Pate de Verre
with
Kimiake & Shin-ichi Higuchi
Corning
2009
Mary Mullaney’s notes
Higuchi system for accessing different colors from Bullseye powder

grams Color/Clear based on 20 grams per color sample

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<tbody>
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<td>A</td>
<td>50%</td>
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<td>B</td>
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<td>C</td>
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<td>D</td>
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- 100# mesh size powder mixed ends up pretty much opaque
- 30-99# mesh size clear mixed with 100# powder looks more transparent
- Bigger frit still for a more transparent look
- Bullseye is slightly coarser than 100 when you buy the powder
- Higuchi's use Kugler at home and a different clear glass that has lead in it that they have specially mixed

We made the ice cube tray molds using a rubber positive that they already had. We used these to put our color samples in to fire small rectangles of 20 grams of color.

4 tints of color A,B,C,D on one side in 100 mesh and 4 tints of the same color in 30-99 mesh on other side, all using one color of Bullseye power, we ended up with eight different color samples

To make the mold:

- Flexible plastic wall around silicon ice cube tray positive
- Support the walls of the thin plastic wall with clay balls or rubber band around it.
- 1-45% plaster to water is the approximate ratio for the Japanese plaster
- Mix plaster in clean stainless bowl to avoid leftover residue which changes the hardening time
- Zero out the digital scale after putting stainless bowl on it
- Measure water and plaster separately, pour plaster into the water bowl, wait until it is completely soaked, then start mixing. Mix in one direction only (to avoid bubbles) at a somewhat fast pace—mix well—tap bowl on counter if you see air bubbles
- Pouring: start pouring into the low part of mold, shake a little to even top
- Wait 30-40 minutes and take the silicon out
- The Japanese plaster mixture which is used in Japan for casting aluminum car parts is only available at Corning for purchase in the US
- Other plasters from the US are ok for open faced molds or Hydrocal, silica powder mixes
- After taking the rubber out, neaten up edges so you don’t get plaster chunks popping off.
- After mixing the powders, (see next page) Pour the powder into the ice cube sections. Mound it in the center moving it away from the walls of the mold to keep those sharp things from forming on the outside of the piece.
- They are ready to fire.
Color Sample Firing Schedule:
At approx. 950 degrees F, this is where water, glue or chemical will burn out. Leave small door or cone hole open from the beginning till 950. You can test by putting a small sheet of glass in front of the hole to see if there’s still moisture to release. It will fog up if there is still moisture.

#1. Up to 400 degrees F in 1:30
#2. Hold for 0:30
#3. 4:00 to get to 1530 degrees F (1130 degrees)
#4. Hold for 0:15
#5. natural cooling, these were small samples 1”X1.5” X 1/4” thick

Making our Lidded boxes with relief designs:
- To make the sculpted lid with clay-
  - roll slab of clay. Make clay slab 1.5 times thicker than finished lid. (we had thin plastic pieces indicating the size and shape of the lid. We used these to measure lid and left them underneath so we could keep checking and correcting the size as we worked on our sculptural top. Keep the side walls nice and vertical using triangle.
  - Put the slab on a piece of thick glass while sculpting so you can move it around.
  - Add design to top of clay. We can have undercuts because we’re using clay, and can pick it out later. Our relief needed a “handle” built into the design. We filled in very deep undercuts, built them up a little.

