



PYROS GLASS STUDIO

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PYROS TECH NOTE #6

Blending colored glass powders for Pâte-de-Verre work

About Pâte-de-Verre

Pâte-de-verre (literally, “paste of glass”) is a technique that produces beautiful translucent pieces, with a look that is often compared to alabaster or jade. To make pate-de-verre, glass powder is formed in a mold and then fired in a kiln until it fuses together. The unique appearance of pate-de-verre depends on light being able to penetrate the piece and illuminate it from within. For this reason, colors are mixed with generous amounts of clear glass.

About Compatible Glass

Only mix glass powders that are compatible with each other. Mixing incompatible glasses makes it likely that your piece will not withstand the fusing process and will break after it cools down. One measure of compatibility is a number called the "COE" (short for "Coefficient of Expansion"). Families of compatible glasses are produced in various COEs, including 90, 96, 104, etc. The first rule is: only blend glass powders with the same COE.

This by itself does not guarantee compatibility, though it is a good start. Other factors such as chemistry, temperature sensitivity or viscosity may cause glasses to be incompatible. For this reason it is a good idea to look for glasses that are "tested compatible", and when in doubt, do your own test by making a small piece before committing the effort and glass to a larger one.

About Clear and Colored Glass

Most manufacturers offer two types of clear: an "ordinary" clear, and a "water clear" (or "crystal clear"). The ordinary clear usually has a slightly green or yellow tint that is not noticeable in thin sections. The "water clear" contains more refined materials and/or decolorizers to remove this tint, which makes the glass more expensive. For pate-de-verre work, though, this is often the better choice.

Different shades of color are obtained by mixing colored powders with clear glass in various proportions. A little color goes a long way! Powders fire much darker than they appear, and even very light colors like yellow will be opaque in thick cross sections. The Pyros Color Mixing Chart can give you an idea of how colors are affected by different blends with clear glass. Even a 5 percent mix of color can be quite vibrant, and tints can be produced with as little as 1 or 2 percent. You can also blend compatible colors with each other to produce new shades.

Should I use opaque or transparent colors?

Many colors are available as both opaque (“opal”) and transparent (“cathedral”) glasses. If you mix in enough clear glass, light will be able to penetrate, even when you use opals. So why choose one or the other? One rule of thumb is to use opaque colors for design elements, and transparent colors for shading. Here's why:

Most jewelry and inlay work is designed to be lit from the front. Light must enter, bounce off the color, and then return through the front of the piece. We mix transparent glass with opal colors to control the appearance of depth. Since opals reflect light, they are good when you want a detail to stand out from its background. If you were making a field of flowers, you might use more opaque blends for the flowers in front, to make them really jump out at the viewer. Surrounding these with more transparent colors gives a depth to your piece that can really make it come alive.

However, some sculptural and architectural works are designed to be lit from the side or from the back. In these cases, light has to be able to go all the way through the glass, and a larger percentage of transparents is favored.

Colors such as blue and violet are so dark that it makes less difference whether an opal or transparent is used for the pure color. Either reflects quite a bit of light. As shading, though, the dark transparent colors are invaluable. Just a touch of violet can be used to darken another color and provide the look of shadows. It may seem odd, but black and white are not used very often. Both of these are very dense, and somewhat defeat the purpose of pate-de-verre, since they stop light from penetrating the work. This can give the piece a "plastic" look. For most work, you should lighten colors by adding more clear glass to an existing opal color. Clear glass by itself will look white after it has fired due to the numerous bubbles trapped in the work.

Another problem is that black tends to absorb more heat in the kiln, which causes it to become fluid before other colors. To counteract this, some manufacturers sell a "stiff black" that does not become as runny as ordinary black. For pate-de-verre, it is usually more effective to use dark violet for shading. In thick sections it will appear black.

Other Coloring Agents

Pate-de-verre powders can be mixed with high-temperature enamels, stainer colors and other coloring agents. Non-glass colorants like glow powder and mica can also be mixed in, but these will not melt by themselves, and must be treated as inclusions in the glass. Inclusions should be surrounded by glass, and you should be careful to avoid large clumps that could introduce stress in the piece.

Cleaning Glass Powder with a Magnet

Glass is crushed commercially in large metal machines, and it is not surprising that many, if not all, commercial powders are contaminated with some degree of iron dust. Manufacturers do their very best to remove this, but it is really impossible for them to get it all when processing thousands of pounds of powder. To remove any leftover iron bits yourself, stir your glass powder with a powerful magnet such as a neodymium button magnet or the Pyros Cow Magnet before mixing it.

