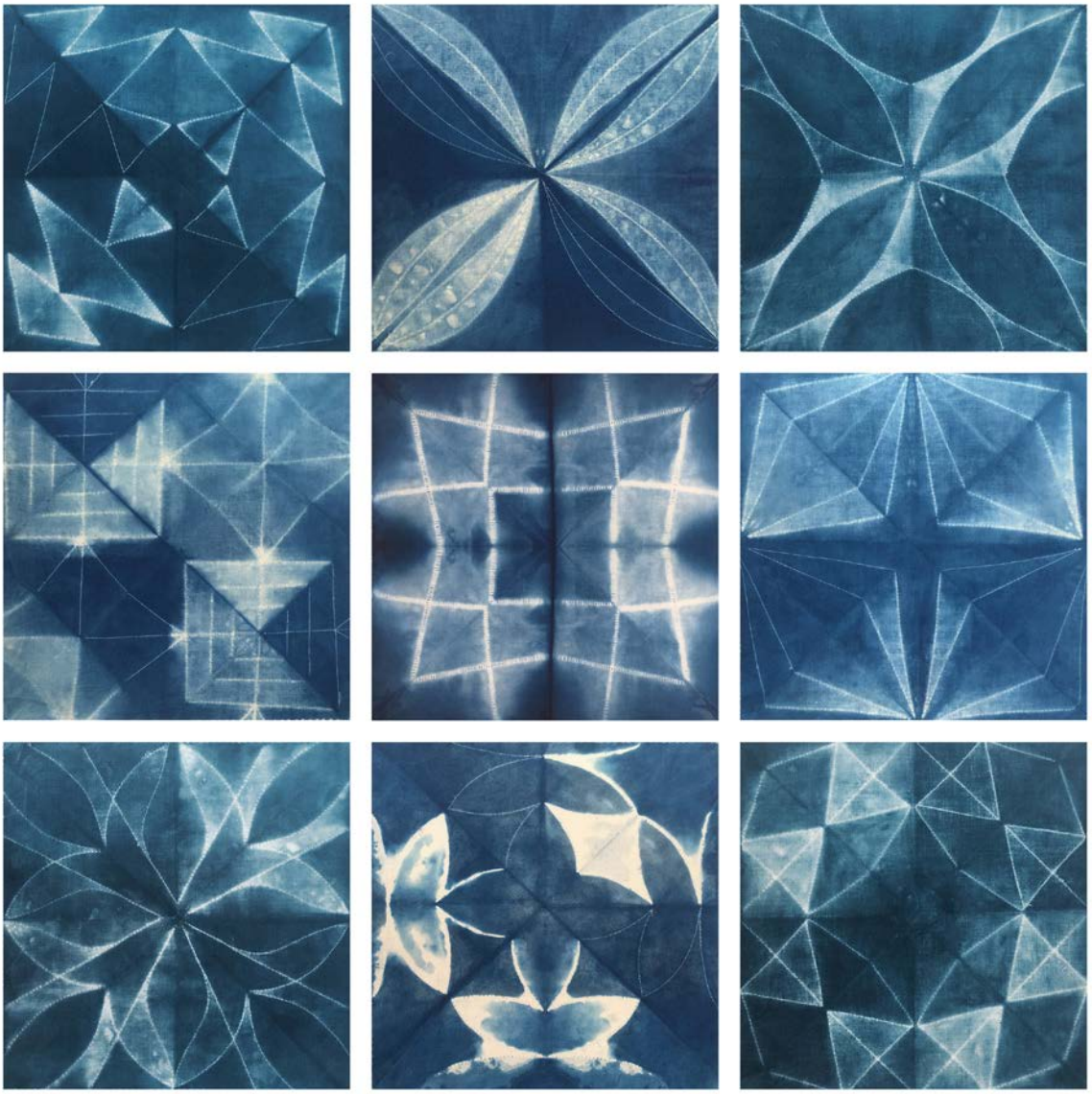
INDIGO

HOW TO MAKE, USE, AND TEND TWO KINDS OF
NATURAL VATS + CLAY RESIST



KIM EICHLER-MESSMER

Background

Indigo cultivation is thought to have existed in the Indus Valley (present-day Pakistan and Northwest India) more than 5,000 years ago and there have been recent discoveries in Peru that date Indigo cultivation and use to 6,000 years ago. It is the only plant pigment that creates a permanent blue dye, and varieties of the plant were discovered and used as dye in many different parts of the world including Africa, Asia, South and Central America, and Europe. The word "indigo" is now used to describe the dyestuff, the plant, and the color.

