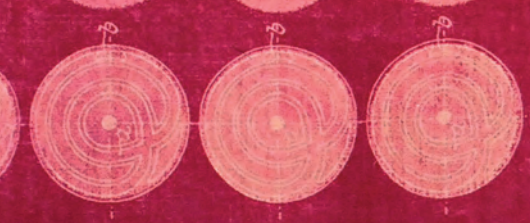
2nd edition
revised and updated

DYEING AND SCREEN-PRINTING ON TEXTILES

Joanna Kinnersly-Taylor



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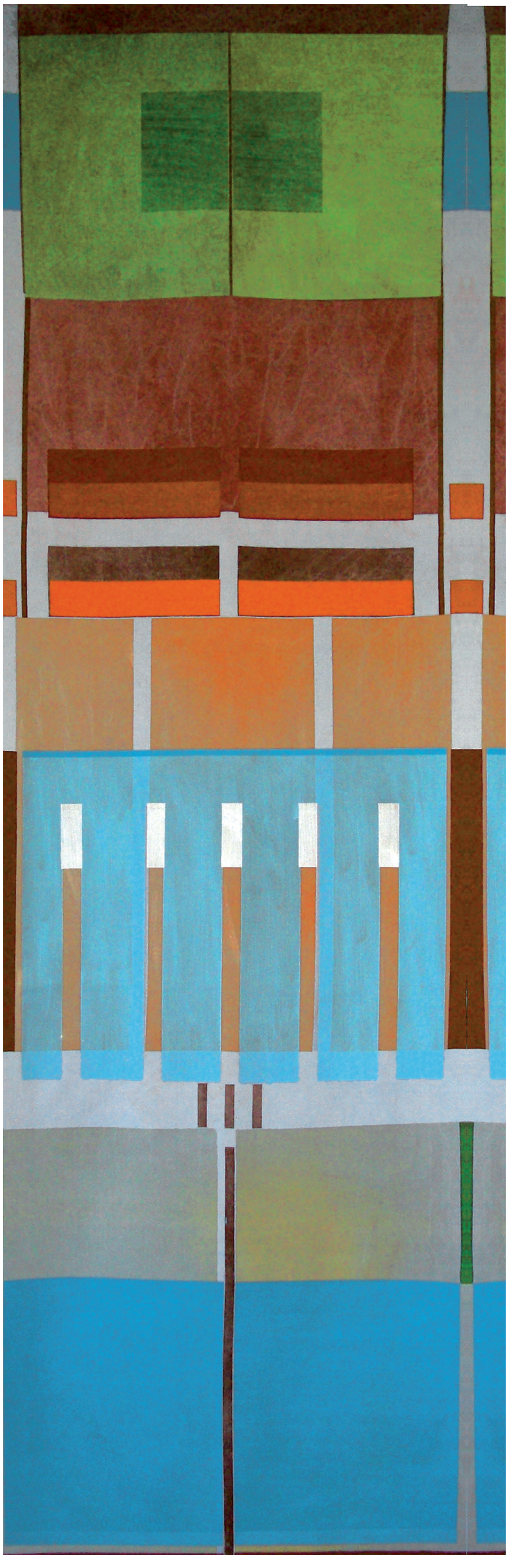
A & C Black • London

Contents



DYE BENCH/TABLE

It is preferable to have a separate area for weighing out and mixing dyes and pastes, positioned near the sink. Have two sockets positioned at this point, for scales and an electric mixer. A domestic hand mixer is invaluable for ensuring pastes are mixed thoroughly; if you need to mix up large quantities of gums on a regular basis, a catering or industrial mixer may be beneficial. Make sure your scales sit on a firm surface, as they are very sensitive. Shelves above are useful for storing all your ingredients.

A galvanised steel rack for storing various sizes of screens.

SCREENS

Overall, I would recommend aluminium framed screens rather than wooden ones. Although they are more expensive, they do not warp, are quicker to dry and are also lighter and therefore more manageable on a large scale, especially if printing alone. You may have different screen requirements depending on whether you are doing repeat lengths or one-off placement prints.

If you are going to be using a registration rail, check your screen frame is at least the same depth as the distance between the table surface and the top of the rail in order for brackets or clamps to work against stops set against the rail. A fairly standard frame depth is 4cm (1½in.).

Screens will also need to have a means of fixing on brackets – see also Chapter 11, 'Attaching the bracket to the screen'. Wooden screen frames have the advantage here as a bracket made from steel flat bar can simply be drilled and screwed straight into the frame, providing the wood is soft enough. Aluminium frames will need to either incorporate some means of allowing a bracket to be screwed in, or clamps can be used. If you do choose wooden screens, make sure they are made from a reasonably water-resistant timber that is not too heavy. The corners should be screwed and glued to provide long-term resistance against the constant wet/dry conditions.

If you have enough storage space, it can be useful to have quite a lot of (different sized) screens, because it takes the pressure off having to clean off images you may wish to go back to at a later date, and also the probable inconvenience and expense of re-exposing. Ideally, screens should be stored in a screen rack where they will be protected from damage; if not, stack vertically in a corner in order of size so that no screen leans onto the mesh of another. Ensure there is enough room to pull out, lift and turn the largest screen, without knocking into any other piece of equipment or furniture – it is very easy to rip screen mesh.

NOTE

It can be useful to number your screens and keep a corresponding list noting the mesh size, overall frame and corresponding maximum image sizes, together with what imagery is on the screen.

Screen mesh

Traditionally, screen mesh was made of silk, but nowadays polyester provides a much more durable and economical alternative. This polyester 'silk' is available as two main types: multifilament and monofilament. Mostly it is available as a plain weave, and occasionally, as a twill.

MULTIFILAMENT This mesh is the cheaper of the two, each strand being made of several strands twisted together. This creates a somewhat rougher surface, and after time a residue of emulsion (if used) and/or pigment can build up around the design area, making the screen much harder to strip. Generally, use of multifilament mesh would be confined to working with paper stencils or using resist techniques with pastes, litho or wax crayons etc. painted or drawn directly onto the screen. Multifilament mesh size denotes the size of the opening between the threads and is described with a number followed by an 'XX'; the smaller the number, the larger the opening and the coarser the mesh. This mesh comes in sizes ranging from 6XX (very coarse) to about 16XX (very fine). For textile printing purposes, a 10XX, 12XX, or 14XX would be suitable.

MONOFILAMENT This describes a mesh woven from single strands of fibre, which can be made into much finer mesh than can be achieved with multifilament. This is the mesh I would recommend using as it will last a long time, withstanding endless stripping and re-coating, and also provide a suitable surface for transferral of artwork produced by almost all methods. Monofilament mesh size is indicated by a number, which denotes the number of threads per linear centimetre or inch, followed by 'T'. The smaller the number, the coarser the mesh. It depends on the type of work you will be carrying out as to which mesh size you choose. A 62T (160T) mesh size is ideal for general use and with half-tones; 55T (140T) or 49T (125T) are also fairly multi-purpose. 90T is suitable for *very* fine imagery, especially small text, but will block easily with pigments. If you are printing onto a coarsely woven cloth with a bold image, especially in pigments, a slightly larger mesh (43T (110T)) may be appropriate. For large flat areas of metallic pigment, an even coarser mesh, say 38T (95T) may be necessary to prevent drying out and blocking. It is important to remember that the coarser the mesh, the more difficult it is to print smooth curves, as these will appear 'stepped', or pixelated.

