

Low-Cost Crucibles

for melting cast iron, brass, bronze, copper, aluminium and other metals

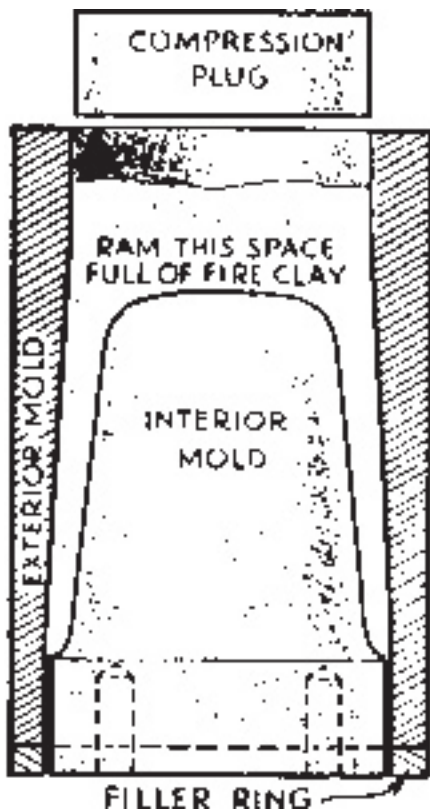
By LEO G. HALL. (Popular Science 1938)

SINCE even the best crucibles do not outlast many heats, the home foundryman or furnace experimenter will find it profitable to make his own.



A few metal molds and crucibles made in them. The mixed fire-clay and fire-brick are rammed heavily into the mold, then ejected, dried and baked.

One method requires a mold, made in four pieces as shown in the drawing below. The outer mold and the compression plug should preferably be made of cast iron or steel. The core mold can be made of softer metal or even wood. Fire-clay crucibles are satisfactory for melting brass, bronze, copper, cast iron, type metal, white metal, babbitt, aluminium, and the like, but not steel and other very high temperature alloys or glass. The fire clay can be bought for a few cents a pound at brickyards or furnace shops. To avoid excessive shrinkage, it is necessary to dilute the clay with broken fire brick, pounded up with a hammer so that it will pass through a piece of fine window screen. Mix 1 lb. of dry fire clay thoroughly with 1½ lb. of the fire brick and add water very slowly until the mixture is barely moist and crumbly, like fresh bread. If more water than this is used, the crucible will stick to the mold.



The four parts of a mold shown in sketch at left. Note filler ring.

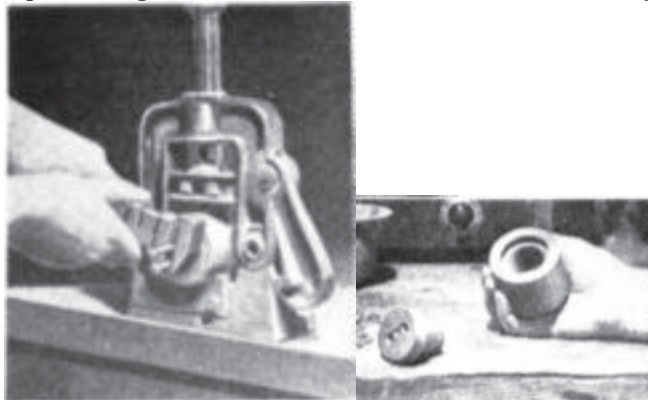
The mixture is inserted a little at a time into the hole at the top of the outer mold, and rammed down thoroughly all around the inner mold with an old half-round file. When the mold is filled nearly to the top, insert the steel compression plug and drive it in with a heavy hammer until flush with the top of the outer mold. Then turn the mold upside down, remove the filler ring, and hammer in the interior mold until its base is flush with the end of the outer mold. This brings the clay at both ends to about equal density.



The moist, crumbly mixture is forced into the mold with a discarded half-round file..

The inner mold must be removed first. To do this, clamp the mold, with crucible inside, in a pipe vise, insert small bolts or pins into the holes in the base of the inner mold, grip them with a wrench, and twist. When the inner mold has been removed, the outer mold is stood on end and the compression plug gently tapped with a hammer to loosen the crucible. Dry the crucible for twenty-four hours on top of the house furnace or for a few hours in a baking oven.

