Investigation into the Colouration of Wool with Indigo

R. CHINNIAH\textsuperscript{a}, S. ROSUNE\textsuperscript{a}, C.M. CARR\textsuperscript{b}
\textsuperscript{a}Department of Textile Technology, University of Mauritius, Email: s.rosune@uom.ac.mv
\textsuperscript{b}Department of Textiles and Paper, School of Materials, University of Manchester

Abstract
This paper describes the colouration of wool with indigo. The wool fabric was pre-treated with different shrink-resist formulations followed by application of indigo. The novel dyeing procedure resulted in commercially acceptable indigo-dyed wool, in terms of improved levelness and reduced yellowness.

While indigo is traditionally applied by the padding technique, in this present work, an exhaust dyeing procedure was investigated. The degree of levelness as well as the depth of shade was further optimised by varying the pH, temperature and dye concentration. The pH of the dye liquor and the dyeing temperature were found to be critical in achieving level dyeing as well as to mitigate fibre damage.

It was found that certain shrink-resist formulations either applied alone or in combinations gave better results in terms of colour yield and fabric handle, while other combinations gave poorer results. The dyed samples were found to exhibit excellent wash fastness. Keywords: wool, indigo, colour yield, fibre damage

1 Introduction
Wool is an expensive and delicate fibre. It is usually wet processed with due consideration to process conditions such as time, temperature, pH and chemical inputs to minimize fibre damage. So far, the colouration of wool has been limited mostly to dyes applicable in acidic or mildly acidic media [Lewis, 1992]. This is, indeed, a serious limitation, both technologically and commercially. Technologically, the application of a number of competitively-priced ‘cellulosic’ dyes such as indigo and sulphur dyes, applicable in alkaline media, have not cascaded down to wool due to risk of fibre damage during dye application. Indigo, as is well known, is used to dye the ubiquitous denim whose commercial appeal has not decreased an iota over the last 150 years [Broadbent, 2001]. Commercially, a number of product segments, mostly in sportswear and casualwear, made of wool, and innovative wool blends have yet to be exploited [Holme, 2006].

In addition, the colouration of wool and wool blends with indigo and/or sulphur dyes may enable the production of a wide range of smart casualwear with a ‘worn-out look’, much appreciated in 100% cotton garments. Hence, significant technological, commercial and value-addition opportunities exist in investigating the application of ‘cotton’ dyes to wool and wool blends. The alkaline sensitivity of wool remains a key limitation [Hill and Ghadimi, 1996] since indigo requires a high application pH together with a fairly high temperature [Broadbent, 2001]. In this project, an attempt has been made to circumvent this problem.

2 Experimental

2.1 Materials
100% lamb's wool knitted fabric, 835 g/m\textsuperscript{2}, was supplied by Floréal Knitwear Ltd, Mauritius. All chemicals used for the pre-treatment and dyeing were of commercial grade. The indigo dye solution (40%) was in pre-reduced form and supplied by BASF, Germany.

2.2 Chemicals Used

The following chemicals were used throughout the process: DCCA shrink-resist (PPT) and PMS shrink-resist (Dynchem Mauritius Ltd); Hercosett (Hercules) and Polymer TEC (PPT) both being resins; Indosol E-50 (Sandoz), a cationic fixing agent; Depsodye; LD-VRD (Uniqema), a leveling agent; Sandoclean PCl (Clariant), a detergent; Kollasol CDA (CHT) a wetting agent.

2.3 Wool Fabric Pre-treatment with Shrink Resists

1kg of wool fabric was pre-treated at a time, liquor ratio 1:30, using the Dytex overhead paddle machine. An untreated sample was used as the control. The shrink resist formulations applied were:

I. DCCA only
II. PMS only
III. DCCA & Hercosett treatment
IV. PMS & Hercosett treatment
V. DCCA & Polymer TEC treatment
VI. PMS & Polymer TEC treatment
VII. DCCA & Indosol E-50 treatment
VIII. PMS & Indosol E-50 treatment

2.4 Dyeing Procedure

Dyeing with indigo was carried out by the exhaust process using the Rotadyer laboratory dyeing machine. 5g samples were dyed at a time, liquor ratio 1:40. The ‘basic’ dyebath formulation was composed of 2% o.m.f. indigo dye solution (40%), 2.5g/l sodium hydroxide, 0.2g/l sodium carbonate and 1g/l sodium carbonate. The dyeing was carried out at 35°C for 45 minutes. After dyeing, the samples were squeezed and air-oxidised for 10 minutes. The dyed samples were then subjected to a series of different washes involving a chemical wash, a detergent wash, a hot wash, an acid wash and a final rinsing with tap water.

The chemical wash was performed with 1.5g/l sodium carbonate, 0.75g/l sodium hydroxide and 1g/l Depsodye LD-VRD at a temperature of 60°C for 10 minutes. A bath containing 0.75g/l Sandoclean PCl and 2g/l Depsodye LD-VRD at 60°C was used for the detergent wash.

The samples were then overflowed with excess hot water at 60°C and then subjected to rinsing with 1g/l ethanoic acid at 40°C. Finally, the samples were rinsed with tap water before drying at 50°C for 30 minutes in the laboratory drying oven. The same washing and drying procedures, termed as ‘standard procedure’, throughout this work, were applied to all dyed samples unless otherwise stated. With the objective of achieving good levelness, the dyeing conditions were varied.

2.4.1 Dyeing Wool with Indigo Using the Basic Dyebath Formulation

Dyeing was carried out using the ‘basic’ dyebath formulation at 35°C for 45 minutes. After dyeing, the samples were air oxidized and then subjected to the different washes as mentioned earlier. The process was completed by oven drying at 50°C for 30 minutes. The washing and drying were carried out as per the ‘standard procedure’.
2.4.2 Addition of a Wetting Agent and a Levelling Agent to the Basic Dyebath Formulation to Dye Wool with Indigo dye

To the ‘basic’ dyebath formulation, a wetting agent, Kollasol CDA (0.5g/l), and a levelling agent, Depsodye LD-VRD (1.0 g/l), were added. Dyeing was carried out at 35°C for 45 minutes. Air-oxidation, washing and drying were performed as per the ‘standard procedure’. Table 1.0 shows the pH values of the different treatments described in sections 2.4.1-2.4.2.

Table 1.0 pH of baths for varying dyeing procedures

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Basic Dyebath Formulation only</th>
<th>Basic Dyebath Formulation + Wetting Agent + Levelling Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyebath</td>
<td>9.6</td>
<td>9.5</td>
</tr>
<tr>
<td>Chemical Wash</td>
<td>10.2</td>
<td>10.2</td>
</tr>
<tr>
<td>Detergent Wash</td>
<td>6.5</td>
<td>6.5</td>
</tr>
<tr>
<td>Acid Wash</td>
<td>3.4</td>
<td>3.4</td>
</tr>
</tbody>
</table>

2.4.3 Adjusting pH by Varying Amounts of Sodium Hydroxide

In the following series of experiments, the concentration of sodium hydroxide was varied with the objective of varying the dyebath pH. The dyebath consisted of 2% o.m.f. Indigo Dye solution (40%), 2.5g/l sodium hydrosulphite, 1g/l sodium carbonate, 0.5g/l Kollasol CDA, 1.0g/l Depsodye LD-VRD and sodium hydroxide in concentrations varying from 0.2 g/l to 0.6g/l. The pH of the different dyebaths is shown, Table 1.1.

Table 1.1 pH values for treatments involving varying concentration of sodium hydroxide

<table>
<thead>
<tr>
<th>Sodium Hydroxide(g/L)</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>10.7</td>
</tr>
<tr>
<td>0.3</td>
<td>11.2</td>
</tr>
<tr>
<td>0.4</td>
<td>11.4</td>
</tr>
<tr>
<td>0.5</td>
<td>11.7</td>
</tr>
<tr>
<td>0.6</td>
<td>11.8</td>
</tr>
</tbody>
</table>

Dyeing was carried out at 35°C for 45 minutes followed by air oxidation, washing and drying as per the standard procedures.

