -0.22	db*= 3.32	dC*= 1.88	dH*= 2.74	

D65/10	dE*= 4.39	Met	D65/10:F11/10	= 1.45 <-
F11/10	dE*= 4.77		D65/10:A/10	= 0.93 <-
A/10	dE*= 4.26		F11/10:A/10	= 0.64 <-

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027
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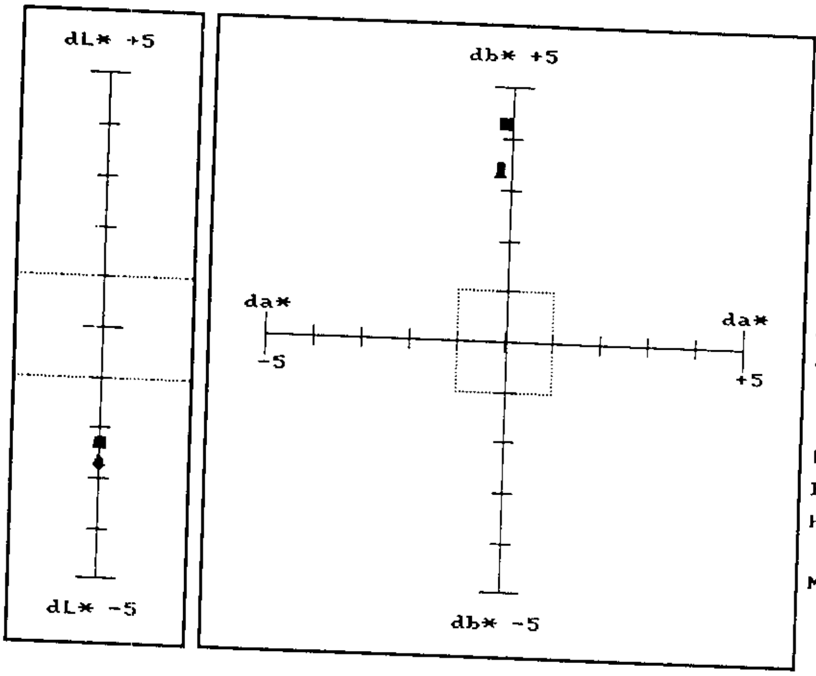
STD. DIR. VICTUS\003\O\
STANDARD A736/7 UNMERCERISED RED
SAMPLE A720/7 MERCERISED RED



DIFFERENCE

Ill.	D65/10 ●	TL84/10 ■
dL*	-2.70	-2.27
da*	-0.24	-0.16
db*	3.46	4.32
dC*	1.33	2.25
dH*	3.20	3.69
dE*	4.39	4.88
Lightn.	+dark	+dark
Purity	+purity	+purity
Hue	+yellow	+yellow

Metamerism D65/10:TL84/10
D65/10:A/10
TL84/10:A/10

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027

Relative Color strength

Substrate 1: 001 SINGLE JERSEY

Sample 1 : A736/7 UNMERCERISED RED Conc: 100.00 %

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
400	6.74	6.32	6.01	5.88	5.69	5.28	4.66	4.00	3.40	2.92
500	2.58	2.43	2.40	2.42	2.49	2.74	3.59	5.81	10.79	19.71
600	31.62	44.22	56.14	65.83	72.73	77.43	80.40	82.35	83.65	84.64
700	85.49									

Substrate 2: 002 SINGLE JERSEY

Sample 2 : A720/7 MERCERISED RED Conc: 100.00 %

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
400	4.59	4.35	4.21	4.11	3.96	3.73	3.27	2.83	2.42	2.14
500	1.94	1.85	1.85	1.86	1.88	2.02	2.53	4.02	8.05	16.33
600	28.28	41.30	52.91	61.23	66.55	69.96	72.17	73.89	75.24	76.46
700	77.46									

	K/S weighting	Best Curve Fit
Relative color strength	139.58 %	136.99 %
Part of dye value	0.7164	0.7300

Color diff.	D65/10	F11/10	A/10	Remaining color diff. D65/10	F11/10	A/10	Remaining color diff. D65/10	F11/10	A/10
dL*	-2.70	-2.29	-2.66	1.43	2.02	1.80	1.28	1.86	1.66
da*	-0.24	-0.10	-0.22	2.31	2.45	2.29	2.35	2.43	2.34
db*	3.46	4.18	3.32	3.25	4.28	3.81	3.40	4.42	3.97
dC*	1.33	2.38	1.88	3.50	4.48	4.14	3.60	4.54	4.28
dH*	3.20	3.44	2.74	1.92	2.07	1.60	2.02	2.19	1.69
dE*	4.39	4.77	4.26	4.23	5.33	4.79	4.32	5.37	4.90