Mesh size conversion

monofilament threads per cm	monofilament threads per inch	multifilament size of opening
34T	86T	6XX–7XX
38T	95T	8XX
43T	110T	10XX
49T	125T	12XX
55T	140T	12XX
62T	160T	14XX
70T	180T	14XX
78T	200T	16XX
92T	232T	16XX
96T	245T	16XX

SQUEEGEES

It is worth getting the best quality squeegees that you can afford; if looked after properly, these will provide you with many years of service. Your selection of squeegee sizes will relate to the internal widths of your screens. The squeegee should fit comfortably within

NOTE

If scouring wool in fleece form, place in a pillowcase or similar to spin dry. Afterwards, separate fibres gently and either dye immediately or dry in a well-ventilated place, away from direct heat and sunlight; do not tumble dry.

Wool

1 Prepare a bath at 40°C (104°F) and add Metapex at 1% of the dry weight of the wool.
2 Gently push the wool under the water and move occasionally over the next 30 minutes – do not handle excessively otherwise felting will occur.
3 Rinse gently in warm water, spin and dry.

Silk

Silk is normally 'de-gummed', i.e. the natural gum sericin and other machine oils have been removed, but raw silks like tussah may need to be treated.

1 Prepare a bath at 85°C (185°F) with 3g soap flakes per litre water and treat the fabric for 45–90 minutes. Do not boil.
2 Rinse well first in warm and then cold water, spin and dry.

Viscose rayon, cellulose triacetate, nylon and polyester

1 Prepare a bath at 70°C (158°F) with 15ml Metapex per litre water and 20g sodium carbonate per litre water and treat the cloth for 30 minutes.
2 Rinse well in cold water, spin and dry.

Cellulose acetate and acrylic

1 Wash in a bath containing 15ml Metapex per litre water at 60°C (140°F) for 30 minutes and rinse well in warm water. Spin and dry.

NOTES

Do not exceed bleach quantities, as fibres can be damaged and cloth weakened.

If a really intense white is required, the cloth can be further treated with an optical brightening agent (OBA). OBAs do not remove colour from the fabric, like a bleach, but instead add themselves to the fabric, like a colourless dye. After treatment, the cloth absorbs ultraviolet light and converts it into visible white light, giving the fabric an enhanced bright whiteness.

1 Make a bath at 40°C (104°F) containing a suitable OBA measured at 0.5% on dry weight of cloth. Stir gently for 5–10 minutes.

2 Rinse thoroughly in cold water, spin and dry.

BLEACHING

For best results, cloth should always be scoured prior to bleaching.

Cotton and linen

Cellulose fibres require an alkaline bleaching bath.

1 Make up a bath with cold water and add 10ml sodium hypochlorite at 4% strength (ordinary household bleach) per litre water, together with 5g sodium carbonate per litre water.
2 Enter the cloth into the bath and leave until the desired whiteness is achieved; this may take from 1–4 hours, or sometimes may need to be left overnight. *Do not heat the bleaching bath*.
3 Rinse cloth thoroughly, and neutralise any alkali remaining in the fibres by subsequently rinsing in a bath containing 1ml acetic acid (20%) per litre water.
4 Rinse again, spin and dry.

Wool and silk

Protein fibres require an acid bleaching bath, however, tussah silk (cream/brown) cannot be bleached.

1. Make a bath at 50°C (122°F). Add hydrogen peroxide (dilution as in List of Auxiliaries) in the following proportion: 1 part hydrogen peroxide (30 volume) to 15 parts water, e.g. 1 litre to every 15 litres water.
2. Add 2g sodium silicate per litre water and stir carefully to dissolve. Sodium silicate gives the bath the slight alkalinity required, controlling the oxidizing action and increasing bleaching efficiency of the chemicals on the cloth. Sodium silicate may be difficult to obtain in small quantities, so sodium carbonate may be substituted; the pH value is similar.
3. Enter *pre-wetted* cloth, gently submerge under the water and leave for up to 6 hours or overnight if necessary. *Do not heat the bleaching bath*.
4. Rinse thoroughly, spin gently and dry.

If further whitening is required:

1. Make a bath at 50°C (122°F) containing a suitable OBA for protein fibres measured at 0.5–1.5% on dry weight of cloth, together with 1.5g sodium hydrogen sulphite per litre water. Treat for up to 1 hour.
2. Rinse thoroughly in cold water, spin and dry.

NOTE

Take great care when using sodium silicate, as it is extremely irritating to eyes and skin. Clean up any spillages immediately; once it has dried, it cannot be removed.

Ulla Warchol (USA), *Untitled*, (detail), 2011. Reactive dyed cotton drill, screenprinted and stencilled with reactive dyes and discharge, 155 x 80cm (61 x 31½in.).
PHOTO: Joanna Kinnersly-Taylor

SUMMARY OF SCOURING RECIPES

Fabric	Temperature	Auxiliaries	Scouring time	Rinsing / Finishing
COTTON AND LIGHTWEIGHT LINEN	100°C (212°F)	sodium carbonate Metapex	30 minutes	thoroughly in warm water / spin and dry
HEAVYWEIGHT LINEN	40°C (104°F) → 85°C (185°F)	sodium silicate sodium peroxide sodium bicarbonate Metapex	45 minutes	thoroughly in warm water / spin and dry
WOOL	40°C (104°F)	Metapex	30 minutes	gently in warm water / spin gently and dry away from direct heat and sunlight (if in fleece form)
SILK – TUSSAH (CREAM/BROWN)	85°C (185°F)	soap flakes	45–90 minutes	warm then cold water / spin and dry
VISCOSE RAYON, CELLULOSE TRIACETATE, NYLON AND POLYESTER	70°C (158°F)	Metapex sodium carbonate	30 minutes	thoroughly in cold water / spin and dry
CELLULOSE ACETATE AND ACRYLIC	60°C (140°F)	Metapex	a few minutes	thoroughly in warm water / spin and dry

SUMMARY OF BLEACHING RECIPES

Fabric	Temperature	Auxiliaries	Scouring time	Rinsing / Finishing
COTTON AND LINEN	cold do not heat the bleaching bath	sodium hypochlorite (4%), sodium carbonate	1–4 hours or overnight	thoroughly in cold water / neutralise any alkali remaining by subsequently rinsing in 1ml acetic acid (20%) per litre water / spin and dry
may be further treated with an optical brightening agent (OBA)	40°C (104°F)	suitable OBA at 0.5% on weight of cloth	5–10 minutes	thoroughly in cold water / spin and dry
WOOL AND SILK	50°C (122°F) do not heat the bleaching bath	hydrogen peroxide, sodium silicate *or* sodium carbonate	up to 6 hours or overnight	thoroughly in cold water / spin gently and dry
may be further treated with an optical brightening agent (OBA)	50°C (122°F)	suitable OBA at 0.5–1.5% on weight of cloth, sodium hydrosulphite	1 hour	thoroughly in cold water / spin gently and dry

5 Dyeing cloth

Please also refer to the 'Dyeing samples' notes in Chapter 3.

TYPES OF VESSEL

Any vessel made from a material that is resistant to chemicals and easy to clean will be suitable for cold water dyeing; glass, enamelled or galvanised metal, and plastic (polythene) bowls, buckets or baths are all appropriate. For dyeing recipes that require the dye-bath to be heated, stainless steel is the best option. *Never* expose galvanised metal to direct heat, as it will give off toxic zinc fumes.

Selection of suitable vessels for dyeing samples and smaller pieces of cloth.