2.5 Determination of Relative Unlevelness Index of Indigo-Dyed Wool

Wool dyed under the different experimental conditions (section 2.5.1-2.5.3) was assessed for unlevelness. This was achieved through calculation of the relative unlevelness index (RUI) (Chong et al., 1992):

\[
(RUI)_t = \sum_{\lambda=390}^{700} \left( \frac{S^2}{R} \right)
\]

Where:
- \( S \) = the standard deviation of reflectance values measured at a specific wavelength
- \( R \) = the means of reflectance values of ‘n’ measurements for each wavelength

In this present work, the reflectance values of twelve randomly selected spots on each dyed sample were measured over the visible spectrum (\( \lambda = 390-700 \)) at intervals of 10nm. All measurements were taken on the DATACOLOR spectrasflash SF-600 spectrophotometer, using illuminant D65 and an aperture of 27mm diameter.

2.6 Determination of Dye Fixation onto Indigo-Dyed Fabrics

The effect of varying concentrations of sodium hydroxide on the colour yield was investigated. The relative colour yield, \( K/S \), of the dyed substrate was determined using the DATACOLOR spectrasflash SF-600 spectrophotometer, illuminant D65 and an aperture of 27mm diameter. \( K/S \) was established according to the Kubelka-Munk equation (Billmeyer and Saltzmann, 1981):

\[
K/S = \frac{(1-R)^2}{2R}
\]

Where \( K \) is the absorption coefficient, \( S \) is the scattering coefficient and \( R \) is the fractional reflectance of the substrate at \( \lambda_{\text{max}} \).

2.7 Results & Discussions

With the objective of achieving a level dyeing, several trials were therefore performed with the following variables:
- The introduction of a wetting agent, Kollasol CDA;
- The introduction of a levelling agent, Depsodye LD-VRD;
- A variation in the dyebath pH.

2.7.1 Effect of Basic Dyebath Formulation on Levelness of Indigo-Dyed Wool

Wool samples dyed with the basic formulation experienced a very high degree of unlevelness, as denoted by the very high (RUI)c, Table 1.2. The samples pretreated with DCCA either alone or in combination with Hercosett or TEC were more unlevel than those pretreated with PMS alone or in combination. An even higher unlevelness was observed in samples pretreated with DCCA-Indosol (6.63) and PMS-Indosol (12.87). It was interesting to note a fairly level dyeing in the sample which was not subjected to any shrink resist treatment.

All samples, except for the sample which was not shrink resist treated, dyed with the basic formulation presented numerous dark blue patches on their surface. The unlevelness of the indigo dyed wool may be attributed to the low dyebath pH which was used during the dyeing process. Since leuco indigo is a weak acid, the pH of the medium may greatly affect the extent of its ionization, so that the substantivity of the dye to the fibre is affected. While literature suggests an application pH of 11.0-12.0 for indigo dye (Xin et al., 2000), the alkaline sensitivity of wool restricted the dyeing conditions such that the dyebath pH was maintained in the range 9.0-10.0. A low dyebath pH, however, favoured the formation of the insoluble vat acid, which had no substantivity for the wool fibres, hence leading to poor quality dyeing (Broadbent, 2001).

Table 1.2 (RUI)c Values for Indigo Dyed Wool Dyed with the Basic Formulation

<table>
<thead>
<tr>
<th>(RUI)c</th>
<th>Assessment of levelness (visual)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.7</td>
<td>Very poor</td>
</tr>
</tbody>
</table>

DCCA only
The reduction of the insoluble indigo dye molecules to the soluble leuco ions is a two-step process, in which the formation of a semiquinone radical is followed by reduction of the radical to leuco indigo [Zhou, 2001]. This reduction process takes place within a pH range. It is highly probable that the combination of non-reduced indigo, semiquinone and leuco indigo generated within the pH range 9.0 – 10.0 has contributed to the unlevelness in the indigo dyed samples.

**Figure 4.0 Reduction of indigo dye**

**Table 1.3 (RUI) Values for Indigo Dyed Wool Dyed with the Basic Formulation, W.A, L.A**

<table>
<thead>
<tr>
<th></th>
<th>(RUI) values for indigo dyed wool, Basic form, W.A, L.A</th>
<th>Assessment of levelness (visual)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCCA only</td>
<td>2.99</td>
<td>Poor</td>
</tr>
<tr>
<td>DCCA &amp; Hercosett</td>
<td>2.93</td>
<td>Poor</td>
</tr>
<tr>
<td>DCCA &amp; TEC</td>
<td>2.7</td>
<td>Poor</td>
</tr>
<tr>
<td>PMS only</td>
<td>2.31</td>
<td>Poor</td>
</tr>
<tr>
<td>PMS &amp; Hercosett</td>
<td>2.74</td>
<td>Poor</td>
</tr>
<tr>
<td>PMS &amp; TEC</td>
<td>2.95</td>
<td>Poor</td>
</tr>
<tr>
<td>DCCA &amp; Indosol E-50</td>
<td>3.70</td>
<td>Poor</td>
</tr>
<tr>
<td>PMS &amp; Indosol E-50</td>
<td>3.63</td>
<td>Poor</td>
</tr>
<tr>
<td>No shrink resist</td>
<td>1.66</td>
<td>Fair</td>
</tr>
</tbody>
</table>

Basic form. : Basic formulation  
W.A.: wetting agent, Kollasol CDA  
L.A.: leveling agent, Depsodye LD-VRD

Furthermore, it was observed that the untreated dyed sample had much better levelness while samples treated with Indosol E-50 were most unlevel, maybe due to similar reasons, already put forward in section 2.7.1.

Furthermore, the introduction of the levelling agent, Depsodye LD-VRD, into the dye liquor may also have contributed to the enhanced levelness of the indigo-dyed wool, as illustrated by the (RUI) values, Table 1.3. Depsodye LD-VRD is known to be very effective in levelling vat dyes [Depsodye LD-VRD, 2007]. The leveling agent may have improved the migration properties of the dye thus enhancing the levelness of the dyed substrate. Furthermore, Depsodye LD-VRD is also known to improve dispersion of vat dyes [Depsodye LD-VRD, 2007]. This could have contributed to the

**Following a series of trials which did not yield any improvement in terms of levelness,a wetting agent, Kollasol CDA and a levelling agent, Depsodye LD-VRD were added to the basic dyebath formulation. Generally, Kollasol CDA finds its application if foam develops during washing, bleaching or dyeing processes [Kollasol CDA, 2007]. As described in section 2.8.1, dyeing with the basic formulation resulted in numerous dark blue patches across the fabric surface. Oxidised indigo dye molecules present in the dyebath may have led to the formation of these patches. Kollasol CDA was therefore used to enhance dye penetration into the wool fibres, thereby controlling the occurrence of patches. Despite the significant improvement in (RUI), which was noted, Table 1.3, the indigo dyed wool samples were still unlevel, except for the untreated wool sample which demonstrated fair levelness. The significant improvement in levelness of the dyed samples may therefore be attributed to the use of the wetting agent, Kollasol CDA, [Xin et al., 2000].**
reduction in dye patches by limiting dye aggregation and providing dispersing action.

2.7.3 Effect of Varying Amounts of Sodium Hydroxide on Levelness of Indigo-Dyed Wool

As the concentration of caustic soda was increased from 0.2g/L to 0.6g/L, a gradual decrease in the (RUI) values was noted, Table 1.4. This was the case for all the samples irrespective of the nature of the shrink resist treatments.