There are a variety of plants that contain the dye molecule indigotin. Indigofera tinctoria, indigofera suffruticosa, Persicaria tinctoria, and Isatis tinctoria (woad) are the most common plants to be grown for their indigo content. Each plant thrives in a different climate. Indigotin is the only blue natural dye, and it is extracted from the leaves of the plant in a number of ways, including water extraction and composting.

Indigo is a very unusual type of dye called a vat dye. Most natural dyes are mordant dyes. They can easily be extracted in water or dissolved in water and they require a mineral mordant (usually alum) to bond with the fiber. Indigo does not require a mordant to bond and the indigo dye molecule is not water-soluble. If you add indigo powder to water the indigo will not dissolve. It will float around, suspended in the water. In order for indigo to become soluble and turn into a dye, it has to go through a process called reduction. Reduction is the opposite of oxidation; it removes the oxygen from the vat. Once a vat is reduced, the indigo appears yellow/green, in its "leuco" form, and is available as a dye. The second half of the equation happens when the cloth is taken out of the vat and the leuco indigo comes in contact with oxygen to oxidize and return to its previous, blue, state, but this time inside of the cloth.

Natural indigo vats made from the two following recipes are capable of dyeing a lot of fiber over a long period of time if kept happy and treated properly. The two recipes have been formulated specifically for a 5-gallon bucket, but both can be scaled up or down easily. A general rule of thumb is to use 2 - 10 grams of indigo powder per liter of liquid in the vat. The other ingredients are added based on how much indigo is used in a 1,2,3 ratio. For the fermented vat this means 1 part indigo + 2 parts calcium hydroxide + 3 parts fermenting agent (we use fruit sugar). For a ferrous vat, the ratio is 1 part indigo + 2 parts ferrous sulfate (iron) + 3 parts calcium hydroxide.

A vat made with 2 grams of indigo per liter will produce much paler shades than one made with 10 grams per liter. The depth of color can be controlled three ways. First, the amount of indigo present will affect how much color is deposited onto the cloth. Second, the length of the dip will affect the depth of color. Longer dips allow the fiber a longer amount of time to bond with the indigo, meaning a deeper color. Shorter dips may seem dark enough at first glance, but the indigo is most likely on the surface of the cloth and will wash off easily or fade in sunlight. And third, more dips make darker colors. Long, slow dips built up on top of each other will create the deepest and longest lasting shades of indigo.

Two Types of Vat - Fermented and Ferrous

Fermented Indigo Vat

Pros
Ingredients are safe to handle
Lower pH in the vat, suitable for all natural fibers

Cons
The vat is temperature sensitive
It needs to be fed after every use
The henna creates a lot of sediment
The color can sometimes shift towards green on protein fibers because of the henna

Ferrous Indigo Vat

Pros
The vat is not temperature sensitive and does not need to be fed
Reduces more quickly than a fermented vat

Cons
Care must be taken when handling iron
Higher pH and presence of iron means this vat is not suitable for wool

Supplies

Kitchen scale that can weigh in grams, plastic bowl, 5 gallon plastic bucket with lid, a stir stick that will reach the bottom of the bucket (like a wooden dowel), white plastic spoon, rubber gloves, dust mask, plastic container with a tight fitting lid, a handful of pebbles or marble, mesh strainer

Fermented Indigo 5-gallon vat

Ingredients
100 g Natural Indigo powder
200 g Calcium Hydroxide (pickling lime)
300 g Henna OR Fructose OR a combination
1 lb Fructose (to feed the vat)

Ferrous Indigo 5-gallon vat

Ingredients
100 g Natural Indigo powder
200 g Ferrous Sulfate
300 g Calcium Hydroxide (pickling lime)

Safety note:
Wear a dust mask when working with the indigo powder, iron, and calcium hydroxide. All are finely ground and can cause irritation.