DYEING WITH DISPERSE DYES

for cellulose acetates and tri-acetates, nylon, polyester, acrylic and some plastics

LIQUOR RATIO	50:1
TEMPERATURE	*start at:* 50°C (122°F) → 100°C (212°F) → 90-95°C (194–203°F) (*or* for acrylic do not exceed 85°C [185°F]).
ASSISTANTS	pH neutral detergent, carrier (for polyester), acetic acid (optional)
DYEING TIME	80 minutes
WASHING OUT	warm (50°C [122°F]) with 2ml Metapex per litre water for 5 minutes / cold until clear

Unlike other dyes, disperse dyes do not dissolve in water to form a solution. Instead the particles disperse in the water, penetrating the fibre when heated. A 'dispersing agent' is required to help even distribution of the dye, preventing it from sinking to the bottom of the dye-bath during the dyeing process. Whilst a pH neutral detergent or soap flakes as a dispersing agent works adequately, you may wish to use a proprietary compound recommended by the specific dye manufacturer.

Different fibre blends take up colour depending on their main constituent. For example, a nylon/acrylic mix accepts colour more readily than a wool/acrylic mix. Disperse dyes are useful for dyeing plastic items such as buttons and buckles. They have a moderate fastness to washing, dry-cleaning and light. Because synthetic fibres have a more open texture, a larger water ratio of 50:1 is required to allow for satisfactory immersion in the dye-bath.

Do not use dyeing vessels made from tin or aluminium for dyeing with disperse dyes. Disperse dye-baths utilising a carrier (for polyester) give off very strong fumes; ensure there is adequate ventilation and wear a mask if necessary.

METHOD

1 Measure out the pH neutral detergent or soap flakes as dispersing agent at 1g per litre water and add to dye-bath. If dyeing polyester, also add appropriate carrier at this stage, calculated as follows:

DEPTH OF SHADE

up to 0.5% = 6% carrier on weight of cloth
0.5–2% = 8% carrier on weight of cloth
2–4% = 10% carrier on weight of cloth
4–8% = 12% carrier on weight of cloth

If incorporating acetic acid, this would also go into the dye-bath at this stage. The quantity would be 6% (at 20% strength) on weight of cloth.

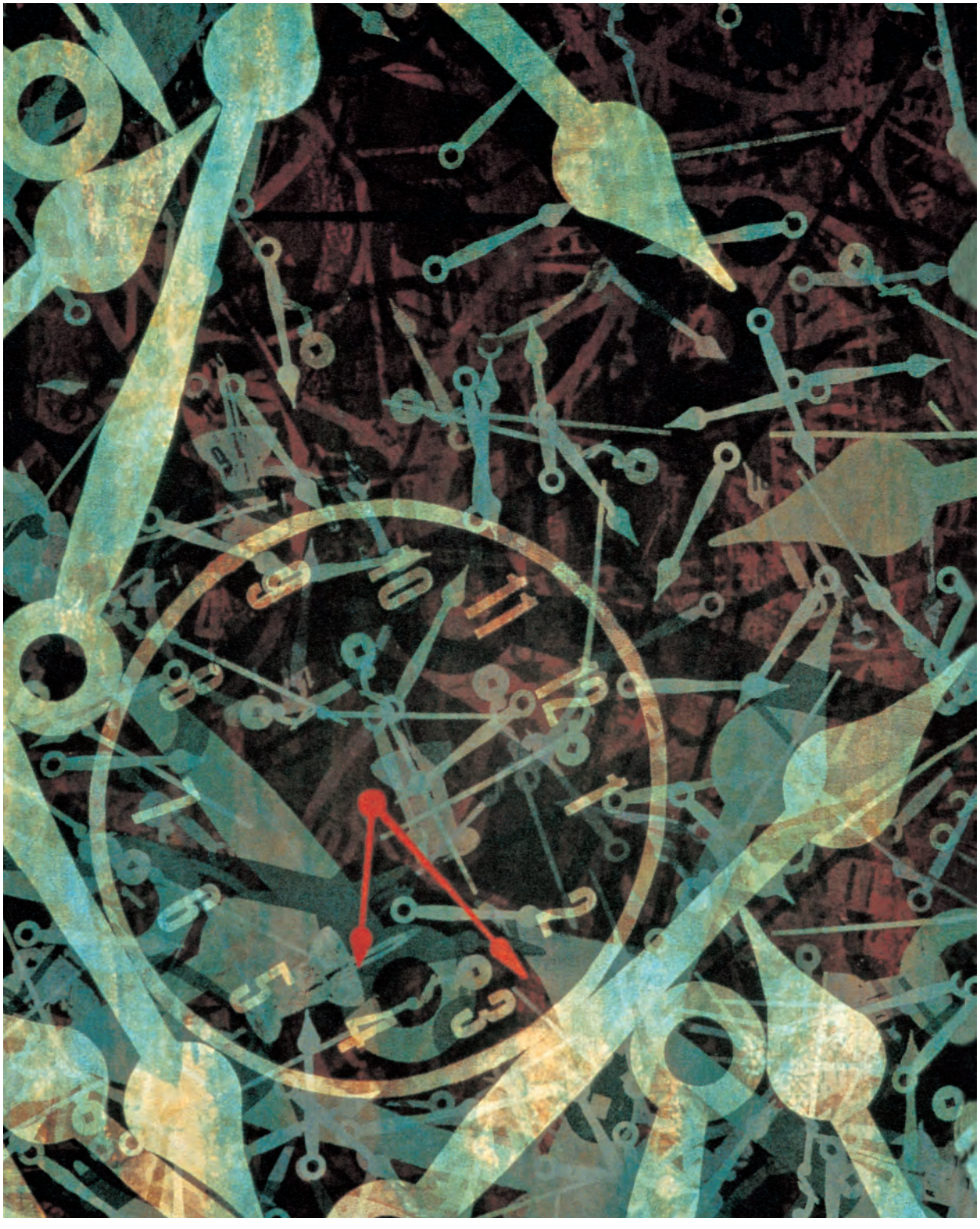
NOTES

If dyeing polyester, a carrier will be required to allow dye to penetrate its tight molecular structure. See Step 1 below.

If washing acrylic, avoid excessive handling.

Although I have used the following recipe successfully, other methods incorporate the use of acetic acid, and you may wish to experiment with this addition to see if it is preferable with certain fibre blends. The acid would be added to the dye-bath at Step 1 below.

FACING PAGE: Amie Adelman (USA), *Controlling Hand* (detail), 1998. Vat dyed, screen-printed and painted discharge on canvas, 173 x 235cm (68 x 92½ in.).



Once final print paste is mixed, it should be covered with cling film, or sealed in an airtight container, and labelled with the colour (cross-referenced in your dye notebook) and date.

RECIPES

At the beginning of each recipe, key information is given about print pastes made with dyes from that particular group, so that a summary of the whole process can be seen at a glance. Where a choice is given for thickeners, refer to Chapter 6 for the most suitable. Step by step instructions for mixing each type of paste are given, with extra notes and information for variations. Each recipe is based on starting with a given amount of thickener, usually 500–600g, which, once all the other ingredients are added, will make *up to* 1000g print paste depending on all the factors mentioned previously. Although this final quantity may not be as much as 1000g, the maximum strengths indicated are described, for example, as 50g dyestuff per 1000g paste, and do relate to a paste mixed in this way, with these amounts of thickener. However, if you are mixing sample colours, it is best to make a smaller quantity to start with to avoid waste, using 125g thickener, (a lesser amount than this makes the auxiliaries awkward to measure). See the charts opposite and overleaf, which summarise appropriate quantities of all ingredients for pastes in amounts of: 1000g, 500g, 250g and 125g.

COVERAGE

As a general guide, 500–750ml print paste will print about 1.25m² of medium-weight cloth or 3.3-3.5m² of lightweight fabric with a half-tone design of about 65% coverage.