At 0.2g/L sodium hydroxide concentration, indigo-dyed wool pre-treated with DCCA-Herc was found to have the lowest (RUI) value (0.90) while PMS-TEC treated wool the highest (RUI) value (1.83). Similar observations were made when using 0.3g/L sodium hydroxide in the dye liquor, that is treatment with the DCCA-Herc formulation generated the lowest (RUI) value (0.80) and treatment with PMS-TEC the highest value (1.45). In both cases, the indigo-dyed wool shrink resist treated with DCCA either alone or in combination was found to exhibit better levelness than any of the shrink resist treatments. At 0.4g/L sodium hydroxide, the lowest (RUI) value (0.69) was achieved by treatment with DCCA-Herc and the highest (RUI) value (1.07) by PMS only. On increasing the dyebath concentration of sodium hydroxide to 0.5 and 0.6g/L wool sample pretreated with DCCA-TEC was most level and sample pretreated with PMS-TEC most unlevel, bearing the lowest and highest (RUI) values respectively. It was interesting to note the higher effectiveness of DCCA treatments (alone or in combination) in imparting enhanced levelness as compared to treatments with PMS alone or in combination. This is consistent with the lower (RUI) values for DCCA treatments as compared to the higher (RUI) values of the corresponding PMS treatments. At 0.6g/L sodium hydroxide concentration, the dyed sample shrink resist treated with DCCA-TEC was found to be nearly twice as level as that treated with PMS-TEC, Table 1.4.

The general higher degree of levelness of all the dyed samples with the increasing concentration of sodium hydroxide may be explained by the rise in the dyebath pH. Reduced indigo exists in three different forms namely: the acid leuco, the mono phenolate and the bi-phenolate form, depending on the sodium hydroxide concentration in the dyebath. The acid leuco form exists in low dyebath pH while the mono-phenolate and bi-phenolate forms prevail at higher pH values [Meritt et al., 2001]. A higher concentration of sodium hydroxide is known to increase the amount of mono-phenolate and bi-phenolate, which have a higher affinity for wool [Kunitou et al., 2005]. According to Etters, at pH 11.0, the mono-phenolate is dominant while the bi-phenolate is dominant at higher pH values [Meritt et al., 2001]. Increasing the concentration of sodium hydroxide from 0.2 to 0.3 to 0.4 to 0.5 to 0.6g/L subsequently increased the dyebath pH gradually from 10.7 to 11.2 to 11.4 to 11.7 to 11.8 respectively. The pH values are irrespective of the shrink resist treatments used.

Table 1.4 Effect of varying conc. of sodium hydroxide on (RUI) values of indigo-dyed wool

<table>
<thead>
<tr>
<th>Conc. of sodium hydroxide (g/L)</th>
<th>0.2</th>
<th>0.3</th>
<th>0.4</th>
<th>0.5</th>
<th>0.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCCA &amp; Hercosett</td>
<td>0.90</td>
<td>0.80</td>
<td>0.69</td>
<td>0.62</td>
<td>0.54</td>
</tr>
<tr>
<td>DCCA only</td>
<td>1.07</td>
<td>0.81</td>
<td>0.76</td>
<td>0.73</td>
<td>0.67</td>
</tr>
<tr>
<td>PMS only</td>
<td>1.65</td>
<td>1.44</td>
<td>1.07</td>
<td>1.01</td>
<td>0.81</td>
</tr>
<tr>
<td>DCCA &amp; TEC</td>
<td>1.40</td>
<td>1.07</td>
<td>0.83</td>
<td>0.57</td>
<td>0.42</td>
</tr>
</tbody>
</table>

It is highly probable that as the pH increased, the subsequent increase in the ratio of bi-phenolate to monophenolate promoted dye-fibre substantivity such that the levelness of the dyed samples was enhanced. The use of 0.6g/L sodium hydroxide, dyebath pH 11.8, yielded samples of a very high degree of levelness; they can even be said to be “perfect”, generating the best (RUI) value. The excellent levelness may be attributed to the dyebath pH.

2.7.4 Effect of Varying Amounts of Sodium Hydroxide on the Depth of Shade of Indigo-Dyed Wool

In this work, the depth of shade of the dyed samples has been reported in terms of K/S values, based on the equation derived by Kubelka and Munk. Increasing the dyebath concentration of sodium hydroxide from 0.2 to 0.6g/L resulted in an apparent increase in the depth of shade, characterized by higher K/S values, irrespective of the shrink resist treatments applied, Table 1.6.

The following observations were made when 0.2g/L sodium hydroxide was used in the dye liquor: The untreated sample exhibited the highest K/S value while the sample treated with DCCA-Herc the lowest K/S value. Higher K/S values were observed for wool samples treated with DCCA only and DCCA-TEC as compared to those treated with PMS only and PMS-TEC respectively. Lower K/S value was observed for DCCA-Herc treated samples over PMS-Herc treated samples.

At 0.3g/L sodium hydroxide concentration, higher K/S value was observed for DCCA treated wool (alone or in combination) compared to the corresponding PMS treatments. The depth of shade of the untreated sample was highest while that of PMS-TEC treated wool the poorest. It was interesting to note highest K/S values for DCCA-TEC treated wool and lowest K/S for PMS-TEC treated wool at 0.4, 0.5 and 0.6g/L sodium hydroxide concentration. Similar trends were observed, that is, indigo-dyed samples subjected to shrink resist treatment with DCCA only were deeper in shade than samples subjected to treatment with PMS only. Likewise, shrink resist treatments with DCCA-Herc and DCCA-TEC resulted in enhanced shade depths over treatments with PMS-Herc and PMS-TEC, respectively. The apparent increase in depth of shade resulting from increasing concentration of sodium hydroxide may be attributed to the increase in dyebath pH. A high dyebath pH may have favoured the formation of the bi-phenolate ions such that dye-fibre substantivity is enhanced; hence yielding deeper shades [Meritt et al., 2001]. At 0.6g/L sodium hydroxide concentration, the pH of the dyebath was noted to be 11.8. The very good depth of shade of the dyed samples may thus be attributed to the high dyebath pH.

Table 1.5 pH values achieved with varying amounts of sodium hydroxide

<table>
<thead>
<tr>
<th>Sodium Hydroxide (g/L)</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>10.7</td>
</tr>
<tr>
<td>0.3</td>
<td>11.2</td>
</tr>
<tr>
<td>0.4</td>
<td>11.4</td>
</tr>
<tr>
<td>0.5</td>
<td>11.7</td>
</tr>
<tr>
<td>0.6</td>
<td>11.8</td>
</tr>
</tbody>
</table>

Table 1.6 Effect of varying amounts of sodium hydroxide on K/S values of Indigo-dyed Wool

<table>
<thead>
<tr>
<th>Conc. of sodium hydroxide (g/L)</th>
<th>K/S values</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>1.27</td>
</tr>
<tr>
<td>0.3</td>
<td>0.97</td>
</tr>
<tr>
<td>0.4</td>
<td>0.77</td>
</tr>
<tr>
<td>0.5</td>
<td>0.72</td>
</tr>
<tr>
<td>0.6</td>
<td>0.70</td>
</tr>
</tbody>
</table>
Table 1.6 Effect of varying conc. of sodium hydroxide on K/S values of indigo-dyed wool

<table>
<thead>
<tr>
<th>Conc. of sodium hydroxide (g/L)</th>
<th>0.2</th>
<th>0.3</th>
<th>0.4</th>
<th>0.5</th>
<th>0.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCCA &amp; Hercosett</td>
<td>13.9</td>
<td>22.6</td>
<td>32.5</td>
<td>33.6</td>
<td>34.8</td>
</tr>
<tr>
<td>DCCA only</td>
<td>21.6</td>
<td>22.1</td>
<td>27.0</td>
<td>29.2</td>
<td>30.4</td>
</tr>
<tr>
<td>PMS only</td>
<td>15.5</td>
<td>21.4</td>
<td>24.9</td>
<td>27.3</td>
<td>28.2</td>
</tr>
<tr>
<td>DCCA &amp; TEC</td>
<td>20.4</td>
<td>21.7</td>
<td>34.0</td>
<td>34.5</td>
<td>35.0</td>
</tr>
<tr>
<td>PMS &amp; Hercosett</td>
<td>14.6</td>
<td>17.6</td>
<td>24.7</td>
<td>25.9</td>
<td>26.0</td>
</tr>
<tr>
<td>PMS &amp; TEC</td>
<td>16.1</td>
<td>17.3</td>
<td>20.2</td>
<td>22.3</td>
<td>26.7</td>
</tr>
<tr>
<td>No shrink resist</td>
<td>23.2</td>
<td>27.2</td>
<td>29.5</td>
<td>29.5</td>
<td>30.5</td>
</tr>
</tbody>
</table>

As DCCA/Herc and DCCA/TEC yielded comparable results, they may be deemed, at this stage of our work, to be the most appropriate pre-treatment prior to dyeing wool with indigo.

