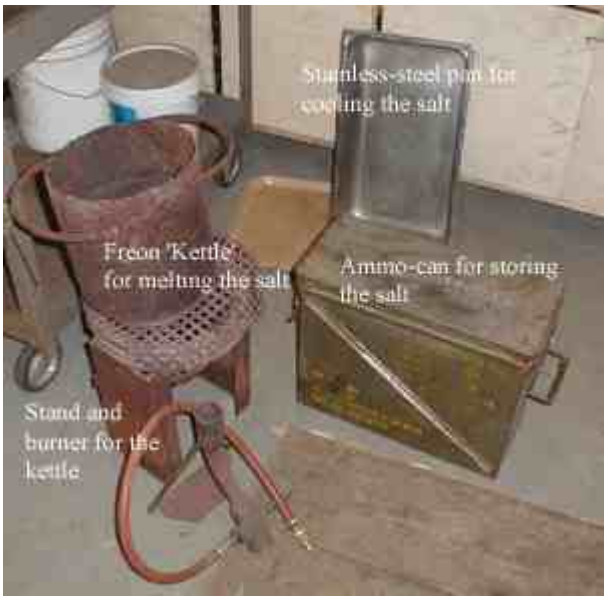
# Tips & Techniques- Salt Pots

If you're into knife making, you're into heat-treating. My personal philosophy is that if I accept payment for a knife, I want to be part of every element that goes into that knife and heat-treating is of paramount importance. While you can get away with the stick-it-in-a-forge - dunk-it-in-oil - cook-it-in-a-toaster-oven school of heat-treating (yup, I've done that), you can get far more consistent and better results from using salt pots. The down side is hassle, expense, and more danger - but you knew that already since the basic rules of the universe haven't changed.

The rationale for salt pots is simple - they give you a high-capacity, evenly distributed source of heat in effectively a zero oxygen atmosphere. There are no more hot-and-cold spots (no, Virginia, there can still be warpage - but it's less likely), no more open-the-door-and watch-the-temp-drop, no doubts about whether the blade is at temp regardless of the oven's readout, and a whole lot less scaling. Down side is you might die. Really. You might die. These puppies are nasty and must be treated with extreme care. I personally think they are worth it but every time I use them, I recite the safety mantra.

To heat-treat in salt you need two salt pots - a low temp unit running at 400..500F and a high temp unit running at 1450..1550 F (at least for the usual high-carbon steels that most of us use). Both pots are dangerous but the high temp unit can be a killer - it will replace the buffer as the most dangerous tool in your shop. What I'm going to describe here is my approach to the problem - I'm not recommending that you try this (though it works well for me). If you get fried, don't come back and blame me (e.g., this is the usual disclaimer about liability and your responsibility).

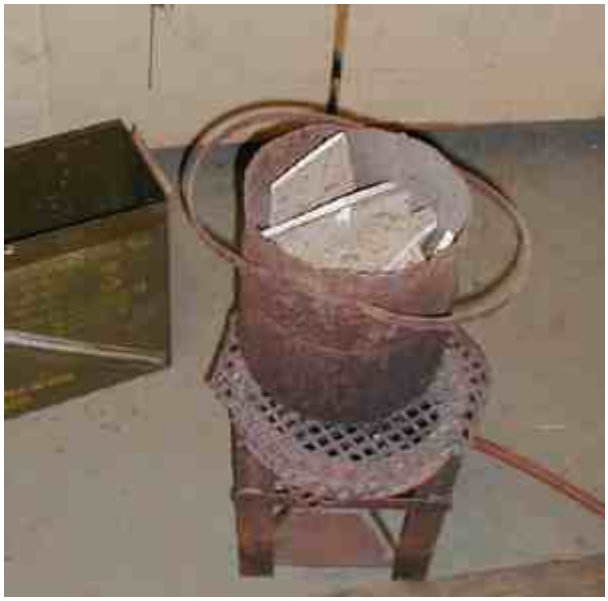
The best way I can convey the essence of the pots is to walk through a typical heat treat. You might first want to review the construction of the low-temp and high-temp salt pots.