FIXING

Readers are reminded that all fixing method information given is only a guide, as variations will occur depending on the type of steaming or baking equipment used. Sampling and testing is paramount to achieve the best results.

DETERGENTS

All the following recipes use a pH neutral detergent referred to as 'Metapex'. This trade name no longer describes the original product, which has been withdrawn since the first edition of this book. However, many suppliers offer an equivalent and still use the 'Metapex' name for ease of recognition. 'Synthrapol' is another familiar name used

PRINT PASTE QUANTITIES (all quantities in grammes)

Reactive: Cold and Hot Water				
Total Quantity of Paste	Thickener	Matexil P-AL	Urea	Sodium Bicarbonate
1000	500	10	50	30
500	250	5	25	15
250	125	2.5	12.5	7.5
125	62.5	1.25	6.25	3.75

Direct					
Total Quantity of Paste	Thickener	Wetting-Out Agent (protein)	Urea (cellulose, viscose rayon & silk)	Glycerine (wool)	Optional Acid Donor: Disodium Hydrogen Phosphate
1000	600	20	50	50–70	20
500	300	10	25	25–35	10
250	150	5	12.5	12.5–17.5	5
125	75	2.5	6.25	6.25–8.75	2.5

Vat				
Total Quantity of Paste	Thickener	Glycerine	Formosol	Sodium Carbonate
1000	600	50	60–175	80–115
500	300	25	30–87.5	40–57.5
250	150	12.5	15–43.75	20–28.75
125	75	6.25	7.5–21.88	10–14.38

Acid					
Total Quantity of Paste	Thickener	Wetting-Out Agent	Urea (silk)	Glycerine (wool)	Acid Donor: Ammonium Oxalate
1000	600	20	50	50–70	20
500	300	10	25	25–35	10
250	150	5	12.5	12.5–17.5	5
125	75	2.5	6.25	6.25–8.75	2.5

Disperse						
Total Quantity of Paste	Thickener	Matexil P-AL	Wetting-Out Agent	Acid Donor: Disodium Hydrogen Phosphate dissolved in same quantity of water (polyester)	Carrier (polyester)	Urea or Glycerine (cellulose)
1000	500	5	20	30–60	3–6	30–50
500	250	2.5	10	15–30	1.5–3	15–25
250	125	1.25	5	7.5–15	0.75–1.5	7.5–12.5
125	62.5	0.63	2.5	3.75–1.88	0.38–0.75	3.75–6.25

NOTES

Disperse dyes come in powder, granular and liquid form. If using the powdered dye, always sprinkle dyestuff onto water, rather than adding water to dye.

Dyes look very different in solution than the final result on cloth.

When printing on acrylic, use Indalca PA/3–R as the thickener.

Alginate and Guar Gums must be used if prints on polyester are baked; cloth also needs to be held to width (e.g. stretched on a wooden frame) to help prevent shrinkage during baking. If printing on polyester, the addition of an acid donor (disodium hydrogen phosphate) in the print paste is necessary. If fixing by atmospheric steaming, a carrier will also be required, particularly for medium-deep shades, although colour yields are 30–50% lower than if fixed by pressure steaming.

PRINTING WITH DISPERSE DYES

for cellulose acetates and tri-acetates, nylon, polyester and acrylic, also some plastics

THICKENER	alginates (Manutex F) *or* Guar Gum *or* British Gum – see notes
AUXILIARIES	oxidising agent (Matexil P-AL), a wetting out agent, plus an acid donor (disodium hydrogen phosphate) (polyester), carrier (polyester – especially with medium to deep shades), *or* urea *or* glycerine (cellulose acetate)
STRENGTHS	10–100g dye per1000g paste, depending on fabric – see notes on next page
FIXING METHODS	saturated steaming at atmospheric pressure: 30–45 minutes, depending on fabric *or* pressure steaming: 21 p.s.i. 20–30 minutes, depending on fabric; *or* baking: 180–200°C (356–392°F) for 30–120 seconds (polyester only) – see notes on the next page
WASHING OUT	cold water until clear *or* (for nylon only) cold water containing 1g sodium carbonate per litre until clear / warm water (max. 40°C (104°F)) with 2ml Metapex per litre for 2 minutes *with* (for nylon only) the addition of 1g sodium carbonate per litre *or* (for polyester only) hot wash at 65–70°C (149–158°F) with 2ml Metapex per litre for 5–10 minutes *or* (for acrylic only) hot wash at 60°C (140°F) with 2ml Metapex per litre for 15 minutes / cold until clear

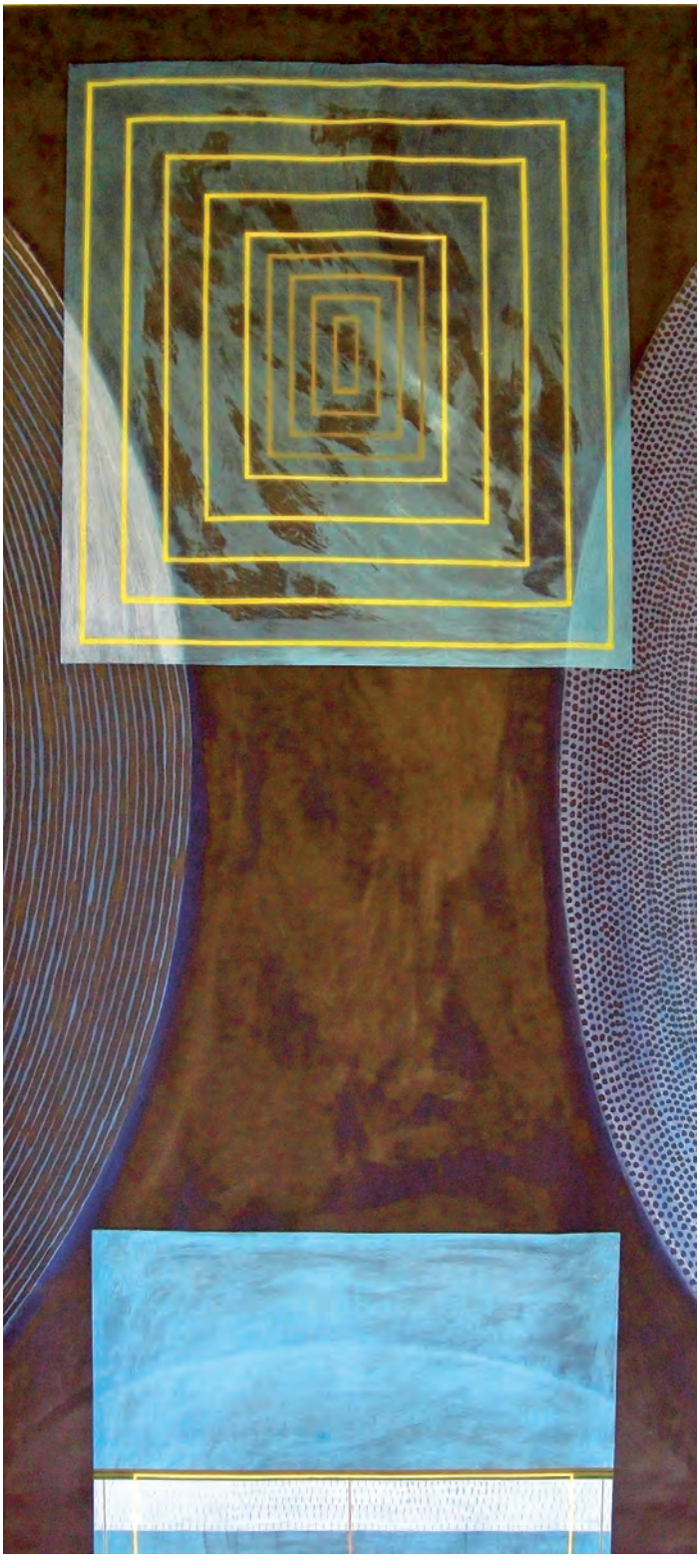
Disperse dyes can be used on most synthetic fabrics and are the only dyes that will colour polyester. There are variations in all aspects of production.