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027

Ref. Dir. : VICTUS\003\O\
Reference : A736/6 UNMERCERISED BORDO

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
300										
400	3.41	3.39	3.23	3.19	3.07	2.96	3.84	3.75	3.58	3.46
500	2.37	2.26	2.18	2.19	2.29	2.37	2.89	2.74	2.57	2.45
600	11.24	15.28	17.69	18.87	20.18	22.56	2.43	2.75	3.94	6.88
700	46.90	51.83	55.95	59.43	62.23		26.11	30.79	36.10	41.54

D65/10	x = 0.4894	y = 0.3174	Y = 5.16			
	L* = 27.19	a* = 32.79	b* = 12.82	C* = 35.21	h½ = 21.36	
F11/10	x = 0.5703	y = 0.3486	Y = 6.54			
	L* = 30.73	a* = 31.54	b* = 19.00	C* = 36.82	h½ = 31.07	
A/10	x = 0.6056	y = 0.3451	Y = 7.06			
	L* = 31.95	a* = 34.03	b* = 21.47	C* = 40.24	h½ = 32.25	

Sample: MERCERISED BORDO, A720/6

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
300										
400	2.47	2.49	2.41	2.35	2.30	2.27	2.68	2.62	2.53	2.48
500	1.80	1.74	1.69	1.70	1.76	1.76	2.18	2.08	1.98	1.88
600	8.28	12.07	14.50	15.75	17.10	19.54	1.75	1.92	2.59	4.62
700	44.25	49.05	53.03	56.39	59.11		23.14	27.91	33.38	38.89

D65/10	x = 0.4970	y = 0.3153	Y = 3.98			
	L* = 23.61	a* = 31.55	b* = 12.18	C* = 33.82	h½ = 21.11	
F11/10	x = 0.5745	y = 0.3468	Y = 5.06			
	L* = 26.91	a* = 29.85	b* = 17.92	C* = 34.81	h½ = 30.97	
A/10	x = 0.6122	y = 0.3409	Y = 5.54			
	L* = 28.22	a* = 33.12	b* = 20.49	C* = 38.95	h½ = 31.74	
D65/10	dx = 0.0076	dy = -0.002	dY = -1.18			
	dL*= -3.58	da*= -1.24	db*= -0.64	dC*= -1.39	dH*= -0.15	
F11/10	dx = 0.0042	dy = -0.001	dY = -1.48			
	dL*= -3.82	da*= -1.69	db*= -1.08	dC*= -2.01	dH*= -0.06	
A/10	dx = 0.0088	dy = -0.001	dY = -1.17			
	dL*= -3.73	da*= -0.91	db*= -0.98	dC*= -1.29	dH*= -0.35	

D65/10	dE*= 3.84	Met	D65/10:F11/10	= 0.71	<-
F11/10	dE*= 4.32		D65/10:A/10	= 0.58	<-
A/10	dE*= 3.96		F11/10:A/10	= 1.11	<-

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027
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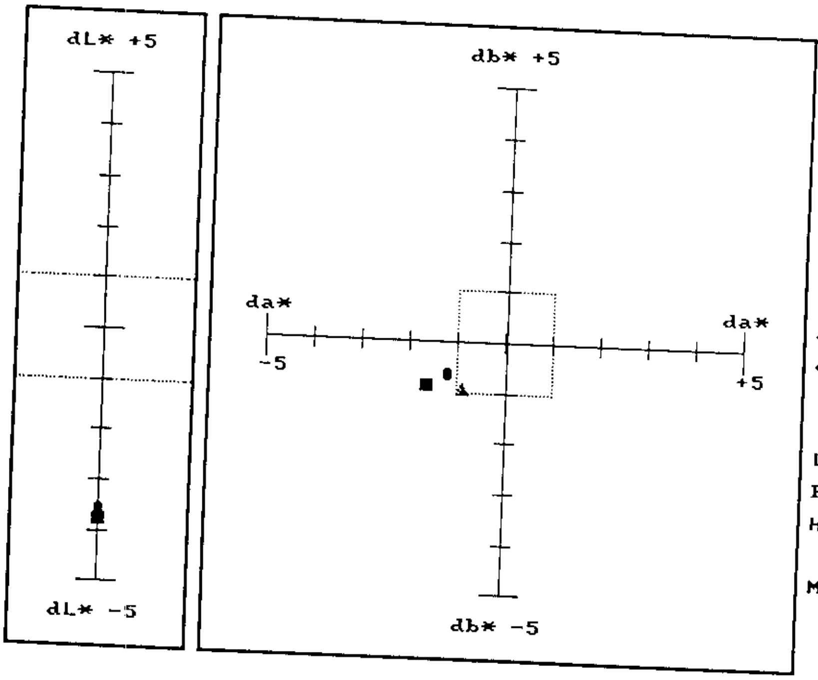
STD. DIR. VICTUS\003\0\
STANDARD A736/6 UNMERCERISED BORDO
SAMPLE A720/6 MERCERISED BORDO