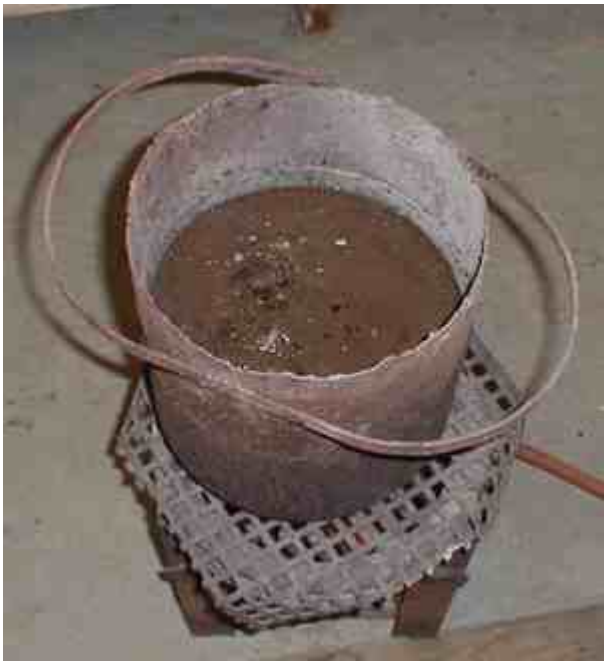



While some folks leave their pots running 24/7, that seems excessive to me. If the pot is to be shut down, you have to deal with the question of restarting it and also deal with the problem of corrosion.

The various components of my solution are shown to the right - the ammo can, the kettle (freon can) and stand, a gas burner, and a SS pan. The salt is stored in an ammo-can that keeps the water away from the salt. When needed, the salt is loaded into the kettle (see below),

When the salt is fluid (~400 F) (to right)

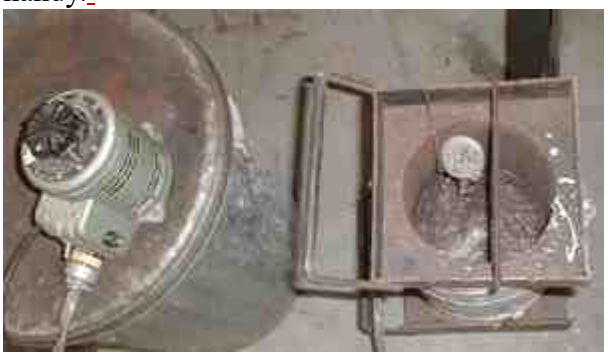




but for now, I will do it manually.

It is poured (carefully!) into the pot. The element is attached to a variac and powered up. I then watch to see that the temp is increasing. If it is, all is good. If it isn't, I can bail out by pouring the salt back into the kettle or jumping to turn-off procedure, and then swap out the element. Trust me - getting congealed salt out of a pot with a blown element is NO fun.

I use a stainless steel candy thermometer (0..1000F) (~$15 Surplus Center, Lincoln, NE) and keep a supply of 20 amp, slow-blow fuses handy.



The temp is adjusted to 475 F (normally at about 50% setting on the variac) and readjusted to keep it there. Maybe someday I'll rig a feedback system,

Once the low-temp pot is stable, the burner is lit off in the high temp forge using a piece of flaming newsprint and about 8 psi of LP. You can see the flame swirl in the shot to the right. Once the forge warms up, the tube is lowered into the forge (the donut of bricks is already in place) and the clamshells swung to the shut-and-support position.

The forge is positioned next to an open door with the flumes directed outside. If needed, a box fan is positioned to force the fumes out the door.