2.7.5 Determination of Colour Fastness to Washing of Indigo-Dyed Wool

Indigo-dyed samples were subjected to wash fastness test according to the M&S C4A standard. Fastness to washing was found to be excellent for all the samples irrespective of the experimental conditions. First of all, no staining of the wash liquor was observed. There was no apparent colour fading of the fabric swatches, no staining of any of the multifibre component was observed. This excellent wash fastness can be explained by the nature and number of washings to which the dyed wool have been subjected to. The chemical wash enables the removal of excess dye molecules while at the same time enhancing the levelness of the fabric. The detergent wash allows the removal of surface dye molecules and contributes to the levelling of the fabric as well. The hot wash is important to remove traces of the chemicals used in the previous washes. Finally, the acid wash neutralizes the alkalinity caused by the chemical wash and the detergent wash.

3 Conclusion

Dyeing wool with indigo by the exhaust process was successful under certain specific conditions, of which, pH was found to be the most critical. At a pH of 11.8, wool fabrics dyed to a very high degree of levelness, generating (RUI) values as low as 0.42. The pH of the dyebath does not only influence the levelness of the dyed substrates but also influences the depth of shade. The depth of shade (K/S) was found to be higher at higher pH. It seemed that the ratio of acid leuco, di-phenolate and mono-phenolate in the dyebath, governed by the pH, was important during indigo dying of wool.

Very good levelness as well as appreciable depth of shade of the indigo-dyed samples was obtained when dyeing was carried out at pH 11.8. The relevant pH was therefore deemed to be the optimum pH for dyeing wool with indigo.

References

Bradford.
8ISS Symposium-Oral on Modern
Performance Running Wear Design

Shu SUN, Yi LI, Lei YAO, Junyan HU, Jinyun ZHOU, Yongjin WANG, Xuyong CAO

The Hong Kong Polytechnic University, Institute of Textiles and Clothing, Hung Hom, Hong Kong, China
Email: tcliyi@inet.polyu.edu.hk

Abstract
Contemporary design needs incorporating artistic creation with new technology from multidisciplinary fields. Thereby rethinking design processes and methods are crucial towards innovative creation. In this paper, we propose a new design model, which focuses on user-oriented needs by considering the human sensory perceptions such as visual, tactile, thermal and pressure transducers embedded in human body to reflect the functional and aesthetic needs in the design process. Consideration and qualification of these multi-sensory responses of users are critical, which were determined, analyzed and translated into garment attributes to generate an integrated innovative solution with development of garment prototypes. It can be a new way of designing and thinking about delving deeper into performance sportswear design in future.

1. Introduction
The performance running wear is designed for professional or amateur athletes, which requires specific attributes that address the users’ needs during running, including both functional and aesthetic needs. Therefore, adopting appropriate design process and design model are key issue for design guidance, not only to identify but also to translate needs into garment attributes for the proposed goal of innovative creation. As Tom Starck (2007) stated, the rapidly changing of the process of design and the management of the design process is a major challenge for today’s designers, requiring them to address a broader range of problems such as incorporate new technology, rethink the design process, and respond innovatively.

2. Methodology
The vertical development processes start with skin senses and visual senses, considering from functional and aesthetic needs that can be gained and analyzed through the sensorial experience, while the horizontal linkages between the two main directions/areas must be considered to integrate design for innovative creation. As shown in Figure 1, a new design model is proposed, which includes the key skin senses such as tactile, thermal, pressure and motion sensations to take into account of the functional needs of human body. They refer to both physiological and medical requirements. Visual elements can be perceived by visual senses, such as texture, color, form/silhouette, and construction/proportion. Aesthetic can be provided both with spiritual and practical needs. It belongs to psychological requirement.

3. Design process
Watkin’s (1995) design process is used to guide developing performance running wear, which includes the following steps: analyze, define, ideate, select, implement, and evaluate. Analyze phase consists of using the multi-sensed design model as method developed to approach proposed goal of the project. In define and ideate phase, key issues of running wear design are determined, and developing sketches to illustrate the whole design ideas and garment constructions to solve the specific problems. In select and implement phase, we select and improve design ideas that is used to match the requirements/criteria for best solution, and finally, to make garment prototype for running wear collection. In the evaluate phase, the functional design is evaluated through using the design criteria and wear trials.

3.1. Analyze
User-centered needs during running are analyzed using the multi-sensed design model, and athlete interviews and observation, as well as literature review as and when necessary. It should consider aspects such as environmental condition, physiological needs, physical mechanisms status, as well as psychological requirements (Figure 2). The research start from skin senses, focus on studying fabric property, thermal balance, wearing comfort/free movement, as well as enhancing power and reducing muscle fatigue and risk of injury; then further considerations from visual senses, the elements such as texture, color, form/silhouette, and construction/proportion are taken into account and the design combining with functional factors, is utilized for best expression of performance.
3.2. Define and Ideate

According to the information from analysis phase, the key issues of functional design are determined as follows:

1) There are main strong sweating areas in human body such as chest, back, waist, legs and back of knees. Sweating may be all over body during running (Figure 3).

Hence, the whole garment should be using MMF to remove moisture from the body to keep skin dry, and strong MMF panels can be applied to the sweaty areas.

2) During exercise, athletes feel very hot, the garment should allow air to circulate as freely as possible over the skin surface to aid convective cooling and evaporation of sweat, such as high breathability as well as air permeability fabric, good ventilation system and adjustable opening, might be selected and designed for the stated purpose.

The garment design should be considered to provide maximum ventilation for the core body.
3) The fabric should be nonconductive in hot weather, so that environmental heat is not easily conducted to the body. As the performance running wear style is proposed close-fitting, the more contact must lead to more conduction.

Therefore, loose structure knitted fabric might be used to solve the problem, which will both reduce conduction and keep cool. However, the outer surface of fabric should be smooth for reducing resistance during running.

4) It is important to consider that circulation is not impaired and the metabolism can be increased through physical activity.

Fabric adopted should be having good elasticity, two/four way stretch; and garment designed should be allowing freedom of movement.

5) As exercise injury risk is high, there is need to provide extra protection to ankle, knee and hip areas.

Accordingly knitted fabrics designed with specific attributes are applied, through using local functional design, for the various protection purposes (Figure 4). As extra protection designs are needed for ankle, knee and hip areas, special fabrics should be used to the areas. For example, in the shaded areas, the transverse direction is stiffer and the lengthways direction is more elastic.

6) Knitted fabrics designed with mild compression property are applied to reduce muscle vibration and provide knee-extension to key muscle groups.

7) In hot environment, light color tone might be considered for reflecting radiant energy from the environment, whereas dark color tone for cold environment.

8) UV protection, microbial management should be provided in hot environment.

9) Light weight garment and fabric with soft handle must be deemed necessary.

As a result, the design concept is developed, as illustrated in Figure 5, which focuses on sweat control, thermal distributing, comfort and muscle power.

Meanwhile, aesthetic requirements are equally important factors along with functional categories, and the visual elements, such as color, form, texture and proportion, are to be considered so that the design integrates with the functional design principles for the best expression of performance.

3.3. Select and Implement

In last phase, garment design requirements and design attributes are identified from both of functional and aesthetic needs. The specifications are translated accordingly into garment attributes by making prototype in this phase. The running wear development applies local functional design in thermal management, provides biomechanical support and injury protection (Figure 6), and carries out integrated clothing engineering technologies, such as dynamic pattern design, localized fabric function with fabric properties fingerprint technology and advanced seamless garment fabrication technology.