DIFFERENCE

Ill.	D65/10 ●	TL84/10 ■
dL*	-3.58	-3.74
da*	-1.24	-1.67
db*	-0.64	-0.86
dC*	-1.39	-1.87
dH*	-0.15	0.05
dE*	3.84	4.18
Lightn.	+dark	+dark
Purity	-sat	-sat
Hue	+red	=

Metamerism D65/10:TL84/10
D65/10:A/10
TL84/10:A/10

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027

Relative Color strength

Substrate 1: 001 SINGLE JERSEY

Sample 1 : A736/6 UNMERCERISED BORDO Conc: 100.00 %

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
400	3.41	3.39	3.23	3.19	3.07	2.96	2.89	2.74	2.57	2.45
500	2.37	2.26	2.18	2.19	2.29	2.37	2.43	2.75	3.94	6.88
600	11.24	15.28	17.69	18.87	20.18	22.56	26.11	30.79	36.10	41.54
700	46.90									

Substrate 2: 002 SINGLE JERSEY

Sample 2 : A720/6 MERCERISED BORDO Conc: 100.00 %

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
400	2.47	2.49	2.41	2.35	2.30	2.27	2.18	2.08	1.98	1.88
500	1.80	1.74	1.69	1.70	1.76	1.76	1.75	1.92	2.59	4.62
600	8.28	12.07	14.50	15.75	17.10	19.54	23.14	27.91	33.38	38.89
700	44.25									

	K/S weighting	Best Curve Fit
Relative color strength	135.82 %	134.52 %
Part of dye value	0.7363	0.7434

	Color diff.			Remaining color diff.			Remaining color diff.		
	D65/10	F11/10	A/10	D65/10	F11/10	A/10	D65/10	F11/10	A/10
dL*	-3.58	-3.82	-3.73	0.02	0.04	0.10	-0.09	-0.08	-0.01
da*	-1.24	-1.69	-0.91	0.57	0.31	0.98	0.53	0.26	0.94
db*	-0.64	-1.08	-0.98	-0.31	-0.29	-0.21	-0.31	-0.31	-0.22
dC*	-1.39	-2.01	-1.29	0.42	0.11	0.73	0.38	0.06	0.68
dH*	-0.15	-0.06	-0.35	-0.49	-0.41	-0.69	-0.48	-0.40	-0.68
dE*	3.84	4.32	3.96	0.65	0.43	1.01	0.62	0.41	0.96

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027

Ref. Dir. : VICTUS\003\O\
Reference : A736/2 UNMERCERISED GOLD

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
300							9.64	8.05	6.83	5.94
400	5.39	5.09	5.04	5.36	5.89	6.64	7.56	8.74	10.70	13.53
500	17.91	23.69	30.91	38.85	47.22	55.60	63.10	69.05	73.35	76.41
600	78.54	80.09	81.30	82.21	83.04	83.92	84.59	85.20	85.71	86.23
700	86.55	86.84	86.96	87.05	87.14					

D65/10 x = 0.4833 y = 0.4449 Y = 51.94
L* = 77.25 a* = 18.68 b* = 75.28 C* = 77.56 h½ = 76.07

F11/10 x = 0.5285 y = 0.4410 Y = 59.47
L* = 81.55 a* = 17.91 b* = 82.40 C* = 84.32 h½ = 77.73

A/10 x = 0.5527 y = 0.4257 Y = 61.15
L* = 82.46 a* = 22.66 b* = 80.74 C* = 83.86 h½ = 74.32

Sample: MERCERISED GOLD, A720/2

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
300							6.92	5.75	4.89	4.28
400	3.90	3.75	3.71	3.96	4.48	5.05	5.79	6.82	8.56	11.06
500	15.08	20.43	27.12	34.43	41.74	48.59	54.28	58.56	61.70	64.02
600	65.82	67.39	68.84	70.13	71.39	72.72	73.92	75.09	76.09	77.08
700	77.90	78.64	79.19	79.68	80.21					