Pouring the Open faced Mold:
We used water based molding clay/ regular potters clay—no terra cotta or black or oil clay. Oil clay will leave oil residue on plaster and color powder glass won’t stick.
- Make a dam as tall as your piece (minus the relief) is thick. Build wall 1 cm away from piece, and 1 cm or so thick.
- Push wall down (like pie crust) so it doesn’t leak.
- Use cubes of clay around outside of wall for support especially where you have a joint.
• Mix 200 grams of plaster with 90 gms of water for first layer. Ratio is 1-45. 90 is 45% of 200.
• Put the plaster into the water, let it become fully soaked before mixing in one direction vigorously. Tap bowl on counter to get rid of bubbles.
• Start pouring into lower parts of the mold and also in the relief part. If there’s a lot of detail, use compressed air, or someone blowing with a straw to push plaster into details while someone else spatulas and brushes it in.
• The first batch of plaster should cover the entire piece.
• As plaster gets a little thicker, you can add it to the highest parts of your relief.
• The goal is to end up with a one centimeter thick even coating around entire piece
• Make legs for bottom—use the dry plaster chips to build up four legs. Soak them in water and place them on the piece. Pile more plaster on top. Place flat glass on top, supported by two small stacks of glass, to level and flatten the little stubby legs.
• The Higuchis use this same leg process even for large pieces, they just make more legs.

45 minutes after pouring, start cleaning out clay. Mold can be scratched, be careful. You can fix bubble holes with a little slightly thick plaster. Wash the mold out thoroughly using a brush and lukewarm water.
• If you see a thin spot/ more transparent than the rest, you can add more plaster.
• While the mold is still wet, and after cleaning clay out of it, measure how much water it holds. If you do it when the mold is dry, the mold will absorb the water and give you an inaccurate reading.
• Fill the mold to where you want the final level of the glass to be, with water, pour out and measure by weight. Do this three times and take the average gram weight. Multiply this by 2.6 and you will have the gram weight of how much glass powder should go into your mold.
• Write it down.
• After my mold dried a little more, I engraved more details into my plaster using a foredoom tool and hand tools. (veins of the orchid)
The Higuchis use thinner walls than 1 cm for eco friendly, and also find that the mold heats evenly and faster and breaks off glass easier and is less likely to break details off finished piece.

Thicker than 2 cm (for Japanese plaster) and the mold is likely to crack

For something very large they use fiber glass (FRP) for making boats. They pull it apart to 1/2” thick, dip in plaster and lay it over the entire piece (on second layer) the legs then go over that.

Chicken wire expands and pulls mold apart so they only use fiberglass. Also, don’t use fiberglass chips for the same reason.

The purpose of reinforcement is to keep mold together if it cracks.

Japanese plaster is used to cast aluminum for cars etc. and doesn’t expand as much as others. US mold mixes are good for open faced molds but not hanging molds or press molds.

See next page
Our Boxes (outside and inside molds)  Two part mold

- We started with a plastic positive of our box shape.
- We put a thin coat of mold release on the whole thing. (not over any clay though) Let it dry.
- Mold soap over that—Shin uses a brush and soaps it up like crazy, getting it all bubbly etc., as if preparing to shave. Then he wipes with water and sponge cleaning off bubbles. Then he dries with a paper towel.
- I used only mold release on my outside of box and then sculpted clay relief onto the outside of my box. Keep the clay damp, don’t let it dry out.
- Get ready to make the mold of the outside.
- Use small balls of clay on inside of rim to attach box to glass plate.
- Cut slab for dam and surround 1 cm from piece, 1 cm high, 1 cm thick.
- Pie crust it down to the glass, use little support squares esp. at your joints.
- You can build the dam all the way up to the top and pour in the plaster if you want, it just has to be really even. Don’t do this method if you have relief details. The walls of the mold will be too thick.
- We started with 200 gms plaster 40% water (80gs) . If there was relief on the piece, we used more plaster for first coat. I think I used 250 gms plaster for mine.
- Again, the goal is 1 cm thick coating everything equally.
- Use the spatula, start by adding plaster to edge of top and work down.
- Wait a little in between coats for the plaster to thicken a little
- Corners are more fragile—build more plaster on corners
- Scrape off “top” flat (this will later connect to the reservoir.)
- Wait 20 minutes and do the inside mold.
Inside of Box

