Solar dyeing workshop – notes

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Solar dyeing is a method of dyeing fibre, yarn* or fabric* with natural dyestuffs using the sun's energy to extract the dye and fix it to the fibres. (*see note below)

The method is very easy to do at home. You need very little special equipment, setting up a dye jar is quick and it is easy to do experiments using a small amount of 'dyestuff' and fibre.

Because the process is more gentle than hot dyeing methods the fibres retain their softness and the colours appear fresher and more vibrant. Some colours are obtainable that would be altered by a hot dyeing method.

Simultaneous mordanting may affect how well the colour is fixed to the fibre, but in practice I have had some very good results which resist fading and washing as well as when using other methods

You can use most of the traditional natural dyestuffs, and because this method is so quick to set up you can experiment with almost anything you think might give colour.

Equipment

Any equipment used for dyeing should not be used afterwards for food use.

Large glass jars with airtight lids, such as preserving jars are best, but ordinary screw-top jars are fine. Generally, the bigger the better but smaller jars are good for experiments.

The size of jar will limit the quantity of fibre you can dye, for example a 2 litre jar will take about 60g of wool or 40g of silk fibre.

You will need scales, a non-metal teaspoon and paper cake cases or non-food-use containers for weighing mordants and dyestuffs. It is ok to use your kitchen scales if you are careful to always use a container for the mordant/dyestuff and wipe the scales thoroughly after use.

Labels, pencil or permanent marker pen and a notebook for record-keeping

Materials

Fibre, yarn or fabric for dyeing. Solar dyeing works best on protein fibres i.e. wool, silk, alpaca, mohair etc.. You can dye unspun fibre (wool fleece, wool tops or roving, silk hankies, cocoons or tops etc.), yarn or fabric. Different types of fibre will have different affinity for dyes. You can dye a mixture of fibres in one jar; but be aware that silk may take up more dye, and more quickly, than wool, so the results on wool may be disappointing if dyed at the same time as silk. Prior processing of fibre affects the way it takes up dye, some industrial scouring processes may make fibre more porous to the dye, some fabric finishes may make it less so. Synthetic fibres or blends will take up dye differently to natural fibres.

Most people dye natural white fibre but overdyeing natural light or darker greys or fawns extends the range and produces subtle nuanced shades.

Cellulose fibres (cotton, linen, bamboo etc.) require a different mordanting process and should be pre-mordanted with a suitable mordant for cellulose i.e. Aluminium Acetate. Note that you will still need alum in the dyejar solution to act as a preservative (see below). Even then, the uptake of dye may be less due to lack

of heat. It is possible to use the left-over solar dye bath, after dyeing protein fibre, to tint paper but the actual solar dyeing process is long and most papers would not survive it.

A *note about dyeing yarn and fabric With solar dyeing the uptake of dye is often uneven to a greater or lesser degree, depending on how tightly the fibre is packed. For unspun fibre the colour can be evened out if desired by blending before spinning, but if yarn or fabric is dyed it will remain uneven in colour. To improve the even-ness of dye uptake, reduce the amount of yarn or fabric in the jar.

Mordant: for protein fibres use aluminium sulphate (alum) as a mordant to fix the dye to the fibre. The amount of mordant is calculated as a % of the dry weight of the fibre (%WOF). The optimal % for aluminium sulphate is 8%. E.g. for 50g fibre you will need 4g aluminium sulphate.

However you may need more alum to act as a preservative, depending on the size of your jar. I recommend a minimum of 3g per litre (see note on fermentation / rotting at end of document).

Cream of tartar helps the mordant to bind to the fabric and may give better colours with some dyes. If you use it(optional)the optimal % is 7%, e.g. 3.5g cream of tartar for 50g fibre. Omit Cream of Tartar when dyeing reds or pinks as it tends to make them more orange.

I buy aluminium sulphate (usually in the form potassium aluminium sulphate) on line. The Cream of Tartar sold in supermarkets for baking is suitable.

These amounts of mordant and assistant are used to ensure that most of the chemical is absorbed on to the fibre and little if any will remain in the dyebath when the dyeing is complete.

Dyestuff

Some plants, or parts of plants, are toxic – please either avoid using these or be very careful in their use.

I am listing here a few you might have to hand or can find easily. This is not an exhaustive list; you will probably want to experiment with other known and potential dye materials.

Kitchen waste:

Onion skins – just the very dry outside papery bits. Red and brown onions give slightly different colours in the yellow – amber range

Pomegranate skins

Red cabbage - outer leaves (best on silk, disappointing on wool) said to fade

Beetroot – cooking water, skins and stems - fades

Hibiscus (most of the red 'fruit teas' are largely hibiscus – look on the label) – you can save up used teabags or loose teas – dry them out or (better) freeze them. fades

Flower petals e.g. Daffodil, Tulip, Bluebell, Chrysanthemum, Dahlia, Gorse, Broom, Camellia, Marigold

"Weeds" e.g. Dandelion, Sorrel, Horse Tail, Cow Parsley,

Most traditional and well-known dye plants will give results when used for solar dyeing.