D65/10 x = 0.4843 y = 0.4496 Y = 44.44
L* = 72.52 a* = 16.62 b* = 73.93 C* = 75.78 h½ = 77.33

F11/10 x = 0.5273 y = 0.4447 Y = 50.96
L* = 76.66 a* = 15.53 b* = 80.72 C* = 82.20 h½ = 79.11

A/10 x = 0.5524 y = 0.4275 Y = 52.20
L* = 77.40 a* = 20.83 b* = 78.67 C* = 81.38 h½ = 75.17

D65/10 dx = 0.0010 dy = 0.0047 dY = -7.50
dL*= -4.73 da*= -2.05 db*= -1.35 dC*= -1.79 dH*= 1.69

F11/10 dx = -0.001 dy = 0.0037 dY = -8.51
dL*= -4.89 da*= -2.39 db*= -1.68 dC*= -2.12 dH*= 2.00

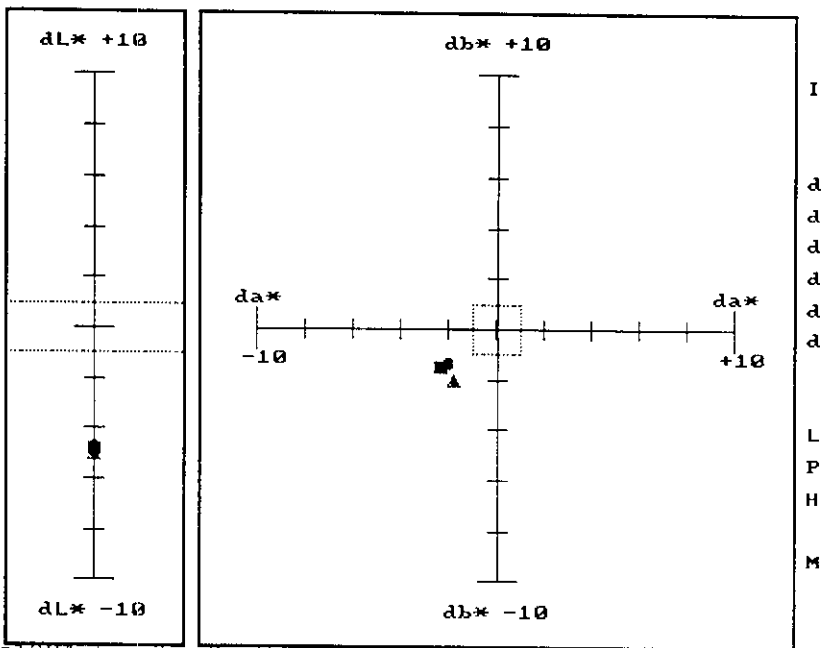
A/10 dx = -0.000 dy = 0.0018 dY = -8.96
dL*= -5.06 da*= -1.83 db*= -2.07 dC*= -2.48 dH*= 1.22

D65/10 dE*= 5.33
F11/10 dE*= 5.70
A/10 dE*= 5.77

Met D65/10:F11/10 = 0.35 <-
D65/10:A/10 = 0.79 <-
F11/10:A/10 = 1.07 <-

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027

STD. DIR. VICTUS\003\0\
STANDARD A736/2 UNMERCERISED GOLD
SAMPLE A720/2 MERCERISED GOLD



DIFFERENCE

Ill.	D65/10 ●	TL84/10 ■
dL*	-4.73	-4.81
da*	-2.05	-2.34
db*	-1.35	-1.51
dC*	-1.79	-1.91
dH*	1.69	2.03
dE*	5.33	5.56
Lightn.	+dark	+dark
Purity	-sat	-sat
Hue	+yellow	+yellow

Metamerism D65/10:TL84/10
D65/10:A/10
TL84/10:A/10

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027

Relative Color strength

Substrate 1: 001 SINGLE JERSEY

Sample 1 : A736/2 UNMERCERISED GOLD Conc: 100.00 %

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
400	5.39	5.09	5.04	5.36	5.89	6.64	7.56	8.74	10.70	13.53
500	17.91	23.69	30.91	38.85	47.22	55.60	63.10	69.05	73.35	76.41
600	78.54	80.09	81.30	82.21	83.04	83.92	84.59	85.20	85.71	86.23
700	86.55									