- If doing relief on outside and inside, or just on inside, sculpt clay on outside, cast the outside mold, THEN sculpt clay on the inside and cast inside. The inside could fall out while you’re casting the outside if it’s hanging upside down in there.
- OK, take dam off, flip the mold over, knife off big spots on outside top edge, don’t bevel though, just clean up a little if the edge is messy.
- Make keys (so you know where the second mold sits) using a drill bit. Choose a wide area of top of lip. You may want to do two on one side, etc.
- Paint inside of box and whole top edge of box and mold with mold release (lightly)
- Fill hole in bottom of plastic with clay (just barely! You will need to bust through it later with air)
- 1 coat mold soap
- Slab tightly around the outside of the mold (tight to the mold) coming up 1 cm evenly above lip. Support with little stacks of quarter inch glass on either side of dam.

- Mix 100 grams at a time, 200 or 250 grams total, using 40% water.
- Plaster up to down, mindful of edge of lip which wants to be thin. Try not to touch or scrape the inside of the mold with spatula. Again, going for an even coating of 1 cm thick everywhere.
- Build three little legs with plaster and put a flat piece of glass on top of the stacks of flat glass.
- Later, a reservoir (made the same way as the outside of smooth box) will be plastered on top of the reservoir hole…demo later.
Releasing the molds

- Wait at least forty minutes or so
- Take dam off
- Clean uneven top edge with Shin’s sharp scrapey tool.
- Shoot compressed air (not too much pressure though) in bottom hole to release outside mold.
- Then shoot air in sides and in hole in bottom, it should come off.
- Gently clean clay out of any relief.
- Sand down “bottom” that is, the edge that will connect to the reservoir using scosh of water on top of sandblasted flat glass piece. Later, do the same to the reservoir.
- Hold mold pieces gently together, matching keys. Fill with water to measure how much glass is needed to fill the mold. Do it 3X and average out weight. Again, do this before the mold really dries out, so you get an accurate reading. Multiply this by 2.6 and write it down. Dry molds off with compressed air.

- Pour your reservoir mold (same way as you did outside of box) I used 150gms plaster. Sand connecting edge as you did with box mold.
- Pack glass powder in the relief details of your mold. (See powder packing instructions)

Attach Plaster reservoir to the open bottom of two part mold

- Bevel the bottom outside corner of inside mold just a little, don’t worry about legs.
- Make sure there’s no dust or chunks. Put the two part mold together using keys, open bottom up. Stack the reservoir right on top, matching exactly on inside.
- Mix 100 gms plaster 48 water, so a little more runny than usual.
- Paint (with brush) bottom joint—start above, go down on top of crack and brush underneath a little also
- Paint top crack, right over the seam itself
- Go over bottom crack good, again.
- After plastering, wait 20 minutes, cover with aluminum, leaving a vent for moisture to come out, and put in a warm place, such as next to furnace. Don’t disturb the upper part! It’s fragile.
- I stacked and attached my reservoir even though my powder details inside were a little damp
- When it’s dry, it’s ready to be charged with frit and fired.
Choosing Color and Packing powder in our molds

- Draw sketch of relief, using colors picked from samples
- Approximate amounts needed for each color. Weigh out, put in bags and label good, it’s easy to get confused.
- Start packing at lowest part of relief, especially if relief is deep
- Use CMC (2 gms) to 1 liter of water/ pre-mix 1 day ahead, available from pottery supply store. This glue doesn’t burn black. Leave in fridge if mixed
- Put color powder into a divot in paint palette. Mix a couple drops CMC and a couple drops of water. Use more water for gradations, and more water if you are working with a super dry mold. You can brush mold with water or even spray before packing an area.
- A thin Chinese brush works really well!
- Build powder up with straight sides to get the full color. Clean powder you spill. Use as little CMC as possible
- Try not to add color by “dotting” this can create air bubbles. More or less, paint it on, let it flow just a little.
- Use dark colors for small areas that you can’t mound up much
- On the top layer of a detail “mound”, seal the surface with a little extra CMC
- Powder, 100# is good for the detail. Either Frit or powder can be used for the background. Background color doesn’t need water or glue. The 30/90# or bigger frit just gets poured in on top of detail.
We checked our pieces as they were an hour or so into the 1600 degree section and charged them with more powder if they needed it. Use the sideways spoon on a long rod to charge the powder. All survived, one color gold ruby made stuff crack a little, fixed with uv glue.
Bullseye Pate de Verre Box