As a rough guide to quantity, dry plant materials 50 – 200% weight of fibre, fresh or frozen materials 100 – 300% WOF. Some including onion skins and hibiscus are very strong so you may only need around 20%.

Collecting dye materials

If you are saving up kitchen waste or garden flowers etc. you can either dry or freeze them until you have enough and are ready to use them. Freezing can change the colour but also disrupts some of the plant cells and helps release the dye. Just remember to label them clearly!

If you are collecting materials from nature, please be responsible – only collect with the landowner's permission (it is illegal to collect certain wild plants in some areas), and only take a small part of what is there (no more than 10% in any one place). Be aware that some plants may be rare or are very slow growing and so should not be collected at all. Many flowers, leaves and seeds can be sensitively collected without damaging the environment but please think twice about collecting roots or whole plants. Consider experimenting with 'nuisance' plants, for example alien invasive species.

Preparation

Scouring: Fibre, fabric or yarn needs to be clean to take up the dye – so you may need to wash (scour) it in advance. Wash according to the fibre type, rinse very well and do not use fabric conditioner. I use Synthrapol for scouring or you can use a pH neutral soap, or washing soda.

Unwashed wool fleece should be carefully washed (to avoid felting) in several changes of warm water with soap or washing soda (or both), then well rinsed and dried. Remember that the clean dry weight of the fleece will be less than its unwashed weight, so you need to wash and dry it before weighing.

Wool yarn should be made into hanks, and the hanks should be tied with loose loops of string in at least three places. Soak in hot water with Synthrapol for at least 2 hours, then rinse. Scour silk yarn or fabric the same way.

Wool tops (industrially prepared for spinning) should already have been scoured. Avoid washing before dyeing as it may felt.

Silk cocoons need to be degummed before dyeing to remove the sericin – boil for 40 minutes with a mixture of soap and washing soda, then rinse several times with boiling or very hot water.

Wetting: Silk fibre, yarn or fabric should be soaked in cold water with a drop of washing-up liquid for at least 12 hours prior to dyeing. Remember to weigh it before you soak it!

Wool yarn or fabric should be soaked as above, ideally for an hour before dyeing – again, remember to weigh it before soaking.

Wool fibre (tops or well-washed fleece) does not need to be soaked before dyeing.

The basic method step by step

1. Figure out how much fibre you want or will be able to dye in your jar – try putting the dry fibre into the empty jar- don't pack it in; take it out and weigh it, then remove about a quarter. That will be the maximum you can dye successfully in your jar. You need room for your dyestuff, so you may need to reduce the quantity of fibre if the dyestuff is bulky. If the fibre (or yarn or fabric) is too compressed the dye may not penetrate properly. If dyeing silk, or a mixture of wool and silk, reduce the quantity as silk absorbs dye strongly. Keep a note of the dry weight of your fibre.
2. Usually for dyeing you are recommended to soak fibres thoroughly in water. For solar dyeing pre-soaking is not needed for wool fibre (tops, roving or fleece). Wool yarn or fabric should be pre-soaked for at least an hour. Silk – tops, cocoons and caps, hankies or yarn - may retain air pockets in the dye jar for months leaving undyed patches of fibre. If you are quite happy with this effect you can use silk dry, but otherwise soak the silk for 24 hours in water with just a drop of washing-up liquid as a wetting agent. Very fine silk fabric does not need to be soaked. Treat mohair as silk.