Substrate 2: 002 SINGLE JERSEY

Sample 2 : A720/2 MERCERISED GOLD Conc: 100.00 %

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1

Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
400	3.90	3.75	3.71	3.96	4.48	5.05	5.79	6.82	8.56	11.06
500	15.08	20.43	27.12	34.43	41.74	48.59	54.28	58.56	61.70	64.02
600	65.82	67.39	68.84	70.13	71.39	72.72	73.92	75.09	76.09	77.08
700	77.90									

	K/S weighting	Best Curve Fit
Relative color strength	132.64 %	135.34 %
Part of dye value	0.7539	0.7389

	Color diff.			Remaining color diff.			Remaining color diff.		
	D65/10	F11/10	A/10	D65/10	F11/10	A/10	D65/10	F11/10	A/10
dL*	-4.73	-4.89	-5.06	1.81	1.94	1.85	1.92	2.03	1.93
da*	-2.05	-2.39	-1.83	-0.37	-0.32	0.02	-0.62	-0.53	-0.19
db*	-1.35	-1.68	-2.07	2.79	2.95	2.55	2.51	2.65	2.22
dC*	-1.79	-2.12	-2.48	2.62	2.82	2.47	2.29	2.48	2.09
dH*	1.69	2.00	1.22	1.02	0.93	0.66	1.19	1.06	0.77
dE*	5.33	5.70	5.77	3.35	3.55	3.16	3.22	3.38	2.95

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027

Ref. Dir. : VICTUS\003\O\
Reference : A736/3 UNMERCERISED ORANGE

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
300							5.93	5.39	4.87	4.45
400	4.14	3.90	3.71	3.54	3.35	3.28	3.31	3.35	3.51	3.68
500	3.98	4.44	5.11	6.14	7.68	10.11	13.90	18.98	25.30	32.73
600	40.70	48.75	56.55	63.44	68.99	73.38	76.56	78.86	80.53	81.76
700	82.75	83.48	84.01	84.40	84.78					

D65/10 x = 0.5529 y = 0.3731 Y = 18.79
L* = 50.44 a* = 46.00 b* = 49.34 C* = 67.46 h½ = 47.01

F11/10 x = 0.5947 y = 0.3759 Y = 23.05
L* = 55.12 a* = 44.06 b* = 57.50 C* = 72.44 h½ = 52.54

A/10 x = 0.6149 y = 0.3676 Y = 25.96
L* = 58.00 a* = 46.66 b* = 62.10 C* = 77.68 h½ = 53.08

Sample: MERCERISED ORANGE, A720/3

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
300							4.28	3.87	3.50	3.22
400	3.07	2.91	2.75	2.66	2.56	2.53	2.53	2.59	2.69	2.84
500	3.07	3.39	3.95	4.77	6.08	8.24	11.67	16.54	22.80	30.30
600	38.19	45.78	52.71	58.41	62.85	66.44	69.22	71.45	73.23	74.73
700	75.97	76.98	77.79	78.55	79.31					

D65/10 x = 0.5644 y = 0.3724 Y = 16.75
L* = 47.94 a* = 46.66 b* = 50.63 C* = 68.85 h½ = 47.34

F11/10 x = 0.6023 y = 0.3730 Y = 20.85
L* = 52.78 a* = 44.93 b* = 59.01 C* = 74.17 h½ = 52.72

A/10 x = 0.6199 y = 0.3654 Y = 23.46
L* = 55.55 a* = 46.79 b* = 63.47 C* = 78.85 h½ = 53.60

D65/10 dx = 0.0114 dy = -0.000 dY = -2.05
dL*= -2.51 da*= 0.65 db*= 1.29 dC*= 1.39 dH*= 0.40