°F

0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40

hours

0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40

°F

0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40

hours
Firing and annealing our pieces
De-molding and Cold-working our pieces

- Wear a respirator when de-molding, watch out for sharp parts.
- Moist the mold slightly with spray, but never dip or soak the whole mold with glass in it because the plaster can expand and crack the glass.
- No sharp metal—use chopsticks or wooden skewer and a wooden hammer. Get it mostly off and then use a toothbrush to clean details in sink, with water. Never hit straight into it, always at an angle.
- Small details or undercuts may require the sandblaster to get all the plaster out.
- Sandblast the whole piece, to get rid of fog. Use under 20 psi, and 220 silicon carbide grit (we used 150 and it was ok too).
- If there’s any clay stuck in it, engrave it out with the fordom tool and a diamond bit.
- We coldworked the pieces with the Gesswein engraver.
- The Higuchis made their own round sandpapers and put double sided tape on them and stuck them to the flat rubber bit on their engraver.
- We used common 180, 320, and 800 wet/dry black sandpaper.
- We sanded dry, being mindful of not creating too much heat. The Gesswein was set on speed 5 I think, not too fast.
- The Higuchis mostly just polish the raised surfaces of their pieces.

• After polishing with sandpaper, we used the Brush Wheel with pumice to get rid of the small circles that had been visible from the sanding circles. Brian used the pumice wheel extensively to polish his lady.
• You can also hand rub with use scotch brite pads and pumice to get into details.
• Belt Sander for rough edges etc. Get to them quickly or they can start a crack.
Primitive Lathe-Used to make a plastic positive of a design

- Build tool as shown. Use Stainless for rod. Use 1 mm thick sheet metal for template. Draw a line of your Inside shape and cut the metal template. The upright rod needs to be removable (sliding up through hole)
- Build approximate shape with stacked clay slabs. Make a clay central supportive core inside the shape if there is a wide flat bottom on your form.
- Leave about 5 mm of space between sheet metal template and the approximate clay form. Start with 100 gms plaster, 60 water (This is regular plaster, not refractory plaster.)
- Spatulate plaster on, use the template (see video) to make shape, spinning only in one direction, adding plaster blobs to places that need it.
- Make new plaster if you need it. Splatter it on—do the template again to fix holes or low spots.
- Let first mold dry—just to set up, 20 minutes or so. Mold release the whole first piece.
- Put mold release and mold soap on the inside one. Cut new template line (outside contour) and cut out with jewelers saw. Remember to leave some space for the key. See drawing.
- Mix 200 gms plaster w 130 of water (65%) Do two batches. Make a new mold right over the first one, using just the regular plaster, no clay.
- To release the two pieces, shoot air in the hole where the metal dowel was. Block the hole and shoot air in the seam between them.
- Separate the two molds, take clay out of inner mold. Inner mold can be discarded.
**Primitive Lathe etc. continued**

- The inner mold is not useful, just the new one which is a plaster positive of your desired shape which you will then:

- take a two part mold from (as we did in class with our plastic box positives.) However, when you make this two part mold, don’t leave the bottom open for a reservoir. Make your outside mold with a bottom. Also, you are **still using regular plaster, not refractory plaster.**

- Then, cast a polyester resin and fiberglass plastic box into this mold.

- Put a layer of automotive wax on molds. Then put layers of resin, fiberglass, resin on both mold pieces and push them together. Once hard, take them apart and clean it up.

- You can use this technique to make shapes other than circles, by cutting up your circular molds and piecing them back together.