Left: The first step in taking out the crucible is to twist the inner mold by using two pins.



Right: The inner mold is removed, and the crucible top can be seen in the outer mold.

The crucible should next be baked to about 1,800 degrees F. This may be done in an electric furnace such as that described in a previous issue (P.S.M., Oct '35, p.72) or in a gas or gasoline blast furnace. Bring the temperature up very slowly and be sure that the crucible is heated uniformly on all sides. The writer frequently bakes crucibles up to temperature, then -and not before- adds the metals.

Pressure-molded crucibles are always more or less porous. If a denser surface is desired, pure fire-clay mixed to a cream with water may be painted on the surface and the crucible re-baked. Another method is to dip the crucibles in a strong boiling solution of aluminum sulphate or epsom salt after being baked, then slowly dry and slowly re-bake them. This may be repeated as many times as desired. Good ventilation must be provided if this process is used because of acid fumes.

When melting metals in a gas or oil-fired furnace, a porous crucible is apt to result in the formation of a good deal of dross, as the furnace gases penetrate the crucible wall and attack the metal. Porosity does comparatively little damage, however, in the electric furnace. To reduce dross formation, crucible covers should be used. They may be made of the same material as the crucible and by the same general methods.

Another method of making the crucibles is to cast them. This gives a much denser product, but more skill is required. Only a single outer mold of plaster of Paris or Portland cement is needed. If made of plaster of Paris, it is well to dissolve a little alum or borax in the water so the plaster will not set too quickly. The plaster (or Portland cement) is then poured slowly into the water, which is stirred continuously until the mixture reaches a creamy consistency. Stir until all lumps disappear and all air bubbles are worked out. To insure this, it is well to strain the mixture through a piece of window screen before it is used.

Pour the mixture into a porous container such as a cardboard box. A metal container will not do. A very smooth metal or wooden pattern turned to the shape of the outside of the crucible is now dipped to the desired depth into the mixture and clamped securely. The pattern should be turned about one tenth larger than the finished size of the crucible. If a wood pattern is used, it must be soaked for several hours in water before use.

After the mold has set but before it is dry, the pattern is withdrawn. The mold should be set aside to harden a few days before use.

Left: The dry plaster mold is filled with a creamy mixture of clay. After a layer has been deposited on the inner surface, the residual is poured out.



Right: Molds of a second type made from plaster of Paris, and the resulting crucibles.

The fire brick must be screened finer than for the pressure-molded article. A screen of 60 or 80 meshes to the inch is about right. About 1 lb. ground fire brick and 2 lb. fire clay are stirred into water until a creamy consistency is reached, using the same precautions required for mixing plaster. Better results will be obtained if the wetted clay (or slip) is left, to stand a few days before being used, then stirred up again.

Enough of the slip is poured into the dry mold to fill the latter. As the plaster absorbs water from the clay, a layer of stiff clay is deposited on the surface of the mold. When this layer has reached about 3/16 or 1/4 in. in depth, the remaining clay slip is poured out, and the mold with the layer of adhering clay is set aside to dry. As the clay dries, it shrinks and breaks away from the mold in the form of a solid cup, which can be removed. Irregularities in the inside surface may be smoothed off with a suitable tool or sandpaper after the crucible is partly dry, but before it is baked.

A little glucose obtained from a candy manufacturer, if dissolved in the water, will make clays more sticky and improve results with some of the poorer clays.

The crucible, once it has come loose from the mold, will continue to shrink. The more slowly it is dried and baked, the stronger and denser it will be. It should be held at baking temperature for a couple of hours before any metal is put in it; and preferably should not be used for melting until it has been slowly cooled to room temperature after the baking heat.

Three or four crucibles can easily be cast from one mold before it has to be set aside to dry, but the casting operation takes longer for each succeeding crucible, as the mold becomes wetter. The mold should preferably be dried at room temperature, not heated, otherwise water is absorbed from the clay too rapidly.

Needless to say, one or both of the processes described can be used for making muffles, tubes, cupels, and other useful clay articles, as well as crucibles. By splitting the outer mold into two or three parts, the necessity for a taper is eliminated, and more complicated shapes can be molded.