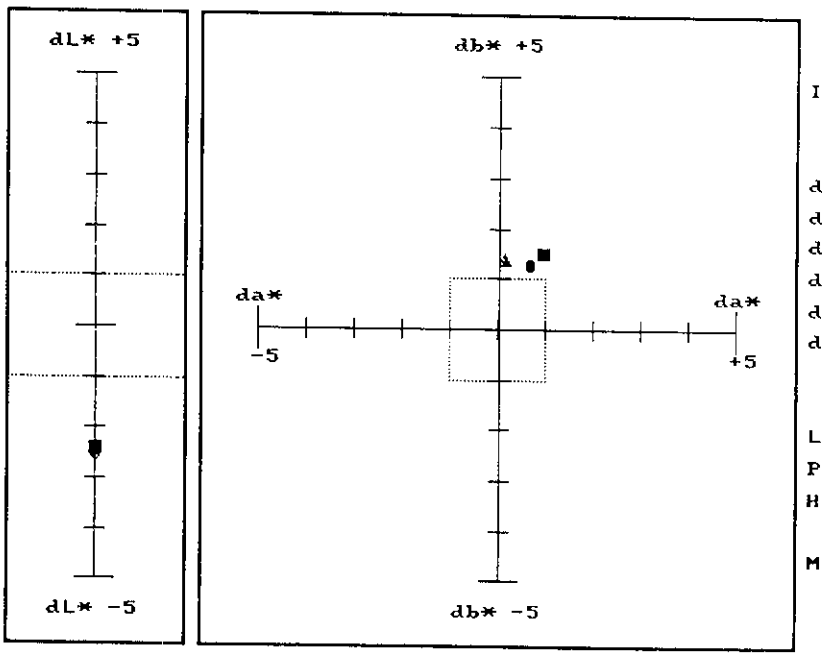
F11/10 dx = 0.0076 dy = -0.002 dY = -2.20
dL*= -2.34 da*= 0.87 db*= 1.51 dC*= 1.73 dH*= 0.23

A/10 dx = 0.0050 dy = -0.002 dY = -2.49
dL*= -2.45 da*= 0.13 db*= 1.37 dC*= 1.18 dH*= 0.71

D65/10 dE*= 2.89 Met D65/10:F11/10 = 0.66 <-
F11/10 dE*= 2.92 D65/10:A/10 = 1.02 <-
A/10 dE*= 2.81 F11/10:A/10 = 0.77 <-

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027

STD. DIR. VICTUS\003\0\
STANDARD A736/3 UNMERCERISED ORANGE
SAMPLE A720/3 MERCERISED ORANGE



DIFFERENCE

Ill.	D65/10	TL84/10
dL*	-2.51	-2.38
da*	0.65	0.94
db*	1.29	1.49
dC*	1.39	1.75
dH*	0.40	0.20
dE*	2.89	2.96
Lightn.	+dark	+dark
Purity	+purity	+purity
Hue	+yellow	+yellow

Metamerism D65/10:TL84/10
D65/10:A/10
TL84/10:A/10

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027

Relative Color strength

Substrate 1: 001 SINGLE JERSEY

Sample 1 : A736/3 UNMERCERISED ORANGE Conc: 100.00 %

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
400	4.14	3.90	3.71	3.54	3.35	3.28	3.31	3.35	3.51	3.68
500	3.98	4.44	5.11	6.14	7.68	10.11	13.90	18.98	25.30	32.73
600	40.70	48.75	56.55	63.44	68.99	73.38	76.56	78.86	80.53	81.76
700	82.75									

Substrate 2: 002 SINGLE JERSEY

Sample 2 : A720/3 MERCERISED ORANGE Conc: 100.00 %

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
400	3.07	2.91	2.75	2.66	2.56	2.53	2.53	2.59	2.69	2.84
500	3.07	3.39	3.95	4.77	6.08	8.24	11.67	16.54	22.80	30.30
600	38.19	45.78	52.71	58.41	62.85	66.44	69.22	71.45	73.23	74.73
700	75.97									

	° K/S weighting	° Best Curve Fit
Relative color strength	° 130.81 %	° 132.15 %
Part of dye value	° 0.7645	° 0.7567

	Color diff.			° Remaining color diff.			° Remaining color diff.		
	D65/10	F11/10	A/10	D65/10	F11/10	A/10	D65/10	F11/10	A/10
dL*	-2.51	-2.34	-2.45	1.60	1.90	1.91	1.70	2.00	2.00
da*	0.65	0.87	0.13	2.01	2.24	1.64	1.94	2.19	1.58
db*	1.29	1.51	1.37	2.92	3.39	3.42	2.90	3.36	3.39
dC*	1.39	1.73	1.18	3.51	4.05	3.72	3.45	4.00	3.66
dH*	0.40	0.23	0.71	0.51	0.28	0.73	0.54	0.30	0.75
dE*	2.89	2.92	2.81	3.89	4.49	4.25	3.88	4.49	4.24

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
300							4.14	3.56	3.11	2.79