3.4. Evaluate

The performance of the design must be evaluated by testing physical properties and conducting human subject wear trials. The running wear presented has characteristics of good thermal management, body compression, protection in low limb and fatigue reduction of main loading muscles, and these characteristics need to be evaluated thoroughly.
4. Conclusion
Watkin’s (1995) design process as guidance is used to
develop the appropriate performance running wear.
User-centered needs during running are analyzed using
the developed multi-sensory design model, which not
only takes into account skin senses and visual senses, in
terms of thermal and biomechanical physiology
requirements but also allows for injury prevention, as
well as visual art elements. The emphasis is on
integrated design. The principle is used in making
the garment prototypes. Finally, the garment is evaluated
through using the design criteria and wear trials, where
characteristics of good thermal management, body
compression, protection in lower limb and fatigue
reduction of main loading muscles. Meanwhile, visual art
elements such as color, form, texture and proportion
have also to be considered and integrated with the
functional design. As shown in Figure 7, the outcome of
the collection illustrates the fusion of fashion, art,
technology and science.

Figure 7 One-pieces running wear prototype

Acknowledgements
We would like to thank Hong Kong Innovation and
Technology Commission and Hong Kong Research
Institute of Textile and Apparel for providing funding
support to this research through projects
ITP-002-07-TP, ITP/014/08TP, ITP/030/08TP and
ITT/001/11TT, the Hong Kong Polytechnic University
through project and A188. Also, we would like to thank
the support of Guangdong Provincial Department of
Science and Technology through the Guangdong-Hong
Kong International Textile Bioengineering Joint Research
Center with project code 2011B050300023, as well as
the sponsorship from Hong Kong Jockey Club Sports
Medicine and Health Science Center.

References
overview. UK: Biddles Ltd, King’sLynn.
framework for apparel design. Clothing and
Textiles Research Journal, 10(2), 42-47.
Li, Y. and Newton, E. (2002). Science and fashion
design. In: Li, Z.D. and Wu, G.Z., editors. Art
and Science. Hubei Fine Arts Publishing House,
417-418.
Liu, R. (2006). Comfort and mechanical function of
compression stockings. Hong Kong: Institute of
Textiles and Clothing, The Hong Kong Polytechnic
University.
Exercise physiology: energy, nutrition, and
human performance. Philadelphia: Lippincott
Williams & Wilkins.
London : Batsford.
and selected projects. Basel, Switzerland;
Boston: Birkhäuser.
Newton, E. and Li, Y. (2002). Fashion - The art of
science and technology. In: Li, Z.D. and Wu,
G.Z., editors. Art and Science. Hubei Fine Arts
O'Mahony, M. and Braddock, S.E. (2002). SportsTech :
revolutionary fabrics, fashion and design. New
York, N.Y. : Thames & Hudson.
Francisco, Calif.: 2000) 49 no5 My 2007, p.194
Thiry, M.C. (2008). Winning the race. AATCC Review,
international magazine for textile professionals,
vol. 8, No. 6, 18-27.
environment. Ames: Iowa State University Press.
Yao, L., Sun, S., Wang, Y. J., Cao, X. Y., Hu, J. Y., and Li,
Y. (2010). Development of High Performance
Running Wear. Textile Bioengineering and
Informatics Symposium 2010.

Authors
Ms Shu Sun obtained her BA from The Central Academy
of Arts and Design and MA from The Hong Kong
Polytechnic University in Fashion Design. She is currently
a Research Associate at the Institute of Textiles and
Clothing, The Hong Kong Polytechnic University.

Dr. Yi Li is a full professor and director of Textile
Bioengineering Research Center in the Institute of
Textiles and Clothing, The Hong Kong Polytechnic
University. His research interests are in the areas of
textile bioengineering, nanotechnology, biomaterials,
thermal bioengineering, clothing biomechanics and
sensory bioengineering, biomechanical engineering,
ergonomics, clothing function and comfort, digitized
textile and clothing functional CAD technology, textile
and clothing industry technology roadmap, textile and
clothing eco design and functional design.
Analysis of the Chinese traditional folk vests’ appearance characteristic in the modern times

Hui’e LIANGa, Mengchu GAOb

aSchool of Textiles and Garment; Jiangnan University; Wuxi; China, E-mail: running94@yahoo.com.
bSchool of Textiles and Garment; Jiangnan University; Wuxi; China, E-mail: c-aya@foxmail.com.

Abstract
This paper is a research about the 53 vests collection from the period of late Qing and Republican in Jiangnan University folk costumes museum. It is recorded and analyzed in the form of listed material objects, to Sum up the mainly feature and component relationships by their style, design pattern, fabric and colors. Then, analysis of the practical value and emotional significance which have been contained in the appearance of Chinese traditional folk vests. In the conclusion, it shows the characteristics of Chinese folk vests’ appearances, contributes to detailed definition of the Chinese folk vests which have no specific research in the modern times and reflects the value of the paper. It can help to deliver the Chinese traditional arts among the people so that we can innovative develop and promote our traditional culture better in the future.

探析我国近代民间服飾馬甲的外形形制特征

梁惠娥a 高梦楚b

a纺织服装学院,江南大学,无锡,江苏, E-mail:running94@yahoo.com.
b纺织服装学院,江南大学,无锡,江苏, E-mail: c-aya@foxmail.com.

Abstract
本文以江南大学民间服饰传习馆馆藏的53件清末民国时期的马甲为研究对象,通过对我国近代民间服饰马甲的款式造型、纹样图案、面料色彩的分析,总结其外观形制的主要特征。

1. 引言

服饰作为日常生活的必需品,是人类文明不断积淀的产物,因而呈现出众多的外在形态。民间服饰指的是平民百姓自己设计制作并用于日常穿着的服饰。既是人们日常生活中的实用品,又是一种表现民间、民俗文化的情感符号,它的生成、积淀、延续、转换都与人类地域文化生活的各种形式如神话、宗教、历史、艺术、科学、哲学等的发展有着较深的渊源,是表现实用功能性的能指符号和表现民间、民俗文化的意指符号的结合,二者是互融共生的辩证关系。

《汉语词典》中“马甲”的释义为:马甲,即背心,指的是不带袖子和领子的上衣。有些地方亦称坎肩,坎肩较之马甲,多指夹的、棉的、毛线织的。我国马甲服饰最早可以追溯到秦汉时期,东汉末年刘熙所著《释名·释衣服》记载道:“裲裆,其一当胸,其一当背,因以名之也。”这便是最早对于马甲的记载。随着历史的推移,马甲先后经过秦汉时期的裲裆、南北朝时期的裲裆铠、唐朝时期的半臂、宋元时期的塔护、明朝时期的罩甲和比甲以及清朝时期的马甲。清朝以后,“马甲”的称谓便确定下来,近代民间马甲的形制基本沿袭了清朝时期马甲的形制。其名称变化虽然繁多,但其基本形制却未改变,均为“无袖上衣”。本文以江南大学民间服饰传习馆馆藏的53件清末民国时期的马甲为研究对象,通过对我国近代民间服饰马甲的款式造型、纹样图案、面料色彩的分析,总结其外观形制的主要特征。

2. 款式造型特征

服装的款式造型指的是服装外形的变化及其存在方式。其中上衣的款式造型变化主要在于内部结构与外部造型上。马甲因其无袖的造型特点,其主要变化则体现在开襟方式及衣领的造型上。

2.1 开襟方式与领形的变化

在对馆藏成人马甲的实物测量中,发现其胸围变化,尤其在90-120厘米,且均无省。另外,马甲的袖窿深度大,袖隆长在50-60厘米。由此可见,近代民间马甲的整体造型承袭了我国传统服饰宽衣大袖的服装风格,变化不大,均袖窿肥大、衣身宽松。在此共性特征基础上,马甲服饰的变化主要体现在其门襟的开襟方式及衣领的造型上。

表1：江南大学民间服饰传习馆藏近代民间服禌马甲领形与开襟形式统计表

<table>
<thead>
<tr>
<th>种类名称</th>
<th>合领（立领）</th>
<th>V领</th>
<th>无领</th>
<th>合计</th>
</tr>
</thead>
<tbody>
<tr>
<td>数量（件）</td>
<td>比例（%）</td>
<td>数量（件）</td>
<td>比例（%）</td>
<td>数量（件）</td>
</tr>
<tr>
<td>对襟</td>
<td>11</td>
<td>20.8%</td>
<td>7</td>
<td>13.2%</td>
</tr>
<tr>
<td>大襟</td>
<td>10</td>
<td>18.9%</td>
<td>3</td>
<td>5.7%</td>
</tr>
<tr>
<td>琵琶襟</td>
<td>4</td>
<td>7.5%</td>
<td>2</td>
<td>3.8%</td>
</tr>
<tr>
<td>一字襟</td>
<td>1</td>
<td>1.9%</td>
<td>2</td>
<td>3.8%</td>
</tr>
</tbody>
</table>