METHOD

1. Weigh 500g of chosen pre-mixed thickener into a 1 litre beaker.
2. Measure 5g Matexil P-AL and add to the thickener, stirring well.
3. Measure 20g wetting-out agent and stir into the thickener.
4. Next, if printing on polyester, weigh out 30–60g of acid donor (disodium hydrogen phosphate), dissolving it in the same weight of water, and also 3–6g carrier. Base exact quantities on colour strength of paste. Add both to the thickener mixture, stirring thoroughly.

   or

   if printing on cellulose acetate, weigh out 30–50g urea *or* glycerine (depending on strength of colour), dissolving urea in boiling water, and add slowly to the thickener mixture.



NOTES

Strengths for different fabrics:

- cellulose acetates, tri-acetates and polyester:
10–100g dye per 1000g paste
- polyamide (nylon) and acrylic:
30–100g dye per 1000g paste

A guide to fixing times for different fabrics:

- cellulose acetates: saturated steaming at atmospheric pressure:
30 minutes
- cellulose tri-acetate: pressure steaming at 15–20 p.s.i.:
20–30 minutes
- polyamide (nylon): saturated steaming at atmospheric pressure:
30–45 minutes
- polyester: pressure steam at 21 p.s.i.:
30 minutes

or bake at 180–200°C (356–392°F):
30–120 seconds

- acrylic: saturated steaming at atmospheric pressure:
30–45 minutes
- Disperse dyes have best fastness properties on polyester.

Sally Greaves-Lord (UK), *Midnight*, 2009. Acid dyed spun silk hand-painted with pigments, 92.5 x 211cm (36½ x 83in.). PHOTO: Factor Imaginum

SUMMARY OF PASTE RECIPES FOR DISCHARGE PRINTING

Fabric	Thickener / binder	Reducing agent	Auxiliaries	Strengths	Fixation	Washing out
WHITE PIGMENT BASED ON MAGNAPRINT'S STANDARD WHITE DISCHARGE PASTE SYSTEM						
most fabrics, best handle on cellulose	Magna Discharge Superwhite AB NJ	Magna Activator AB *or* Decrolin	Softener TS (optional)	20–60g reducing agent per 940–980g binder	baking: 165°C (329°F): 4 minutes *and/or* saturated steaming at atmospheric pressure: 7–10 minutes	(optional) gently in warm water + 2ml Metapex per litre / cold rinse to remove suds
COLOUR PIGMENT BASED ON MAGNAPRINT'S STANDARD COLOUR DISCHARGE PASTE SYSTEM						
most fabrics, best handle on cellulose	Magna discharge base AB AW (strong shades) *or* Magna Discharge White AB AW (pastel shades)	Magna Activator AB *or* Decrolin	Softener TS (optional)	1–60g pigment and 60g reducing agent per 880–939g binder	baking: 165°C (329°F): 4 minutes *and/or* saturated steaming at atmospheric pressure: 7–10 minutes	(optional) gently in warm water + 2ml Metapex per litre / cold rinse to remove suds
(LOW FORMALDEHYDE) WHITE DISCHARGE PASTE BASED ON MAGNAPRINT'S ULF WHITE DISCHARGE PASTE SYSTEM						
most fabrics, best handle on cellulose	Magna Discharge Super White ULF	Activator 'M'	Softener TS, Retardant Gel, Crosslinker 100 (all optional)	20–60g reducing agent per 940–980g binder	baking: 180°C (356°F): 2½ minutes *and/or* saturated steaming at atmospheric pressure: 7–10 minutes	(optional) gently in warm water + 2ml Metapex per litre / cold rinse to remove suds
(LOW FORMALDEHYDE) COLOUR DISCHARGE PASTE BASED ON MAGNAPRINT'S ULF COLOUR DISCHARGE PASTE SYSTEM						
most fabrics, best handle on cellulose	Magna Discharge Base ULF (strong shades) *or* Discharge Blending White ULF (pastel shades)	Activator 'M'	Softener TS, Retardant Gel, Crosslinker 100 (all optional)	1–40g pigment and 60g reducing agent per 900–939g binder	baking: 180°C (356°F): 2½ minutes *and/or* saturated steaming at atmospheric pressure: 7–10 minutes	(optional) gently in warm water + 2ml Metapex per litre / cold rinse to remove suds

9 Other techniques

DEVORÉ PRINTING

This technique involves printing a chemical paste, which 'burns' away one of the fibres in a mixed fibre cloth when subjected to heat. This creates patterns of open or translucent areas, contrasting with the unaffected solid fibres. The devoré paste is best applied by screen-printing for maximum control and even penetration.

There are principally two types of devoré:

- an acid paste, which destroys cellulose fibres, nylon, cellulose acetate and triacetate; the active ingredient in an acid paste is either aluminium sulphate (burns away cellulose and nylon)
  or
  sodium hydrogen sulphate (burns away cellulose, cellulose acetate and triacetate); this is a much more aggressive acid.

and

- an alkali paste, which destroys protein fibres; the active ingredient in an alkali paste is sodium hydroxide (caustic soda)

Generally, the fibres need to be mixed in both the warp and the weft, otherwise the fabric can disintegrate. However, in a single fibre cloth, it is possible to create an interesting effect by making a complete hole, if the open areas are not too large. Other variations include:

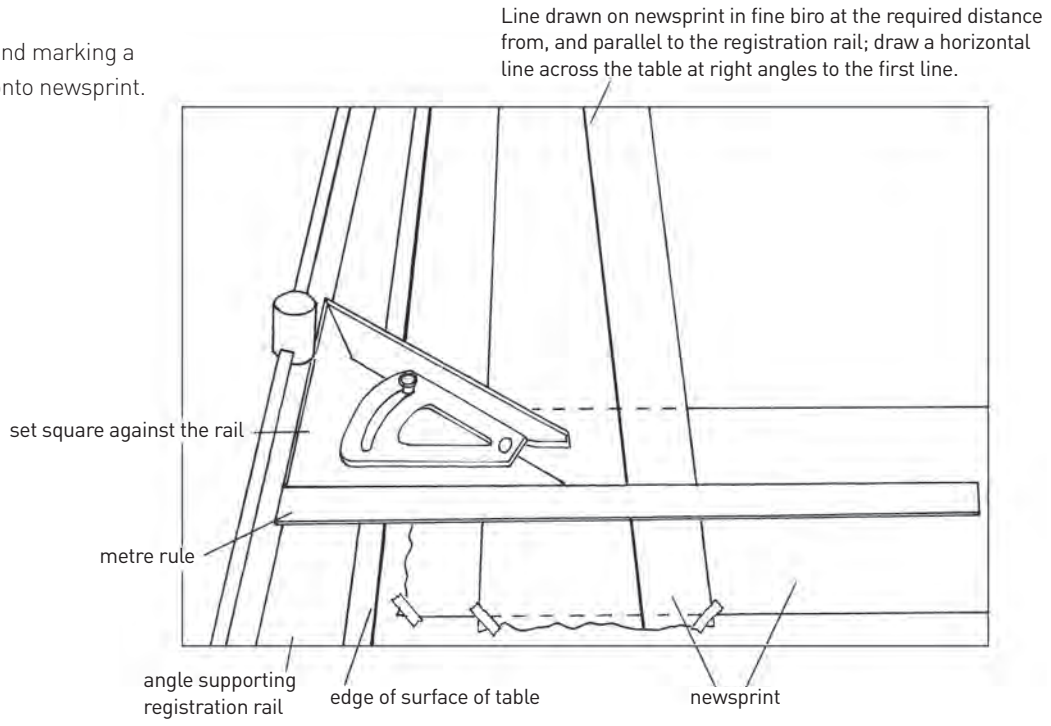
- multi-layered: where there are two devoré-resistant fibres present
- floating thread: where the devoré-resistant fibre is only present in either the warp or the weft
- 'embossed': using a thick, single fibre fabric like cotton velvet, can, with care, result in just the pile being eaten by the devoré paste