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027
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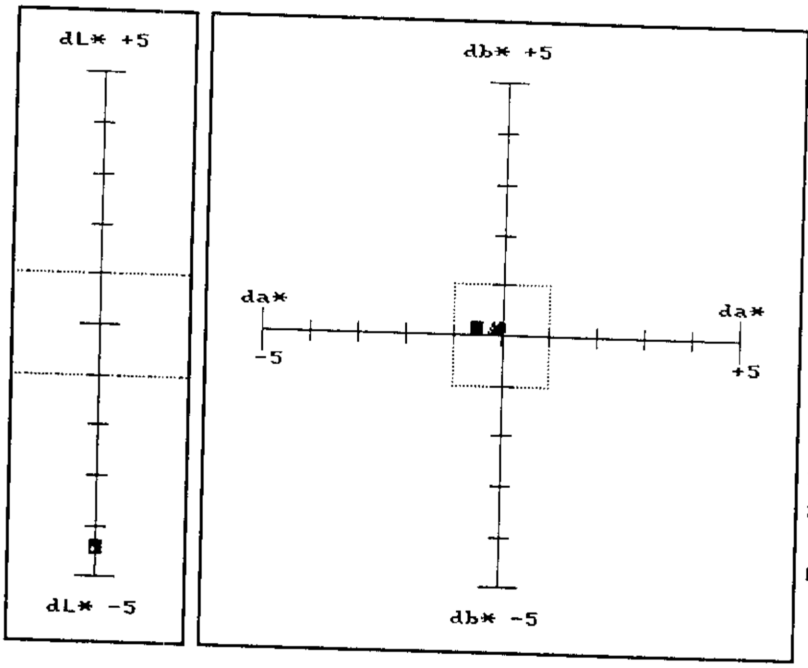
STD. DIR. VICTUS\003\0\
STANDARD A736/12 UNMERCERISED GREEN
SAMPLE A720/12 MERCERISED GREEN



DIFFERENCE

Ill.	D65/10	TL84/10
	•	■
dL*	-4.41	-4.38
da*	-0.03	-0.55
db*	0.16	0.17
dC*	0.17	0.30
dH*	-0.01	0.49
dE*	4.41	4.42
Lightn.	+dark	+dark
Purity	+purity	+purity
Hue	=	+green

Metamerism D65/10:TL84/10
D65/10:A/10
TL84/10:A/10

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027

Relative Color strength

Substrate 1: 001 SINGLE JERSEY

Sample 1 : A736/12 UNMERCERISED GREEN Conc: 100.00 %

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
400	3.80	3.62	3.59	3.79	4.18	4.65	5.29	6.06	7.47	9.41
500	12.33	15.88	19.38	21.98	23.15	23.13	22.25	20.82	19.32	18.35
600	17.87	17.54	17.18	17.11	17.89	20.02	23.42	28.04	33.39	38.82
700	44.35									

Substrate 2: 002 SINGLE JERSEY

Sample 2 : A720/12 MERCERISED GREEN Conc: 100.00 %

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
400	2.60	2.49	2.51	2.71	2.92	3.32	3.76	4.35	5.42	7.03
500	9.50	12.65	15.83	18.19	19.32	19.31	18.40	17.00	15.59	14.66
600	14.21	13.94	13.61	13.61	14.42	16.51	19.96	24.67	30.21	35.91
700	41.50									

	K/S weighting	Best Curve Fit
Relative color strength	140.70 %	143.79 %
Part of dye value	0.7107	0.6954

	Color diff.			Remaining color diff.			Remaining color diff.		
	D65/10	F11/10	A/10	D65/10	F11/10	A/10	D65/10	F11/10	A/10
dL*	-4.41	-4.40	-4.45	1.22	1.28	1.20	1.53	1.60	1.52
da*	-0.03	-0.62	-0.18	-0.99	-1.26	-0.71	-1.01	-1.25	-0.71
db*	0.16	0.21	0.10	2.24	2.38	2.03	2.30	2.44	2.09
dC*	0.17	0.34	0.12	2.41	2.60	2.09	2.48	2.66	2.15
dH*	-0.01	0.56	0.17	0.43	0.69	0.51	0.44	0.67	0.51
dE*	4.41	4.44	4.45	2.73	2.98	2.46	2.95	3.18	2.68

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027

Ref. Dir. : VICTUS\003\O\
Reference : A736/8 UNMERCERISED VIOLET

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
300							11.41	13.29	15.27	17.51
400	19.97	22.17	23.63	24.17	23.96	22.95	21.04	18.64	16.09	14.00
500	12.18	10.57	9.26	8.38	7.81	7.24	6.70	6.47	6.60	6.91
600	7.04	7.00	6.86	6.86	7.33	8.64	10.97	14.42	18.86	23.75
700	28.81	33.53	37.70	41.36	44.46					