170
如表1所示，根据对江南大学民间服饰传习馆收藏的53件近代马甲归类分析，我国近代民间服饰马甲的开襟方式主要有对襟、大襟、琵琶襟、一字襟、肩部开襟、单肩及侧缝开襟等方式，领形大体分为两种，即立领与无领，其中无领又分为面领及V领两种形式。

领形与开襟方式的搭配多种多样，无固定模式。以立领的对襟马甲数量最多，立领大襟马甲次之，均是近代民间服饰马甲的基础款式。而V领马甲较少。均占总数的7.5%。面领马甲的搭配方式最广，各种开襟方式都可以搭配，仍以对襟最为常见，其中肩部及侧缝开襟的马甲较为特殊，均为儿童用马甲，便于穿脱的同时增加了服装的趣味性，如图1所示。除此之外，馆藏马甲中另有一件造型独特的儿童马甲，一件外套衣片，前片从袖窿下方至第一粒纽扣处为圆领对襟款式，以此为分割的弧线下方并无衣片相连。如图2a及2b所示，进而构成了如图2a及2b所示，进而构成了前片仅有三分之一衣片的独特造型。儿童马甲一件是单侧侧缝开襟，另外一件夹棉儿童马甲仅有一件衣片，前片剪裁呈矩形状，仅肩部相连，两侧侧缝均不相连。由此可见，我国民间服饰马甲的款式造型多变，除常见的基础款外，仍有许多创新特色的设计，也以此体现了我国人民丰富的文化与智慧沉淀以及我国民间多彩的民俗与地域特色。

如表2所示，根据对江南大学民间服饰传习馆收藏的53件近代马甲归类分析，我国近代民间服饰马甲的开襟方式主要有对襟、大襟、琵琶襟、一字襟、肩部开襟、单肩及侧缝开襟等方式，领形大体分为两种，即立领与无领，其中无领又分为面领及V领两种形式。

领形与开襟方式的搭配多种多样，无固定模式。以立领的对襟马甲数量最多，立领大襟马甲次之，均是近代民间服饰马甲的基础款式。而V领马甲较少，仅占总数的7.5%。面领马甲的搭配方式最广，各种开襟方式都可以搭配，仍以对襟最为常见，其中肩部及侧缝开襟的马甲较为特殊，均为儿童用马甲。便干穿脱的同时增加了服装的趣味性，如图1所示。除此之外，馆藏马甲中另有一件造型独特的儿童马甲，一件外套衣片，前片从袖窿下方至第一粒纽扣处为面领对襟款式，以此为分割的弧线下方并无衣片相连。如图2a及2b所示，进而构成了前片仅有三分之一衣片的独特造型。儿童马甲一件是单侧侧缝开襟，另外一件夹棉儿童马甲仅有一件衣片。前片剪裁呈矩形状，仅肩部相连，两侧侧缝均不相连。由此可见，我国民间服饰马甲的款式造型多变，除常见的基础款外，仍有许多创新特色的设计，也以此体现了我国人民丰富的文化与智慧沉淀以及我国民间多彩的民俗与地域特色。

如表2所示，根据对江南大学民间服饰传习馆收藏的53件近代马甲归类分析，我国近代民间服饰马甲的开襟方式主要有对襟、大襟、琵琶襟、一字襟、肩部开襟、单肩及侧缝开襟等方式，领形大体分为两种，即立领与无领，其中无领又分为面领及V领两种形式。

领形与开襟方式的搭配多种多样，无固定模式。以立领的对襟马甲数量最多，立领大襟马甲次之，均是近代民间服饰马甲的基础款式。而V领马甲较少。均占总数的7.5%。面领马甲的搭配方式最广，各种开襟方式都可以搭配，仍以对襟最为常见，其中肩部及侧缝开襟的马甲较为特殊，均为儿童用马甲，便于穿脱的同时增加了服装的趣味性，如图1所示。除此之外，馆藏马甲中另有一件造型独特的儿童马甲，一件外套衣片，前片从袖窿下方至第一粒纽扣处为面领对襟款式，以此为分割的弧线下方并无衣片相连。如图2a及2b所示，进而构成了前片仅有三分之一衣片的独特造型。儿童马甲一件是单侧侧缝开襟，另外一件夹棉儿童马甲仅有一件衣片，前片剪裁呈矩形状，仅肩部相连，两侧侧缝均不相连。由此可见，我国民间服饰马甲的款式造型多变，除常见的基础款外，仍有许多创新特色的设计，也以此体现了我国人民丰富的文化与智慧沉淀以及我国民间多彩的民俗与地域特色。

我国传统服饰的上衣下裳或连体袍服样式，多为平面造型，服装无论平放还是展开悬挂均呈现平面状态，只有穿人穿着后，才会随着人体曲线的起伏和运动趋于立体。[2]我国的上衣与下裳为连裁，即只有一片衣片，并采用直线式的剪裁以及平服式的结构处理，无肩斜、省道、分割缝等可以勾勒出人体曲线的收放量。马甲也是依据了这种办法，但在袖部结构的处理上却与我国传统服工艺不同，即马甲的剪裁是以平服剪裁，但是大部分马甲分为前后两片，且具有肩斜量，使马甲更符合人体曲线。此种特殊的剪裁方式可归因于马甲的无袖形制。如前文所述，我国传统服饰多平面造型，因其宽松肥大的剪裁方式，经人穿着可以随着人体曲线的起伏运动趋于立体。上外宽大的袖子可以垂坠下来，从而勾勒出人们的肩部线条。而因马甲无袖，若无肩斜的收量，马甲的肩缝处会高于人们的肩部，且无法满足人们对于服装审美的需要及舒适度的需要。在西方裁剪制衣技术尚未传入我国的时候，马甲的肩斜设计已充分展示了我国古代人民的聪明才智及当时制衣技术的日趋成熟。

3. 纹样图案特征

3.1 常用纹样图案的题材类别及装饰位置

我国近代民间服饰马甲的纹样图案主要以机织的提花面料图案与刺绣图案两种表现形式为主，其素材丰富多样，可分为几何纹样、植物纹样、动物纹样和组合纹样四类。图案的装饰位置也各不相同，是立体、自由、大体可以分为居中式、对称式、呼应式和满地式。江南大学民间服饰传习馆收藏的近代民间服饰马甲中有12件是无纹样的马甲，其余41件马甲的具体图案纹样信息如表2所示：

如表2所示，按纹样的种类区分，组合纹样与植物纹样马甲最多，是最常用的民间服饰马甲的装饰图案。组合纹样指的是由几何纹样、植物纹样、动物纹样等多种纹样混合组成的图案，一般都是各种图案的变形或组合。我国近代民间服饰马甲中有12件是无纹样的马甲，其余41件马甲的组合图案装饰信息如表2所示：

如表2所示，按纹样的种类区分，组合纹样与植物纹样马甲最多，是最常用的民间服饰马甲的装饰图案。组合纹样指的是由几何纹样、植物纹样、动物纹样等多种纹样混合组成的图案，一般都是各种图案的变形或组合。我国近代民间服饰马甲中有12件是无纹样的马甲，其余41件马甲的组合图案装饰信息如表2所示：

除了以面料的织造来表现服饰图案以外，刺绣也是我国传统服饰最常用的装饰手法之一。刺绣于宫廷服饰可谓无处不在，且丝线亮丽，手法细腻。民间服饰中的刺绣不比宫廷服饰的华美，但却有着自身的朴实与美丽，当然其中也不乏有些手工精致的上佳之作。如图4a、4b所示女士琵琶襟双面刺绣马甲，该款女士马甲为满地式刺绣，且手法细腻，图案惟妙，具有浓郁的满族风格。然而如此奢华的满地式刺绣马甲在民间服饰中数量很少，通常人们喜欢在正面或者背面进行单面刺绣，或是服饰的边缘刺绣装饰。如表2中所统计的9件居中式组合纹样马甲均为单面刺绣图案，因为居中式的图案一般是
具有特定含义或者一定的标识作用的图案，所以民间马甲的居中式图案皆是以刺绣手法表现的寄托人美好愿望的吉祥图案。