Directions for both vats

1. Add 4 gallons of hot water to the 5-gallon bucket. Use the hottest water you can handle. Hot water will result in a vat that reduces more quickly.
2. Weigh the henna / iron and then stir it into the hot water, adding a small amount at a time and stirring well. The henna may take extra stirring to make sure there are no lumps.
3. Weigh the calcium hydroxide and dissolve it in some hot water. Add this to the vat and stir well.
4. Put the marbles or pebbles into the small plastic container with a lid. Weigh the indigo powder into a plastic bowl and then carefully add it to the marble container. Add hot water. Put the lid on and shake vigorously for a minute or two. This is called “crushing” the indigo and will allow the indigo to reduce more quickly in the vat.
5. Pouring through a mesh strainer, add the crushed indigo to the bucket. Rinse the marbles and plastic container with some more hot water and add this to the bucket as well. Don’t waste any precious indigo. You may have to rinse the container and marbles with hot water more than once. Stir the vat gently.
6. If there is a lot of room left at the top of the bucket, add more hot water so the water level is just a few inches below the top of the bucket.

7. Cover the vat and wait at least an hour for the indigo to reduce, stirring gently every 20 minutes or so. Waiting longer is ideal and overnight is best.
8. Observe the vat. When it is ready, the surface of the vat will be shiny with a metallic looking coating. It will have dark bubbles on the surface, called the flower . A spoon dipped below the surface will show greenish yellow or amber liquid. Dip a small piece of fabric at the beginning of every dye session to make sure your vat is happy and healthy.

three small test vats (l) and dip tests (r)

Dyeing Tips / Rules

- If you are going to be doing a lot of dyeing, gently remove the flower and keep it safe in a bowl until you're done dyeing. Then carefully put it back in the vat before stirring and covering the vat.
- Always move slowly and deliberately when using a vat. Any extra oxygen that is added to the vat through splashing, aggressive stirring, or dripping can exhaust the vat.
- Wet fabric will introduce less oxygen to the vat than dry fabric and will absorb dye more evenly.
- Wet the fabric first and dip slowly and gently into the vat. Allow the fabric to be submerged in the vat for at least 5 - 10 minutes.
- Avoid letting the fabric sink to the bottom where it will come in contact with the sediment. This can cause splotchy results.
- Remove the fabric carefully from the vat, being careful not to drip into the vat. The fabric should be yellowish green and will gradually change to blue in the air. Placing the fabric in a container of clean water can speed up the process.
- Once the fabric is fully oxidized it will look completely blue and it is ready to be dipped again. Your fabric will get darker with each dip in the vat.


freshly dipped fabric as it oxidizes

Tending a Natural Indigo Vat

Both vats will begin to get tired after a long dye session. You will notice the value on your fabric becoming lighter and it will become difficult to build up deep shades. These are signs that your vat needs to rest.
To help your vat replenish itself, at the end of each dye session do the following:

Fermented Vat:

1. Add any very dark oxidizing soak water back into the vat. The soak water contains un-reduced indigo and much of it goes to waste if it isn't saved and reintroduced to the vat at the end of each day. For the fermented vat, you can heat this liquid up to keep your vat a warm temperature. If there is very little oxidizing soak water and the level of your vat looks low, heat up some water to top up the liquid.
2. Add 1 - 2 Tbsp. of fructose and stir carefully and thoroughly.
3. Cover the vat and let it rest over night. It should be ready for use the next day.
4. If you have left your vat unused for a few days (or more) it will need to be fed before you can use it. Give it a couple Tablespoons of fructose a couple of hours before you plan to use it (or the night before), stir it well, and it should be ready to go.

Ferrous Vat:

1. Add any very dark oxidizing soak water back into the vat. The soak water contains un-reduced indigo and much of it goes to waste if it isn't saved and reintroduced to the vat at the end of each day. If the level of your vat looks low, add some hot water to top up the liquid.
2. Stir well, making sure all the sediment from the bottom gets mixed up to the top.
3. Cover the vat and let it rest over night.