- Remember to compensate for any taper you have in your box when you draw the cut lines on the plaster.

- Cut slightly to the inside of your drawn lines (after mold sits overnight) Super glue them together filling the gaps with plaster. Sand and make nice, and make a 2 part mold with a bottom, fill with resin fiberglass mixture as described previously. OR, you can keep taking regular plaster positives and fixing up until you get a really nice one that’s ready to take a final plastic positive off of.
Patte De Verre Mosaic molds

- You can use 0.5 mm aluminum sheet metal to make geometric shapes.
- Score the sheet metal and fold it.
- Make a two part mold with a reservoir.
- Shin makes them about 12 cms tall. Shin says you can go a little taller but Brian says it’s easy to have blowouts if you go too tall.
- You can make a regular plaster positive if you want. Thin out some shellac, paint it on the plaster positive (make sure it’s totally dry before doing this) then mold release, mold soap (each time you take a refractory mold off it) You should be able to use the plaster positive about 10 times.

- Be creative about making various types of jigs (see drawing) to make new shapes or parts of new shapes that you can superglue/plaster together to make positives to take molds off of.
Various materials, formulas and where to get stuff and other random notes

- **CMC**—Can be bought from Pottery Supply—2 gms to 1 liter of water. Pre mix one day ahead, leave in fridge if mixed

- **Mold Release**—Glycerine + Dehydrate Ethanol
  
  \[
  \begin{align*}
  \text{Glycerine} + \text{Dehydrate Ethanol} & = 3 \text{C}_3\text{H}_8\text{O}_3 + 7 \text{C}_2\text{H}_6\text{O} \\
  (84-87\%) + (99.5\%) & < \text{don’t get a lesser percentage!}
  \end{align*}
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  Using mold release under mold soap allows for less layers of mold soap. It puts a slightly oily coat on the mold so that the moisture from the mold soap doesn’t get absorbed by the dry plaster mold.

- **Mold Soap**—Also known as green soap. Buy from Pottery Supply

- **German Grinder**—Gesswein Powerhand 2X—shin says get the “regular” head, not the micron

- **Sanding pads**—Buy regular wet, dry black sandpaper. 180, 320, and 800. Back with a sheet of two sided tape. Cut into circles using the **Circle cutter/compass** Stick the circles on the end of the flat rubber bit and use for dry sanding/finishing of the pate de verre

- **Brush Wheel**—run slow, use medium pumice or extra fine pumice. Shin has a hand tool like this that he had custom made for him.

- **Japanese Plaster**—Can only get from Corning for 150 per bag plus 35 for shipping. Higuchis say it is strong and leaves the nicest surface. Caster Y—they had it analyzed, but didn’t have much luck mixing their own.

- **Other Plasters**—Karr Plaster—Shin says ok for open faced molds, or HydraCal and silica powder or Hydroperm plaster (the pre-mixed one used to cast car parts) Shin says is good for most things. Charlie Miner uses Hydrastone, Hydrocal and 200 mesh silica sand.

- **Cinco Garbage Disposal** (has no blades) Charlie uses for grinding glass frit.

- **Fusing Kilns at Corning Studio**—30” square on the outside. Front loaders with a peep door in the front. Very nice
Materials etc. cont.

- **Pug Mill**—expensive but nice for recycling clay etc.
- **Porcelain Ball Mill**—Use 1/3 empty, 1/3 frit, 1/3 porcelain balls of three different sizes. Get one made of porcelain or better still “new ceramics” which is harder than porcelain. Rotate for 45 minutes. Sift to 100 mesh, put bigger stuff back. 100 mesh means 100 square holes per inch in the sifter.
- **Silicon Rubber**—like what was used to make the 11 year old! ice cube tray positive was: Rhodosil RTV 1104A, use the catalyst 11032 It is a French Company
- **Very Nice powder charging tool**, sideways spoon on a long rod