### 表2：江南大学民间服饰传习馆藏近代民间服饰马甲纹样图案统计表

<table>
<thead>
<tr>
<th>种类名称</th>
<th>居中式数量(件)</th>
<th>居中式比例</th>
<th>对称式数量(件)</th>
<th>对称式比例</th>
<th>呼应式数量(件)</th>
<th>呼应式比例</th>
<th>满地式数量(件)</th>
<th>满地式比例</th>
<th>合计数量(件)</th>
<th>合计比例</th>
</tr>
</thead>
<tbody>
<tr>
<td>几何纹样</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2.4%</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>17.1%</td>
<td>8</td>
<td>19.5%</td>
</tr>
<tr>
<td>植物纹样</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2.4%</td>
<td>3</td>
<td>7.3%</td>
<td>11</td>
<td>26.8%</td>
<td>15</td>
<td>36.9%</td>
</tr>
<tr>
<td>动物纹样</td>
<td>9</td>
<td>22.0%</td>
<td>2</td>
<td>4.9%</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>4.9%</td>
<td>3</td>
<td>7.3%</td>
</tr>
<tr>
<td>组合纹样</td>
<td>9</td>
<td>22.0%</td>
<td>5</td>
<td>12.2%</td>
<td>1</td>
<td>2.4%</td>
<td>4</td>
<td>9.8%</td>
<td>23</td>
<td>56.1%</td>
</tr>
<tr>
<td>合计</td>
<td>9</td>
<td>22.0%</td>
<td>5</td>
<td>12.2%</td>
<td>1</td>
<td>2.4%</td>
<td>4</td>
<td>9.8%</td>
<td>23</td>
<td>56.1%</td>
</tr>
</tbody>
</table>

综上所述，我国近代民间服饰马甲的图案与分布中，满地式植物纹样的马甲数量最多，这是因为每一种纹样都有其特定含义和文化内涵，对称式纹样次之。而居中式纹样则以吉祥图案为题材类别，以刺绣手法表现，如图1所示儿童马甲，图案所表达的蝶恋花与凤求凰的场景，属于祈求婚姻美满的吉祥图案。我国自古以来有着与蝴蝶有关的许多美丽的神话传说，例如梁祝化蝶，自古蝴蝶便成为了爱情的使者。蝶生性恋花，娇艳的花朵配上翩飞的蝴蝶，象征着夫妇的爱情和美、恩爱和谐。而凤凰作为吉祥之鸟，在民间俗信中与龙代表丈夫，与代表妻子，描写的是凤凰与鸣，代表的是夫妻关系的默契与幸福。如图3所示儿童五毒马甲，五毒指的是蛇、蝎、蜈蚣、蟾蜍、壁虎，时常装饰于孩童的服装上，以为涂有保护色之毒虫，此为“以毒攻毒”，祈求孩童可以健健康康的成长。属于祈求趋吉避凶的吉祥图案。而图4a与b所示女士琵琶襟刺绣马甲，从“花团锦簇”的刺绣来看，这是一幅富家小姐所用的马甲。高洁的梅花，花中君子的兰花，象征健康的菊花三种各富寓意的花草秀满服饰的领身、襟边、袖管边，蝴蝶穿梭于花草丛中寓意爱情的美好，如图所示，前胸和后背鲜艳的突出因素象征吉祥“多子、多福、多寿”的“三多”图案是民间最高的理想境界。

3.1 吉祥图案的广泛运用及其情感语意的表达

吉祥民俗文化是中华民族的一个古老而又悠久的生命主题，它从图腾崇拜、自然崇拜、神灵信仰、宗教信仰走来，是人类为生存繁衍存在的一种心理情感和精神追求，是人类心灵的镜子，是民族的血脉和源泉。

3.2 面料与色彩特征

服装的面料与用色是决定服装外观与功能性的重要因素之一。面料是影响服装服用性能的直接因素，而色彩作为一种表现符号，是人类情感表达的重要手段。色彩与面料相结合，客观角度表达出现代民间服饰的面料与色彩亦是如此，具体统计表如下所示：
如表3所示,马甲材质构成丰富,在我国近现代民间服饰马甲最常用的面料为丝类织物,其中丝绸最为普遍。棉类织物与夹棉马甲次之,棉织物松软舒适,吸湿保暖,是服装的理想面料。夹棉马甲为冬季用马甲,多用棉花、羊毛等作为填充物,加之较厚实的面料以防寒。马甲的装饰色彩,总体可以分为单色与多色两大类,其中单色马甲馆藏实物有黑色、褐色、红色、紫色、蓝色、绿色。多色马甲主要有对比色与同色系两大类,其中,对比色的多色马甲数量最多。在近代民间服饰马甲中,人们喜欢选用色彩艳丽、对比强烈、装饰色丰富的颜色来增加服饰的喜庆、祥和气息。常用的配色有红绿配、红蓝配、红黑配、黄紫配等,并以黑白二色为中间色进行视觉上的调和,这种配色方法也是沿袭了我国古代几千年的“五行色”之说。其次,纯色马甲中黑色最多,约占总数的三分之一。中国古代尚黑、尚红、尚紫,认为这些是代表喜庆、吉祥的色彩,黄色为古代皇室的专用色,因此在民间很少使用,红色与紫色的使用则较多。相较于这些喜庆的色彩,黑色明显压抑、沉重,但反之也体现出安全、稳定、高贵的意味。同时黑色颜色较深,人们在生活劳作的日常服饰中,黑色的选用较为耐脏而实用。

综上所述,我国近代民间服饰马甲的面料选用使马甲成为四季均可服用的实用型服装。其中丝绸的选用最为广泛,是制作马甲的主要面料。色彩的选用体现了中国传统的色彩文化观,通过色彩这种表象符号来诠释制作者与穿着者的情感因素。明亮的对比色与实用的黑色是我国近代民间服饰马甲中的常用配色。

5. 结论

基于对江南大学民间服饰传习馆的53件近代民间服饰马甲进行详细的分类整理,细分了其具体形制特征:近代民间马甲的款式造型特征以宽松的袖窿与衣身、流线型的剪裁、独特的肩斜设计组合而成,并配合多变的领形与开门襟方式,其中以立领对襟马甲与立领大襟马甲最为常见。其次,近代民间马甲的图案纹样种类繁多,分为几何纹样、植物纹样、动物纹样和组合纹样,最具特色且运用广泛的是具有吉祥寓意的吉祥图案,常以刺绣的手法表现于马甲之上以寄托人们对美好生活的期冀。近代民间马甲的面料色彩的运用与其服用性能及外观特色有着直接的关系,丝绸为马甲最为常见的服用面料。而色彩作为人们表达情感因素的符号与媒介,马甲的色彩多样,以对比色的多色马甲与实用的黑色马甲最为常见。通过对近代民间服饰马甲的系统研究,进一步论证了我国传统服饰的“尚黑”、“祈福纳祥”,并体现出民间服饰研究的价值性所在,有利于传承我国传统民间文化艺术,并将有力推进我国传统文化的创新性发展及提升。
梁惠娥 (1967－), 女, 汉, 山东邹平人, 香港理工大学纺织制衣学系硕士, 教授, 博士生导师。研究方向: 服饰文化与服装设计。E-mail: running94@yahoo.com。

高梦楚 (1988－), 女, 江苏徐州人, 江南大学纺织服装学院 2010 级硕士研究生, 研究方向: 服饰文化与服装设计, E-mail: c-aya@foxmail.com。
Fiberart: Material and Process

Chika OHGI
Nagoya University of Arts, associate professor

Abstract
1980年からテキスタイルアート作品を制作してきた。その作品は自作の和紙や半透明ビニールを使った空間性の高い作品である。日本やヨーロッパ諸国で発表した自作を紹介する。
2005年から名古屋芸術大学（Nagoya University of Arts）、テキスタイルデザインコース、准教授に着任。コースの目標は、地元の繊維産業にテキスタイルデザイナーを入れることである。ここでは、有松絞り産地での教育活動を紹介する。