Troubleshooting:

If your vat stops providing a blue color, there are two possibilities. The most likely issue is that the vat has come out of reduction. This is common and is caused by over use, too much oxygen getting in the vat, or from the pH of the vat getting too acidic. The pH of your vat should be between 9 - 11. If it is below that, it's too acidic. Add 1 - 2 Tbsp of calcium hydroxide, stir well, and let the vat sit a few hours. If the vat seems to suck up the calcium hydroxide readily, that's a good sign the pH was out of whack.

The second possibility is that the vat is exhausted, meaning it has run out of available indigo. This is less likely, but will happen if the vat gets heavy use over a long period of time. If this happens, you can start a new vat OR refresh your vat by doing the following:
Decant 1 gallon of the vat into a stainless steal, aluminum, or enamel pot. Use this liquid to make a new mini-vat by heating the liquid to 170 degrees F, and then adding the following ingredients:

Fermented vat:
20g indigo
40g calcium hydroxide
60g henna / fructose / combo

Ferrous vat:
20g indigo
40g ferrous sulfate
60g calcium hydroxide

Stir well and then carefully add the mini-vat to your large "mother" vat. Allow everything to hang out over night.

Clay Resist

Clay resist is a thin paste that can be brushed or stamped onto dry fabric to resist indigo. The clay rinses off easily in water, but will stay put in the alkaline environment of an indigo vat. It can be made ahead of time and keeps well for a few days.

Ingredients

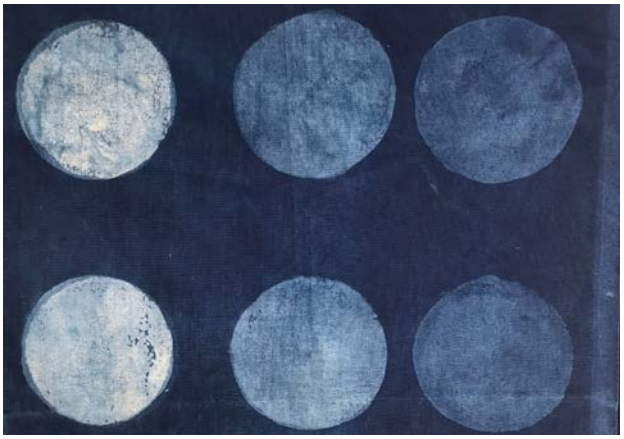
Magnesium Sulfate (also called Epsom Salt)
Gum Arabic (also called Acacia Powder)
Clay – use either Rhassoul clay or a 1/2 and 1/2 mixture of Bentonite and Kaolin

Directions

To make a little (for small tests):
100 ml warm water
10 g Epsom salt
20 g gum arabic
30 g clay (15 g bentonite and 15 g kaolin)

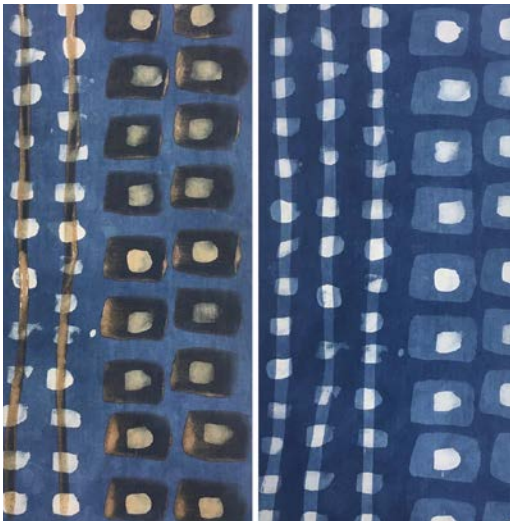
To make a lot (for large pieces of fabric):
1000 ml warm water
100 g Epsom salt
200 g gum arabic
300 g clay (150 g bentonite and 150g kaolin)

1. Dissolve the Epsom salt in the water. This takes a bit of time, use a whisk/blender.
2. Add the gum and whisk to blend.
3. Add the clay and whisk to blend. Continue whisking until the clay resist is smooth.
4. Apply the clay resist to dry fabric using a brush, stamp, or other mark-making tool. Let it dry completely.
5. Dip the dry fabric in the indigo vat for about a minute.
6. Option 1: If you want to build up deeper values of blue, allow the fabric to oxidize and dry and then dip in the indigo again. You can repeat this steps as many times as you like, but the clay should be allowed to dry in between dips to prevent it from disintegrating.
   Option 2: If you want to create a variety of values of blue on your cloth, allow the fabric to oxidize, then rinse the piece in a bucket of cool water and gently rub to remove the clay. Dry the fabric. Repeat steps 4 and 5. This step can also be repeated as many times as you like.
7. Rinse the piece in a bucket of cool water and rub gently to dissolve the gum and rinse off any excess dye.
8. Finish the indigo dyed cloth as described on the next page.