The temperature is monitored with an Omega digital temperature meter with an 18" long Type-K probe (~$100 for the set). The picture to right shows the salt at 1367 F approximately 45 minutes

after lighting off. At 8..10 psi, the temp rise is approximately 5 F/minute. Given the mass of the tube, I've elected to run the temp up slowly and not overshoot. While the pot is humming to itself, the time is

spent getting the knives ready. I've found that suspending the blades on a stainless steel hook (made from 1/8" SS rod) is convenient. The hook end inserted in the tang is closed so the blade cannot slip off and the other end is large enough to fit over a handle that is located near the high-temp pot. I typically run about a dozen blades at a time (see photo to right). What is absolutely critical is that they be dry.

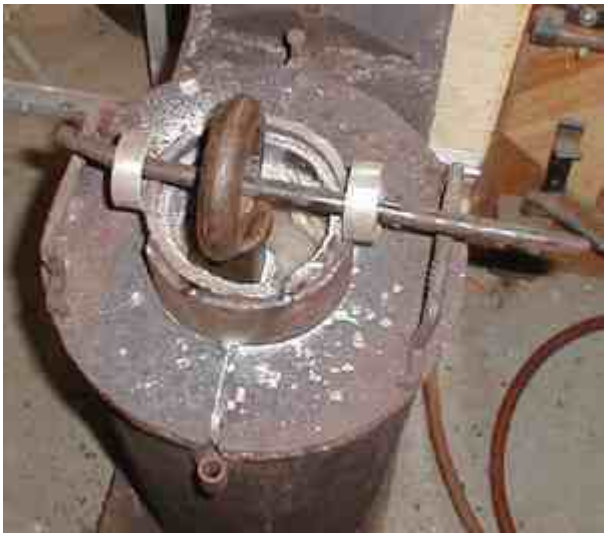
An overview of the system is shown to the right. 'A' is the Paragon furnace on a steel cart whose handle is used for hanging knives. 'B' is the high-temp pot, 'C' is for oil quenching, 'D' is the low-temp pot, and 'E' is a stump and wooden hammer used to correct any warps. The ladder in the doorway keeps the dogs out.

When the temp is correct, a bar is slipped across the tube and a knife is hung.

I wear welding leathers, an apron, gloves and a face shield anytime I'm near the pot (better sweaty than sorry!). I use tongs to hold the wire while sliding the blade into the lava pool. The high temp

pot appears to be full of a translucent orange fluid and as the blade slips under the surface, you can see the color move into the blade. Eventually (in about 30 seconds), there is a dark shadow in board of the spine and then even that winks out. Let it soak for maybe another 30 seconds and remove it.

You can then either let it air cool to gray and repeat the process three times (normalization and grain refinement) or if you're ready for the quench, slip the blade into your quenching medium. If you are using the low temp pot, this consists of slipping the blade beneath the surface of the low temp salt and hooking the wire on a bar over the pot. (see picture above and right). That's it. If I cycle a single blade (especially if it is a small one), there is no appreciable effect on temperature in the high temp pot. If I run four blades at the same time, I generally have to bump the gas from 4..5 psi to 7..8 psi to compensate. I also stir the pot with a carbon rod to insure even temperature and leave the temp probe in place to continually monitor the temperature. If I drop a blade, a long hook made of 1/4" SS rod is up to fishing it out (another advantage to the hook on the tang!). If a large number of blades are added to the low-temp salt, the variac may have to be backed down a bit.



After you've quenched all the blades, shut down the high temp pot. After the salt drops to a dull red (but still fluid), slip the taper into the pot. IT MUST be rust-free and dry! I use a rod to position the taper in the center as show to the right. After a couple of hours, the taper can be removed, wire-brushed and oiled or waxed for the next time. The pot (when cold) is oiled and wrapped in oiled cloth and returned to storage. Residue salt is removed from the forge.

After several hours (long enough to generate banite), the low-temp salt is poured into a SS pan and allowed to cool. When cold, the block is broken up and place in the ammo can for next time. The blades are washed and stored awaiting the final grind and the hooks are washed and stored. The heat-treat shown here for thirteen blades took a total of five hours from start to finish.