Measuring Glass Powder

Mixtures of glass are always described by weight. This is because the volume of glass powder varies quite a bit depending on how finely it is ground and how tightly it is packed. If you want repeatable results, you should use a scale. Kitchen scales are usually accurate to within several grams, and are OK if you are weighing out large quantities. For jewelry work you may want to invest in a more precise scale that is accurate to a tenth of a gram or better. Electronic pocket scales cost between 25 and 100 dollars, and can weigh several hundred grams at a time, which is plenty for jewelry work.

If you have a color chart, it shows the results of mixing various percentages of colored glass with clear glass. If you do not have a chart, it is a good exercise to mix and fire small samples using various percentages of clear and colored glass. Such samples are invaluable for reference as you build a palette of colors that you like to use.

To figure the correct amount of color to use for a given piece, multiply the total weight of your finished piece by the percentage in the desired color. Then make up the balance with clear glass. Remember that 15 percent is really 15/100.

Example - a 15 gram pendant using a 5% mix of red:

Amount of red = total weight x percentage = 15 grams x 5/100 = .75 grams

Amount of clear = total weight – color weight = 15 grams - .75 grams = 14.25 grams

You can also mix shades of color in larger quantities and store them for later:

| | |
|-------------|--|
| 50% mixture | 1 gram of clear for each gram of color |
| 20% mixture | 4 grams of clear for each gram of color |
| 10% mixture | 9 grams of clear for each gram of color |
| 5% mixture | 19 grams of clear for each gram of color |

How do I know how much glass fits in a mold?

Often the manufacturer of the mold will tell you. The capacity of a pate-de-verre mold is usually expressed by weight. Jewelry molds hold between 5 grams of glass (for a small pendant) and 100 grams of glass (for a bracelet). Molds for tableware can hold as much as 600 grams.

If you make your own molds, the following technique will give you a pretty good idea of how much glass you need. First measure how much water it takes to fill the mold. Then multiply the weight of the water by 1.5 (for Freeze ‘N’ Fuse molds) or 2.5 (for refractory molds). The difference is because Freeze ‘N’ Fuse pieces shrink when they fire and thus use less glass.

What if I don’t have a scale?

In a pinch you can measure by volume, though this is not as accurate as measuring by weight. Use a measuring spoon, and count the number of spoons full of powder. Use a small spoon or you'll use up all your glass in a hurry!

| | |
|-------------|--|
| 50% mixture | 1 spoon of clear for each spoon of color |
| 20% mixture | 4 spoons of clear for each spoon of color |
| 10% mixture | 9 spoons of clear for each spoon of color |
| 5% mixture | 19 spoons of clear for each spoon of color |

Blending colors

Colors must be mixed thoroughly before use. There are several ways to blend powder. The traditional way is to place the powders on a flat sheet of paper and use a palette knife to mix them. Then pass the mixture through a sifter. Repeat this at least three times.

If you're doing Freeze 'N' Fuse work, we find that it works just as well to add the powders to your mix water, and stir the mixture with the palette knife while it is very fluid. Then let the powder settle for a minute and pour off the excess water.

Filling a mold

You may want to place colors precisely in a mold to match the design. Dry glass powder will not stick to the mold, and must be mixed with a little bit of glue. The glue must be a type that will burn out cleanly at fusing temperatures. For pate-de-verre work in refractory molds you can use a variety of products, including diluted white glue (e.g. Elmer's), or special pate-de-verre glue (e.g. Fusion Pate-de-Verre Glue). For Freeze 'N' Fuse work, we recommend a dilute solution of Pyros Ultrabind.

An inexpensive painter's palette makes a good tool for mixing small batches of glass paste. Pour a little bit of glue in one of the wells; a few drops are all that you need! Put your glass powder in one of the other wells and use your dropper to add a drop of the glue. Then use the dropper to add water, and stir your glass until it is wet. It should be a thick, sticky paste. You can use any tool that you want to transfer glass paste to the mold. Palette knives, dental tools, toothpicks, paint brushes and fingers all give good results.

Annealing

A pate-de-verre piece is powder when it is fired, but it is a solid piece of glass when it is cooled down. Glass must be cooled slowly to release stresses in the glass that could cause it to break later on. The larger the piece, the more slowly it must be cooled. This process, called "annealing", is critical to the production of work that will be durable. Each type of glass has its own characteristic temperature and time for annealing. Please check the glass manufacturers' web sites for their best recommendations.