

**INDIGO DYEING DEMONSTRATION: Jay Rich**  
**National Quilting Day at IQSCM March 16, 2013**

**Indigo producing plants:** 50-60 plants around the world produce indigo precursors. Which plants, how they were processed, extracted, stored, shipped and used presents an overwhelming global study.

Common: *Indigofera tinctoria*: grown in India, high concentration of indigo precursors

*Indigofera guatamalensis*: South American variety, likely more indirubin

*Isatis tinctoria*: European source of blue, woad

*Polygonum tinctorium*: Japanese knotweed, close to smartweed

*Strobilanthes cusia*: Chinese indigo, see photos, propagated by cuttings

**Processing:** Indigo precursors are preserved in the dye stuff after extraction from the raw leaves. Extracts were easier to store, transport, export and move around. The extraction was done in a variety of ways: hot water soak, partial decomposition, partial fermentation, complete fermentation as in sukumo (Japanese traditional process of 100 days compost on cement with turning and ritual)

**Vat dyeing:** The classic way of using indigo was by preparing a vat for immersion dyeing. The precursors of indigo known as INDICAN are white, colorless and insoluble in water. Indican is easily hydrolyzed to glucose and INDOXYL. Indoxyl plus oxygen creates INDIGOTIN otherwise known as indigo. See structure of indigo.

Fresh leaf dyeing is possible and results when the fresh leaf is pounded, rubbed or crushed for direct use on fabric. The indican loses its glucose and attaches without being reduced. Color is more toward turquoise and differentially attaches in this form to silk.

Vat dyeing requires reduction or elimination of the oxygen molecule which then prepares the precursor Indoxyl for attachment to the fiber. Indoxyl plus indoxyl plus oxygen binds the blue indigo around the fiber. The bond is easy and fairly quick so if extra oxygen is available from a lot of splashing at the vat or introducing large amounts of fabric/yarn with trapped air, the indigo bond is created without locking on to a fiber. This extra indigo then sits on the surface without a bond and creates crocking or rub off of blue.

Indigo reduction historically has been done with fermentation: bacterial action in the solution of plant extract takes oxygen out of the vat, then the oxygen comes off the indigo creating indoxyl. Fermentation takes time and very specific skills to master. Other reducing agents have included zinc-lime as in traditional Japanese kimono vat. Iron sulfate reduction has been done since the 1750s.

More recent awareness of **ORGANIC INDIGO VATS** has become more popular. Michel Garcia of Lauris, France has researched historical recipes and shares an overview in a new DVD, Natural Dyes. This approach uses alternate organic materials as anti-oxidants or reducing agents: henna (high concentration of luteolin) fructose, maltose, other flavenoids, vitamin C. Indigo dyers have used a broad range of reducing agents. A common denominator has been WHAT'S AVAILABLE and what's COST EFFECTIVE. Other possibilities: rhubarb Rheum, Rumex, Frangula alnus (bark of alder), cassia seeds, Aloe vera leaves, honey but it's expensive.

We have all assumed that these recipes for sugars and organic materials were for FERMENTATION vats where the sugars provide food for the bacteria that do the reducing. This assumption is wrong. The organic substances themselves are the reducing agents and the reduction happens much faster than fermentation could! The reduction starts within minutes and is more complete after 12-15 hours.

Michel Garcia, has worked out some basic recipes for beginning experimentation of ORGANIC INDIGO

VAT DYEING. These proportions make it easy to experiment with this kinder, greener version of indigo dyeing making it possible to avoid harsh reducing agents like thiox or sodium hydrosulfite.

**Michel Garcia's Organic Indigo Vat Dyeing Recipes for Sugar Vat** combined in following proportions by weight: 1 part indigo, 2 parts lime (calcium hydroxide), 3 parts FRUCTOSE, table sugar is not a reducing sugar

Sequence: First suspend the indigo: Combine indigo powder in warm water in a plastic, covered jar filled with marbles. Shake vigorously. This makes a suspension, other methods make a paste. The fine particles of indigo have to be wet, close to water, in suspension in order to be available for the action of alkalinity and reducing agent. Indigo clumps or rocks at the bottom of your vat aren't available for reduction or dyeing. As the indigo is a valuable resource, the marbles get washed into the vat. Second, add the sugar. It should dissolve easily. Third, add the lime. This may settle requiring stirring WITHOUT introducing a lot of oxygen. Create the vortex. Fourth, wait for reduction which actually is pretty fast, but can take overnight. See time based sampling.  
General advice on Organic Vats

**1. Respect the sludge.** While the droppings at the bottom of your vat are unpleasant, they are where the chemical reactions between the three parts are happening. When the vat is stirred to maintain, let it settle before using again.

**2. Finishing is important** as the lime and sludge can coat the fabrics, yarns. Wash out well. Give things a vinegar rinse, even your cottons. The lime needs to be neutralized chemically.

3. Mr. Garcia feels **these vats don't require as much working of materials under the surface** as with other vats. Keep track and decide for yourself. We're all dyeing different things, often a tight shibori bundle does indeed require some working at both ends of submersion in the vat and oxygenation outside of the vat. He oxidized all this fabrics in water.

4. These **vats may have a slower rate of oxygenation** so after submersion in your vat, be sure to give things adequate time. Observe how slowly or quickly things turn from green to blue.

5. The **coppery color or mirror floating on the top** is what you're going for. It means the reduction is happening. Other general color rules of indigo apply: yellow/green is good. Bubbles on the surface mean the oxygen is coming off, indican reduction to indoxyl is happening.

6. **Maintaining:** add more fructose solution to improve reduction. Stir and give it some time. Green/yellow healthy vat color should come up again. Same general rules about exhausting a vat, starting with lighter shades, proceeding to stronger vats with subsequent dips, building up color rather than expecting it to happen in one dip.

pH should be around 9, though the options were not explored thoroughly.

Resources:

Natural Dye Workshop with Michel Garcia: Colors of Provence Using Sustainable Methods, Studio Galli  
[www.slowfiber.wordpress.com](http://www.slowfiber.wordpress.com)

Blue Alchemy Stories of indigo: A Documentary by Mary Lance, New Deal Films, Inc,  
[www.newdealfilms.com](http://www.newdealfilms.com)

Shibori: Celebrating 400 years of Japanese Artisan Design, An Arimatsu Shibori Mutsumi-Kai, Galli Film Studios Production; [www.gallifilms.com](http://www.gallifilms.com) or [www.shibori.org](http://www.shibori.org)

Arashi Shibori: A Language of Stripes by Ana Lisa Hedstrom, [www.analisedstrom.com](http://www.analisedstrom.com)