3. Calculate the amount of mordant. For most purposes on protein fibres I use Alum and Cream of Tartar together as a mordant. You need 8% (of the dry weight of fibre - WOF) of Alum and 7% WOF Cream of Tartar. You can use a non-metal spoon and a paper muffin-case on your kitchen scales for weighing out the mordants. (if you don't have scales, 4g of Alum (for 50g fibre) is about three-quarters of a teaspoonful).
4. Put the mordants into the jar and add about a mug-full of boiling water to dissolve them– add a bit of cold water before the hot or the jar may crack. Carefully swirl it about until the alum crystals have all dissolved.
5. Half fill the jar with cold water then add the dyestuff. If the dyestuff is very bitty – for example some of the wood chip dyes or madder root – you could tie it *loosely* in a fine mesh bag, some muslin or a piece of nylon hosiery. Muslin will take up space in your jar and may absorb some of the colour.
6. Add the fibre, pushing it down well. In bigger jars you might want to layer the dyestuff and fibre for better colour distribution. Put the fibre in slowly – as it absorbs the liquid you will be able to get more in, but if it is too compacted the dye may not penetrate all parts. Top up the jar right to the top with cold water and put the lid on tightly.
   After a day or two some more of the liquid may have been absorbed, or some air bubbles may have risen to the top. You may be able to get some more water into the jar. Aim to have it as full as possible.
7. Label the jar. It may be months before you open it and you will want to know the dyestuff, the mordant, the fibre and the date you started the jar. Write the label in pencil – ordinary pen will run if it gets wet and permanent marker is likely to fade. I stick the label on the lid so it isn't obstructing the sunlight getting to the jar contents.
8. Keep a separate note of dyestuff, mordants, fibres and date in case the label comes off. I give each dyelot a unique reference number on the label and in my notebook..
9. Stand the jar in a sunny place. When the jar heats up in the sun it may well overflow – if you can stand it in a bowl you will prevent mess and you could return the dye liquid to the jar when it is cooler. A dark surface absorbs heat so I stand my jars on a dark towel
10. If your jar lid has a good seal you can occasionally turn the jar upside down for a day or longer – this helps to distribute the dye more evenly. You could even open the jar and move the fibre around – catch any drips in a bowl and put them back in the jar.
11. Leave it for as long as it takes!!! I've had dye jars 'ready' after as little as two or three weeks, others that I have left for nearly a year. Checking the colour of the free liquid in the jar will give you a clue – eventually it may become nearly clear. The dyestuff too may lose colour – flower petals can go nearly transparent.
12. When you want to take the fibre out of the jar, stand the jar in a basin. This will catch any spills, and if you decide that it really needs a bit longer you can return it all to the jar.
13. Rinse your fibre gently and give it a wash with mild pH neutral soap (test a small sample first as soap may affect some colours), rinse again and hang to dry. You can make waterproof labels for your wet fibre by cutting up plastic yoghurt pots, writing on them with waterproof marker pen and tying them on with string.
14. If you think there is still colour in the dye, you could add more fibre – with more mordant calculated for the weight of fibre and dissolved in a little hot water mixed in first – for an exhaust bath. I've used some dyestuffs like madder root and logwood as many as five times.

Special effects

Layered jars Putting one dyestuff at the bottom, then the fibre, and another dyestuff at the top of the jar can have interesting effects. If the fibre is uncarded fleece one dye can be absorbed at the tips, one on the rest of the fibre. For example I dyed fleece with madder at the bottom and logwood at the top, the tips of the fleece were dark purple, the rest of the fibre was brick red. Variegated yarn can be dyed in this way. The

dyestuff at the top may go mouldy - a layer of fibre or a circle of fabric or waxed paper on top may help prevent this.

Modifiers (washing soda/ammonia, vinegar, iron sulphate or copper sulphate) can be used after dyeing to alter the colour. Test a small sample first. Make up a basin of warm water with a small amount of the modifier dissolved in it, then put in the fibre for 5 – 15 minutes. If there is no effect after 15 minutes don't bother with a modifier. Remember that too much ammonia or iron can damage fibres and both iron and copper are toxic.

Troubleshooting

Mouldy jars occasionally a solar jar develops a layer of mould on the surface – much like a jar of jam. You can just skim or cut this away and the remaining fibre will be fine to use. If the fibre is very precious I often put a small amount of a cheaper fibre at the top or cover the surface of the dye with circle of fabric (I use wool blanket) or a disc of wool fibre or even cotton wool before putting the lid on so I won't lose any of the precious fibre.

Fermentation / rotting More rarely, something goes really rotten in the jar and it smells awful. The smell doesn't wash out so you may have to throw this fibre away. Try not to get it on your hands! (voice of experience). I have noticed this more if I dye a small sample of fibre but use a bigger jar and volume of water -so the alum is more dilute. Alum is a preservative as well as a mordant. For the mordant function of alum the proportion of alum to fibre is the important factor, but for the preservative function the proportion of alum to water seems to be important. When I use 6g alum in 2 litres I rarely get rotting, but with only 2g in 2 litres rotting is common. If you notice lots of small bubbles forming after a week or so, or the liquid looks cloudy, that may be the start of fermentation/rotting. If you catch it early enough you may be able to rescue it by adding more dissolved alum, or by converting to a hot water method – put the contents of the jar in to a dyepan (a pan you don't intend to use for food), add more water if necessary and heat it gently to just below boiling. Keep it at a gentle simmer (80 – 90 degrees if you have a thermometer) for an hour, then let it cool in the dyepot overnight before rinsing.

Second batches and Lake Pigments

You can use the liquid left in your dye jar for a second batch of solar dyeing – add some more alum as the first batch will have absorbed some or most of the original alum.

Making a lake pigment will capture any remaining colour from your dye jar. Strain out the plant material and add 10 – 30g per litre Aluminium sulphate to the liquid (the more colour there is in the liquid, the more alum you will need to bind all the pigment molecules). Leave it for 1 – 2 hours, then add sufficient washing soda or soda ash to make it fizz – you need to use a large container. Let it settle for a further 1 – 2 hours then strain through a cloth or coffee filter. Let it dry completely, which may take several days, and grind to a powder (wear a face mask). To make paint, mix with egg white or other suitable binder. To use it as a dye, dissolve the powder in warm water with vinegar – 1 part vinegar to 2 parts water. No mordant needed.

Alternatively, when the pigment has drained for about 24 hours, mix in a few drops of clove or tea tree oil and store in lidded glass jars to use as paint.