1. Samples

1995 filled with light, water in the air

2009 距離感のみちかけ
Authors

Chika OHGI

194-18 Echigocho, nakagyo, Kyoto, 604-8256
JAPAN

blanc@y2.dion.ne.jp

Biography
2000-06 Kyoto City University of Art ,Ph. D. Fine
2005- Accoc. Prof. School of Design, Nagoya
University of Arts

Selected Group Exhibition
1992  The 15th International Lausanne
Biennial,Lausanne, SWITZERLAND
2001  Textural Space: Contemporary Japanese
Textile Art, U.K. (tour)
2002  Bulgaria-Japan Contemporary Textile
Art,Sofia, BULGARIA (tour)
2005  5th INTERNATIONAL TEXTILE TRIENNIAL
EXHIBITION, Tourma, BELGIUM
2010  13th International Tapestry triennial, Lodz,
Poland
2011  Bite-Size: Miniature Textiles from Japan and
the UK, London, UK

Selected Workshops
2000  Yokohama Museum of Art, Kanagawa,
JAPAN
2001  Sainsbury Centre for Visual Arts, Norwich,
U.K.
2003  National Academy of Art, Sofia, BULGARIA

Publication
2001  Portfolio Collection Volume 4: Chika OHGI
(Telos Art Publishing ISBN 1-9020-152-58)

2011 板締め絞り浴衣

2001 Portfolio Collection Volume 4: Chika OHGI
(Telos Art Publishing ISBN 1-9020-152-58)
An On-Going Dialogue with Material

Waverly Wei-Qun LIU

Artist, writer, curator, waverwaver@yahoo.com

Summary

Both Sibori technique and intaglio etching rely on the active chemical action and the resisting of it to create desirable images. It is the tension between push and pull that allow a conversation between the artist and the medium. Often accidents happen in the chemical, leading to unexpected results. This creates obstacle as well as bonus for the technique: proper improvisation of the circumstances helps the artist make a leap in her or his work, making the medium work for instead of against her. An on-going dialogue with the chosen medium is an essential part of the artistic creation and expression.

1. a dialogue with intaglio etching

My artistic career started in watercolor, a western medium closely resembling the traditional Chinese ink painting in its spontaneous movement and its unforgiving nature. By closely monitoring the amount of water and pigment in the brush, and pushing coloring on the paper surface, I am able to create illusion of three dimensionality in a two dimensional surface.

Although its inks are oil-based in nature, intaglio etching opens up an opportunity for me to converse with the medium. The laborious process only slows me down and loosen up, embracing the often times accidental effects happening during the etching process, often times the best element in the entire process.

The process of etching is game of push and pull between the artist and the acid. It’s about resisting the acid from getting to certain areas of the plate by stopping out with various methods. In this sense, shibori dyeing is a form of 3D etching, in which dye bath replaces acid, and fabric replaces paper. By shaping and sewing the fabric in a certain way, we are able to direct the dyeing process to a certain degree. Accidents do happen in the dye bath, as in acid tank, so every time putting a piece of prepared fabric in the dye bath one takes a leap of faith.

2. a dialogue with circumstances

In May 2008, I did a textile installation with yardages of Chrysanthemum-tea dyed silk in Madison, WI. The fabrics were printed with repeat pattern created from a recipe of Chinese herbal medicine written in my doctor’s handwriting, an unexpected find in my childhood remnants. On the morning of May 12th 2008, the day of the opening, our phone ran at 6:30. My husband’s parents told us in a hurry: “We are fine, we are fine.” before the line got disconnected. When we tried to call back the line was busy. We didn’t find out until later that day, when we read the news, that a massive 8. 3 earthquake had hit Chengdu, Sichuan, where they live. The full impact of the disaster only came to be known as the days went by. This coincidence of dates had prompted me to extend this body of work originally addressing my personal journey of sickness, pain and healing, to a wider sphere to include the universal experience living with and recovering from catastrophic events.

3. a dialogue with shibori

The silk panels for the first installation measured 40cm by 300cm. To create a new vocabulary, I tore up the fabrics into 25cm by 25cm square samples, one by one, shibori dyed them repeatedly with different folding, clipping and wrapping techniques, until each of them stood on their own as complete piece of art. When I had created dozens of them and lay them down side by side, a new vision had surfaced. The original texts from the herbal recipe was still somewhat visible, now imbedded under layers of dyes they became more mysterious, almost ancient looking as if excavated from a historical site.

To anchor these panels, I dyed tiny squares of black silk organza pieces around 7cm by 7cm to place in the center of each shibori square, echoing the gold-leafed paper-currency burnt at traditional Chinese funerals.

Then I had a friend cast some of silk pieces in resin panels, thus forever freezing them in time, much like the kids who lost their lives in the unexpected quake, on their last day to school, bidding daily farewell to their parents, their smile frozen in the survivors’ memory as the last thing they remembered of their children for the rest of their lives.

4. a dialogue with space

In a gallery room was about 20 square meters by size. I painted everything visible a stark white, including all the walls, heaters, door knobs, and stretched white fabric over the carpet. On the white walls, I copied the names of 4800 dead children’s names one by one in pencil. (the total death toll fo children were more than 5300, but these were the names I was able to find) This job took me four days with almost no sleep or food.

The gallery was on a quiet street with little traffic. At night working in the gallery alone, listening to the water dripping upstairs and the furnace making noises was like listening to the pulse and breathing of the building. The tip of my pencil slashed on the bumpy wall surface, leaving some strokes thicker and smoother than others. An average Chinese character has 10 strokes, an average Chinese name has 2-3 words—this means in a mere 20-30 strokes, a name was completed. Many people asked me, it must have taken a very long time to write all these names; my answer was, not long enough to remember the brief lives these children had. After writing for many hours, my brain was numb, and I could see the pencil moving almost at its own will, I was merely a vehicle drive by god’s will to deliver a message of remembrance of these lost souls.

5. a dialogue with time

While the process of writing these names was in itself part of the artwork, erasing them at the end of the show was symbolism of how the authority tried to cover up the facts, how many of the bodies were never discovered, and simply pronounced “missing”, how individual destinies are trivial in the face of history and times.

After finishing the names on the walls, silk panels were installed, the central piece, a shibori-dyed fabric mounted on a wood panel was surrounded by dry jasmine flowers,
fanning out towards the rest of the gallery space, symbolizing the spirits of children bidding farewell with their family and the world before ascending to heaven.

At the end of the show, after dissembling all the pieces, I painted over the wall in two hours, covering up everything I had done just a few days before, just like how the bodies were buried right on site, many without even a nametag, just a numbered marker in the yellow earth.

In the span of a week, during the installation of this show I ate or slept little and lost a total of ten pounds. Time not only became part of my work, it also left a visible mark on me as an artist.

6. a dialogue with the audience

On the opening day, approximately 100 people came through the show. No more than 3 people were expected to be in the room, known as “the prayer chamber”, at a time. As soon as the visitors entered the space, their voice naturally dropped, they became quiet. Almost all the women, especially young mothers, came out teary. I had a very emotional journey creating this work myself, but the impact it had on the audience exceeded my expectation. It was through my work that my emotion was passed onto the audience, this became an indirect conversation more meaningful and powerful than most which are face to face.

Conclusion

No matter the chosen medium, keeping an open-mind, working with circumstances, thus having an interactive and on-going dialogue with the material is essential for artists who want to constantly make progress and break-through, who perpetually reach for new height.

Sample Images

http://www.douban.com/photos/album/37358331/
Biography

Waverly is an artist, writer and curator who works in watercolor, intaglio etching, textile, and installation. She has exhibited in the United States and Japan, her works are in private and public collection in United States, Japan, Korea, Ukraine, Spain, Sweden, Argentina, etc. She has curated exhibitions, given talks at academic conferences, hosted panel discussions, been interviewed on public radio and television. She currently divides her time between San Francisco and Shanghai.