These three-dimensional effects can be further enhanced by the use of dyeing, either before or after the devoré process:

- dyeing the polyester fibres with disperse dyes
- dyeing the cellulose fibres with reactive, direct or vat dyes
- dyeing protein fibres in acid dyes
- dyeing nylon in reactive or acid dyes

Joanna Burdett (UK), 2009. Screen-printed with reactive dyes, discharge and devoré on reactive dyed silk viscose Roman georgette.
PHOTO: Joanna Burdett

Measuring and marking a right angle onto newsprint.



NOTE

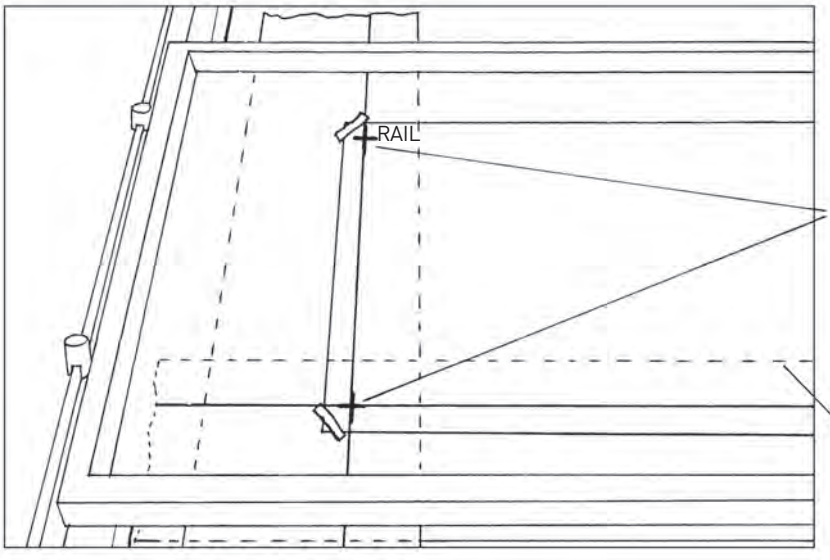
A tracing paper positive can be awkward to position accurately, as it does not lie completely flat. If the screen is large, get someone to help position it so that the artwork does not buckle.

5 Next place the screen over the positive, ensuring the frame is right up against the rail or stops, or that clamps are in position. Centre the design on the screen if possible (between long edges), although if there are imperfections in the screen mesh, the image can be positioned to avoid them. If the repeat depth is very shallow in comparison to the screen size, you may wish to position imagery nearer to one edge of the screen (depending on whether you print from left to right or right to left down the table), so that as you print, the screen will not touch the previous wet print.

6 Carefully transfer the four registration crosses, as well as the identifying word or symbol on the positive, to the screen using a blue biro and a ruler for accuracy. This mark ensures correct and consistent positioning of positives on all screens before exposure.

7 For colour separations, register all subsequent screens to the *same* positive already on the table, (you have already registered them to each other on the light box). It does not matter if the frames vary in size, or if each colour positive is further up or down the screen, as long as the transferred crosses drawn on the mesh are all in the *same position in relation to the rail*. All the screens should now be marked with four crosses and the identifying word or symbol written by the lower right hand cross, ready for exposure.

Transferring registration crosses on the postive to the screen.



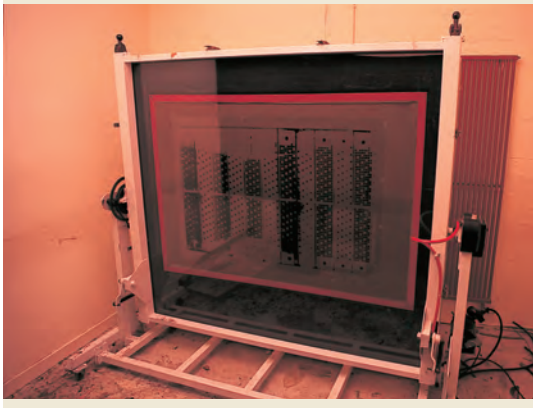
COATING A SCREEN

If you are coating screens for a repeat image, it is essential to first register the screen(s).

There are many different types of photographic emulsion on the market and it is therefore important to choose one that will suit your particular needs. Emulsion comes in two parts: the emulsion itself and the sensitiser, which, when added to the emulsion, makes it light sensitive. This means the emulsion should be handled ideally in dark-room conditions, but if this is not possible, then in subdued light. The sensitiser normally comes in a small bottle, to which water is added and then shaken to dissolve. This solution is then thoroughly stirred into the emulsion, which should be left to stand for a few hours to eliminate all air bubbles. Once the emulsion has been sensitised, it has a shelf-life, the length of which depends on the particular brand and storage conditions. For example, 'Ulano 995WR', an American brand of emulsion, will last for up to about 4 months once sensitised, providing it is kept in a cool, dark place. However, it is worth remembering that the fresher the sensitised emulsion is, the more readily it washes out after exposure. It may therefore be helpful to use up older emulsion on bolder designs with solid areas of colour, and the fresher one with fine or half-tone images. It is also useful to have a small jar of old emulsion for touching up screens after exposure. Always write the date of sensitising on the emulsion. If you use emulsion fairly infrequently,

Shelving can be made to fit under an existing table for drying coated screens. Attach black-out fabric with Velcro around the table to create a darkroom environment, allowing extra in width and length to ensure complete darkness

A vacuum frame is used in conjunction with a UV light source housed in a separate unit to expose screens at Double Helix's studio.



Once the vacuum pump has expelled the air so that the rubber 'blanket' is sitting tightly around the screen, the unit is rotated through 90° to a vertical position ready for exposure.

section having received the longest exposure (six times that of the first), and the last, the shortest time.

When exposing several different images onto one screen, make sure that there are no overlapping areas of Kodatrace and allow some space around each image, so that areas can be masked off easily. Only combine images that are compatible in terms of exposure time. Position images 'square' to the screen as it is easier to position imagery at the right angle when placement printing.

Use 'magic tape' instead of Sellotape when attaching artwork to the screen for exposure; it is easier to remove and does not become as sticky with the heat of the lights.

The following should also be carried out in subdued lighting or dark-room conditions.