L: clay applied with a round wooden stamp to build value

R: wet clay painted over a previous layer of resist and the subsequent cloth



Washing or "Finishing" Indigo Dyed Fabric

It is important to "finish" indigo dyed cloth so that it doesn't crock, or rub off, on other fabrics, furniture, walls, or you. The first step is to make sure you are practicing long dips and letting the cloth fully oxidize in between dips. The second step is to make sure that your indigo dyed cloth is fully oxidized once you're finished dyeing. A long soak (overnight) in cold water will accomplish this easily. Then:

1. Rinse your fabric well in cold water.
2. Wash by hand in a bucket of hot, soapy water. A pH neutral soap like blue dawn or synthrapol are good detergents to use when washing dye out of fabric. Rinse well with hot water.
3. Add about 1/4 cup of distilled white vinegar OR 1 Tbsp of citric acid to a gallon of cold water. This will be enough for small pieces. If you have larger pieces of cloth, scale up the amounts of vinegar / citric acid and water. Submerge your indigo dyed cloth in the vinegar water for about 10 - 20 minutes. The weak acid helps neutralize the alkalinity of the indigo on your fabric.
4. Some dyers recommend boiling gently for 30 minutes in a pot that isn't used for food with a small amount of pH neutral detergent like synthrapol, orvus paste, or blue dawn. The finishing and boiling step can happen right away, or you can wait until you have several pieces ready to finish. I tend to skip this step unless I'm making something that will be in contact with skin.

Suggestions



Left: Indigo works perfectly with shibori. Because it doesn't seep or wick into fabric like other dyes, it creates a strong, beautiful resist. Invite some friends over and have fun!

Middle: These fabrics all had a white background and were perfect for over-dyeing. For the bottom piece, I folded it and clamped it in the style of Itajime shibori to mirror the printed pattern.

Right: This little quilt was made from my accumulated dip tests. They show a record of the health of my vat and feel a little like a self portrait - some are cleanly and carefully dipped, others were fabrics picked up off the floor or forgotten about in the vat.

Resources

Supplies

Maiwa (Vancouver, Canada)
Indigo, instructions, tools
http://www.maiwa.com

Dharma Trading Company (California)
Lots of pfd fabric
http://www.dharmatrading.com

Botanical Colors (Washington)
Dyes, information
http://botanicalcolors.com

Stony Creek Colors (Tennessee)
Indigo grown in the US
https://dye.farm/

Star West Botanicals
Henna, clay
https://www.starwest-botanicals.com/

Information

Michel Garcia (French, botanist and chemist)
Workshops and DVDs
https://naturaldyeworkshop.com/

Catharine Ellis (North Carolina)
Very informative blog and book: The Art and Science of Natural Dyes
http://blog.ellistextiles.com/

Rowland Ricketts (Indiana)
Indigo inspiration, information, seeds
http://www.rickettsindigo.com/

Aboubakar Fofana (West Africa)
Inspirational work and Indigo revival in Mali
https://www.aboubakarfofana.com/

Graham Keegan (LA)
Information, supplies, and workshops
http://www.grahamkeegan.com/

Other useful books

Shibori: The Inventive Art of Japanese Shaped Resist Dyeing by Yoshiko Wada, Mary Kellogg Rice, and Jane Barton

Indigo: Egyptian Mummies to Blue Jeans by Jenny Balfour-Paul

Feel free to get in touch with any questions. My contact info is below.
Tag me if you join the blue hand club and post your natural dye adventures on instagram. I would love to see what you make!

For information on other natural dyes, check out my Natural Dye Primer, also available at kimemquilts.com/dye