D65/10	x = 0.2317	y = 0.2169	Y = 8.93				
	L* = 35.85	a* = 9.10	b* = -29.76	C* = 31.12	h½ = 287.00		
F11/10	x = 0.3160	y = 0.2860	Y = 7.98				
	L* = 33.95	a* = 3.16	b* = -33.36	C* = 33.51	h½ = 275.41		
A/10	x = 0.3717	y = 0.3323	Y = 8.01				
	L* = 34.01	a* = 0.51	b* = -31.28	C* = 31.28	h½ = 270.94		

Sample: MERCERISED VIOLET, A720/8

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
300							7.55	9.06	10.72	12.69
400	14.89	16.82	18.13	18.59	18.52	17.73	16.22	14.23	12.09	10.31
500	8.79	7.45	6.40	5.74	5.32	4.87	4.42	4.25	4.39	4.63
600	4.80	4.80	4.70	4.74	5.14	6.25	8.27	11.42	15.66	20.45
700	25.54	30.35	34.61	38.35	41.48					

D65/10	x = 0.2249	y = 0.2049	Y = 6.25				
	L* = 30.05	a* = 9.95	b* = -29.67	C* = 31.29	h½ = 288.54		
F11/10	x = 0.3057	y = 0.2725	Y = 5.51				
	L* = 28.14	a* = 3.77	b* = -33.29	C* = 33.50	h½ = 276.47		
A/10	x = 0.3636	y = 0.3206	Y = 5.54				
	L* = 28.23	a* = 1.34	b* = -31.20	C* = 31.23	h½ = 272.45		

D65/10	dx = -0.006	dy = -0.012	dY = -2.68				
	dL*= -5.80	da*= 0.85	db*= 0.09	dC*= 0.17	dH*= 0.84		
F11/10	dx = -0.010	dy = -0.013	dY = -2.47				
	dL*= -5.81	da*= 0.62	db*= 0.07	dC*= -0.01	dH*= 0.62		
A/10	dx = -0.008	dy = -0.011	dY = -2.47				
	dL*= -5.79	da*= 0.83	db*= 0.07	dC*= -0.05	dH*= 0.83		

D65/10	dE*= 5.87	Met	D65/10:F11/10 = 1.01	<-
F11/10	dE*= 5.84		D65/10:A/10 = 1.00	<-
A/10	dE*= 5.85		F11/10:A/10 = 0.22	<-

Measured by TREETEX
Executed by: VICTUS DYEINGS
TIRUPUR PH:0421-711623/710301. FAX:710027

Relative Color strength

Substrate 1: 001 SINGLE JERSEY

Sample 1 : A736/8 UNMERCERISED VIOLET Conc: 100.00 %

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
400	19.97	22.17	23.63	24.17	23.96	22.95	21.04	18.64	16.09	14.00
500	12.18	10.57	9.26	8.38	7.81	7.24	6.70	6.47	6.60	6.91
600	7.04	7.00	6.86	6.86	7.33	8.64	10.97	14.42	18.86	23.75
700	28.81									

Substrate 2: 002 SINGLE JERSEY

Sample 2 : A720/8 MERCERISED VIOLET Conc: 100.00 %

Status : CM3600/MAV/SCE/UVIncl/Zero-White/N=1
Refl. Values:

nm	0	10	20	30	40	50	60	70	80	90
400	14.89	16.82	18.13	18.59	18.52	17.73	16.22	14.23	12.09	10.31
500	8.79	7.45	6.40	5.74	5.32	4.87	4.42	4.25	4.39	4.63
600	4.80	4.80	4.70	4.74	5.14	6.25	8.27	11.42	15.66	20.45
700	25.54									

	K/S weighting	Best Curve Fit
Relative color strength	151.10 %	151.92 %
Part of dye value	0.6618	0.6582

Color diff.	D65/10	F11/10	A/10	Remaining color diff. D65/10	F11/10	A/10	Remaining color diff. D65/10	F11/10	A/10
dL*	-5.80	-5.81	-5.79	0.11	-0.05	-0.04	0.18	0.03	0.03
da*	0.85	0.62	0.83	1.54	0.81	0.72	1.53	0.80	0.72
db*	0.09	0.07	0.07	-2.64	-2.91	-2.77	-2.64	-2.91	-2.77
dC*	0.17	-0.01	-0.05	2.98	2.98	2.78	2.98	2.98	2.79
dH*	0.84	0.62	0.83	0.67	0.51	0.65	0.66	0.50	0.64
dE*	5.87	5.84	5.85	3.06	3.02	2.86	3.06	3.02	2.86