1. Check that the screen coating is completely dry and stick the positive face down onto the *outside* of the screen, matching exactly all crosses and the identification mark, if doing a repeat.
2. Check that the glass of the exposure unit is clean and grease-free and place the screen *artwork side down* onto the middle of the glass. Lower and secure the lid, turn on the vacuum pump and wait for the black rubber blanket to completely suck down around the screen. If using a light box without a vacuum pump, place a piece of foam inside the screen (it should fit as closely as

APPROXIMATE GUIDE TO EXPOSURE TIMES

The following are all subject to type of unit, strength of power source, brand of emulsion and quality of positive

Type of artwork	Approximate length of exposure with a 3kW light source sited 1.25–1.5m from vacuum frame
photo-opaque on Kodatrace	2–2½ minutes
photo-opaque on Kodatrace – fine lines and detail	1 minute 45 seconds – 2 minutes 15 seconds
filmwork	2 minutes – 2 minutes 15 seconds
filmwork – fine lines and detail	1 minute 40 seconds – 2 minutes
black oil pastel, wax crayon, lithocrayon, chinagraph pencil etc.	1 minute 40 seconds – 2 minutes
photocopy on acetate (may increase time if using 2 or 3 layers together)	1 minute 40 seconds – 2 minutes
photocopy on tracing paper	1 minute 40 seconds – 1 minute 50 seconds
photocopy on oiled photocopy paper (only suitable with a bold image and if no other method is available)	2½–3 minutes

possible) and lay a piece of wood the same size on top of this. Then place heavy weights on top of the wood; this will help ensure good contact between the positive and the screen.

3 If the unit has an automatic timer, set this to the required exposure time. Turn off any lighting and draw the blackout curtain. Turn on the light source and expose the screen for the required time.

IMPORTANT: If using ultra violet as the light source, it is very important not to expose your eyes to this damaging light; wear UV protection goggles.

After exposure, turn off the vacuum and wait a few moments for the rubber blanket to release, then lift the lid, remove the screen and take off the positive.

WASHING OUT A SCREEN

The washing out process should be done immediately after exposure and can be done in normal lighting conditions.

1 Use a hose and start with fairly low water pressure and cold water. Briefly wet the screen gently on the outside.

2 Turn the screen so that the *inside* is facing you and move the hose back and forth across the mesh evenly. You should see a faint impression of the image appearing quite quickly, but it may take time for the actual emulsion to wash away from the areas to be printed. This will depend on the quality of the image and the length of exposure time; the shorter the exposure, the more fragile the emulsion and the image.

3 Continue until the whole image has washed out. Check that there is no excess emulsion, as this can cause a blockage if left to dry on the mesh. Gently run your fingers over the inside surface of the screen; if it feels slimy, it needs more washing. Hold the screen up to the light to check that there are no blockages and that all parts of the image have properly washed out. Allow to dry thoroughly.

APPLYING GUMMED TAPE

Once the screen is dry, the next stage is to apply gummed tape (a brown paper tape with gum on the shiny side) around all four edges of the outside of the screen. Brown, shiny parcel tape may also be used, if preferred, although this can be difficult to remove at the reclaimation stage, especially if it has been on the screen for a long time. The

A UV lamp.

NOTES

If it becomes apparent after some time that the image is not appearing, several things can be done:

- increase the water pressure
- increase the water temperature
- use a cloth to gently rub at the areas on the inside of the screen which are not washing out
- hose the *outside* of the screen
- as a last resort, use a high pressure hose on the inside of the screen. This may cause the image and emulsion to break down.

If none of the above work, the only thing to do is reclaim the screen and start again. The quality of the positive probably needs to be improved, or the exposure time could be reduced.

Hydrophobic
A substance which tends to repel or fails to mix with water.

Hygroscopic
A substance which tends to absorb moisture from the air.

Illuminating dye
A dye which is suitable for use in colour discharge printing. A good illuminating dye will have *poor* dischargeability (i.e. be very fast), so that it withstands the effects of the reducing agent.

Levelling agent
A surfactant which may be added to the dye-bath to restrict the rate at which dye is absorbed, helping to promote even or 'level' dyeing.

Liquor ratio
In a dye-bath, the proportion of water to the weight of cloth.

Metal-complex dyes
These fall within the acid dye group, having a natural affinity for protein fibres without the need for a mordant. They are divided into two types: 1:1 (1 metal atom to 1 dye molecule) and 1:2 (1 metal atom to 2 dye molecules).

Modified starch
As a starch ether, modified starch can withstand strong alkaline conditions without breaking down, and is used in gums for discharge printing.
eg: 'Solvitose C5' (UK)
'Monagum' (USA)

Moiré
A pattern of irregular wavy lines caused by the superimposition of two sets of closely spaced lines.

Mordant
Mordants are chemical assistants, mostly made from metal salts, alum being the most commonly used. Applied in solution to the cloth, they assist dye fixation. Most natural dyes require a mordant.

Oxidize
To cause to combine chemically with oxygen. To undergo a reaction in which electrons are *lost* to another substance; the opposite of reduce.

Oxidizing agent
A substance that withdraws hydrogen from, or adds oxygen to another substance; the opposite of a reducing agent. In printing, an oxidizing agent is used in the print paste to prevent decomposition of the dye and aid its absorption and fixation on the cloth.
e.g. 'Matexil P-AL' (UK)
'Ludigol' / 'Ludigol F' (USA)
'Chem Flakes' (USA)

pH value
A figure indicating the acidity or alkalinity of a solution on a logarithmic scale, where 7 is neutral, numbers below 7 are more acid and numbers above more alkaline. The pH value measures the level of hydrogen ion concentration.

pH neutral detergent
A fine, concentrated, neutral detergent, used in the hot wash after dyeing or steaming prints. It helps to prevent staining into unprinted cloth by keeping dye particles in suspension.
eg: 'Metapex' (UK)
'Synthrapol SP' or 'Synthrapol LF' (USA)

Photogram
An image produced with photographic materials, such as light sensitive paper, but without a camera.

Pressurised steaming
This is when saturated steam is generated under artificial pressure producing steam that is hotter than that created at atmospheric pressure. Fixation of some dye-stuffs is only possible under these conditions.

p.s.i.
Pounds per square inch. Used as measurement of pressure.

Reactive dyes
These dyes react directly with the fibre, and when chemically fixed in an alkaline environment, produce a permanent bond. This results in excellent washing and lightfastness properties.

Reduce
To cause to combine chemically with hydrogen. To undergo a reaction in which electrons are *gained* from another substance; the opposite of oxidize.

Reducing agent
A substance that withdraws oxygen from, or adds hydrogen to another substance; the opposite of oxidizing agent. In discharge printing, the use of a reducing agent, results in colour removal during steaming.
e.g. 'Decrolin' (UK)
'Formosul' (UK/USA)
'Thiox' (USA)

Saturated steaming
Steam which is at the same temperature as, and in the presence of, the water from which it was evaporated.

Slurry
A semi-liquid mixture.

Starch ether
Formed by etherification of a starch to produce a dissolvable substance used as a thickener capable of withstanding strong alkaline conditions.
e.g. 'Solvitose C5' (UK)
'Monagum' (USA)

Substantivity
The affinity between a substrate and a dye or other chemical applied to it. A mordant is not required.

Substrate
The base cloth or fabric to which dyes and chemicals can be applied.

Surfactant
A substance which reduces the surface tension of a liquid in which it is dissolved. Surfactants can be used as wetting-out and levelling agents.
eg: 'Synthrapol SP' / 'Synthrapol LF' (low foaming) (USA)
'Synthrapol' may also be used as a pre-wash and as an after-wash.

Thickener
A thickener forms the basis of all print pastes, and is the vehicle for the other printing auxiliaries and dyestuffs which are added to it.

Twaddell – abbreviated to °Tw
Scale of specific gravity or density of liquids measured with a hydrometer.

