



## Best Practices in Glass Recycling

### *Permanent Molds for Fusing Glass*

#### **Material: Recycled Glass**

**Issue:** *Most molds used for fusing glass are either expensive to make or are waste molds, only useable one time. In order for small-scale glass fusing businesses to develop, permanent, inexpensive, castable molds from readily available materials are needed. For a description of recycled glass fusing, see Fusing Recycled Glass Best Practice.*

**Best Practice:** The requirements for a permanent mold for fusing glass include: the ability to withstand repeated kiln cycles up to 1600F; that it be easily formed or cast; and that its surface should freely release fused glass on its own or with a coating. In addition, it should be inexpensive enough that a product developer can freely cast test molds without incurring unreasonable costs.

Calcium aluminate cement is a high-alumina cement used in refractories. One type of calcium aluminate, which is high in both alumina and iron, is called fondu. When combined with suitable aggregates, fondu can be used as the cement for making permanent molds that will repeatedly withstand the temperatures used to fuse glass. Suitable aggregates are granular materials that are stable at kiln temperatures and have coefficients of thermal expansion compatible with fondu. Among suitable aggregate are fireclay grogs, olivine sand, chamotte, flint, and other temperature-stable pre-fired aggregates that will not go through a silica conversion when heated to 1700F.

To make permanent molds:

1. Find a source for calcium aluminate cement. It can often be purchased in 100-pound bags at cement supply stores. One manufacturer is LoneStar LaFarge. Also find sources for one coarse and one fine compatible aggregate. In general, coarse means particle sizes larger than 50 mesh and fine means particle sizes smaller than 200 mesh.
2. Find the most efficient particle packing relationship using 25% cement by weight combined with the two aggregates (for a description of a particle packing technique, see *Simple Particle Packing Best Practice*). One mixture that has worked well is:
  - 100 grams fondu cement
  - 50 grams kaolin clay (improves the mold surface)
  - 100 grams fine aggregate
  - 150 grams coarse aggregate
3. Prepare a master and a moldbox for casting. The master is the original form, which is to be reproduced. **Keep in mind that calcium aluminate shrinks while curing, so the master must be made with a non-rigid material.** Foam sheathing, clay, and urethane pourable molds all work well.
4. Blend the dry ingredients.

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5. Put the water in the mixing bowl. Then add the dry ingredients. The instructions for fondu cement recommend a maximum water:cement ratio of 2:5 by weight. In casting fusing molds, especially by hand, it may be necessary to use a water:cement ratio as high as 1:1. Experience will tell. The water requirement is highly dependent upon the gradation and character of the aggregates. For example, the mix above could require up to 100 grams of water. The most important characteristic is that the mixture flow into the mold with vibration and not result in an inordinate amount of pooling water.
6. Mix. Mixing can be done by hand in a large plastic mixing bowl while wearing a heavy duty glove (nitrile gloves work well) or with a cement or grout mixer. All materials must be thoroughly wetted.
7. Scoop or pour the wet mixture into the moldbox and place on a vibratory compactor (for instructions on how to make a vibratory compactor, see *A Simple Vibratory Compaction Table* Best Practice). Vibrate until the top of the mixture is level and smooth. Excess water may be poured off.
8. Cover the mold with plastic to keep moisture in and leave the mold overnight. Adequate drying is a matter of experience. Too warm a drying temperature and/or exposure to dry air may cause the mold to shrink too fast and crack.
9. Remove the mold from the moldbox.
10. Fire the mold empty in a kiln and soak for one hour at a temperature at or above expected glass fusing temperatures. 1700°F has been found to work well. Expect to smell sulfur as the fondu fires.

Coat the mold with a light coat of release before each firing. Commercial glass fusing “shelf paints” are available. Alternatively, a combination of 40% kaolin 60% alumina hydrate works well.

**Implementation:** These instructions for mold making can be used with the Best Practice *Fusing Recycled Glass* to begin experimenting with glass fusing.

**Benefits:** Current prices and sources, f.o.b. Seattle, for the materials described above are as follows:

<u>Material</u>	<u>Source</u>	<u>Price</u>
LaFarge Fondu	Lone Star Cement	\$32.00/100#
Kaolin clay	Seattle Pottery Supply	\$20.00/100#
Ione grog 65 mesh	Seattle Pottery Supply	\$19.50/100#
Ione grog 20x48 mesh	Seattle Pottery Supply	\$19.50/100#

Therefore, 400 pounds of mixture can be made for \$90.50, under 23¢ per pound. If properly made, these molds have been used more than 20 times without cracking or spalling.

**Application Sites:** Crafts shops, small businesses.

**Contact:** For more information about this Best Practice, contact CWC, (206) 443-7746, e-mail [info@cw.org](mailto:info@cw.org).

**References:** For a general discussion of glass fusing and moldmaking:

Lundstrum, Boyce, *Glass Casting and Moldmaking*, Vitreous Press, 1989

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