Vat dyes
These dyes are insoluble and have to be 'reduced' in the dye-bath in order to transfer to the cloth. The dye is then fixed to the fibres through oxidisation where it returns to its insoluble form. Suitable for cellulose fibres, with excellent light and washfastness properties.

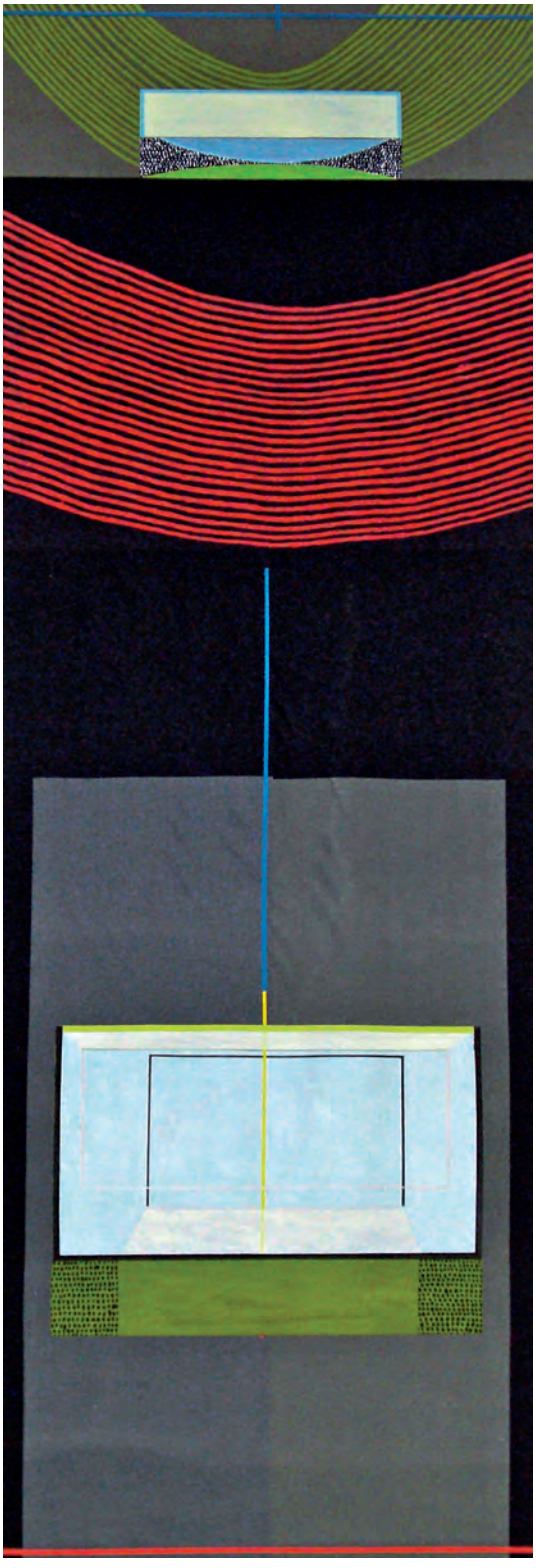
Vortex
A mass of whirling fluid.

Wet development
This is an alternative method for developing and fixing cloth dyed with vat dyes, some other dye systems and for resist techniques like batik. The cloth is treated in a bath containing a suitable oxidising agent, which stimulates full colour development.

Wetting-out
The process in which cloth is thoroughly saturated with the water in the dye-bath prior to the addition of the dye.

Wetting-out agent
A surfactant that may be used as an addition to the dye-bath, to assist wetting-out and subsequent dye absorption on certain fabrics, especially those that are tightly woven.
eg: 'Perminal KB' (UK)
(equivalent to 'Matexil WA-KBN')
'Calsolene' (USA)

Whitener
Zinc oxide or titanium oxide are whiteners which may be used in Decrolin discharge pastes to improve whiteness.



Sally Greaves-Lord (UK), *New Elvet*, 2009. Digitally printed with reactive dyes on plain cotton and hand-painted with pigments, 72 x 218cm (28¼ x 85¾in.).
PHOTO: Factor Imaginum

Conversion charts

CAPACITY

litres	US gallons	and pints	US gallons	litres
1		2.11	1	3.7853
2		4.23	2	7.5706
3		6.34	3	11.3559
4	1	0.45	4	15.1412
5	1	2.56	5	18.9265
6	1	4.68	6	22.7118
7	1	6.79	7	26.4971
8	2	0.91	8	30.2824
9	2	3.02	9	34.0677
10	2	5.13	10	37.8530
15	3	7.70	20	75.7060
20	5	2.27	30	113.559
25	6	4.83	40	151.412
50	13	1.66	50	189.265

LENGTH

Centimetres	Inches
1	.394
2	.79
3	1.18
4	1.575
5	1.97
6	2.36
7	2.756
8	3.15
9	3.546
10	3.94
50	19.69
100	39.37

* to convert from inches to centimetres: multiply by 2.54

Feet	Metres	Yards
3.28	1	1.094
6.56	2	2.187
9.84	3	3.28
13.12	4	4.375
16.4	5	5.47
19.69	6	6.56
22.97	7	7.66
26.25	8	8.75
29.53	9	9.84
32.81	10	10.94

* to convert from feet to metres: multiply by 0.3048
* to convert from yards to metres: multiply by 0.9144

WEIGHT

Metric (grams/ kilograms)	Imperial (ounces/ pounds)
1	0.035
2	0.07
3	0.11
4	0.14
5	0.18
6	0.21
7	0.25
8	0.28
9	0.32
10	0.35
15	0.53
20	0.71
25	0.88
50	1.76
100	3.5
500	1.15lbs
1000 (1kg)	2.2lbs

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A0	841 x 1189	33⅛ x 46¾
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A5	148 x 210	5⅞ x 8¼
A6	105 x 148	4⅛ x 5⅞
A7	74 x 105	2⅞ x 4⅛

TEMPERATURE

Celsius °C	Fahrenheit °F
30	86
35	95
40	104
45	113
50	122
55	131
60	140
65	149
70	158
75	167
80	176
85	185
90	194
95	203
100	212
110	230
120	248
130	266
140	284
150	302
160	320
170	338
180	356
190	374
200	392

* To convert from Celsius to Fahrenheit:
F = (⁹/₅ x Celsius) + 32
* To convert from Fahrenheit to Celsius:
C = ⁵/₉ x (Fahrenheit – 32)

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First published in Great Britain 2011
A&C Black Publishers,
an imprint of Bloomsbury Publishing Plc
50 Bedford Square
London WC1B 3DP
www.acblack.com

ISBN: 978-1-4081-2475-8

A CIP catalogue record for this book is available from the British Library

Cover design:
Page design: Susan McIntyre
Publisher: Susan James
Project editor: Davida Saunders

This book is produced using paper that is made from wood grown in managed, sustainable forests. It is natural, renewable and recyclable. The logging and manufacturing processes conform to the environmental regulations of the country of origin.

Printed and bound in China

FRONT COVER ILLUSTRATION: Taken from *Cam Grid 2*, Joanna Kinnersly-Taylor, 2004.

FRONTISPIECE: Joanna Kinnersly-Taylor (UK), *The Shape of Things*, 2009. screen-printed with reactive dyes and discharge on Irish linen 133 x.260 cm (52 x 102 in) PHOTO: Electric Egg Ltd

CONTENTS PAGE: Sally Greaves-Lord (UK), *1924*, 2007. Acid dyed spun silk, hand-painted with helizarin pigments, 65 x 215cm (25½ x 84½ in.). PHOTO: Factor Imaginum

Unless otherwise stated, all photographs, other that artists' work, by Ruth Clark.