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Technique...

Making Your Own CHARCOAL

Materials:
(1) 50 gallon oil drum
(1) 20 gallon oil drum
(1) approximately 50 lbs of white pine (or other wood)
(1) pile of scrap wood for fuel
(4) fire bricks

Tools:
Circular Saw and metal cutting tool such as Jig saw with metal cutting blade, torch, air chisel etc.

November, 2001 Issue

Tool Tip:
Modify your anvil cutter with a length gauge.

Gallery:
Pictures From PGI 2001.

Technique:
Learn how to make your own charcoal.

Introduction:
Making your own charcoal might sound like one of those obsessive endeavors engaged in by the hard core pyro who is bent on fabricating everything from elemental raw materials. Given the fact that some pyros are actively growing their own forests of paulownina trees for the sole purpose of harvesting them into charcoal, perhaps it really is a fringe activity within a fringe activity. Considering that commercial charcoal can be purchased for as little as 30 cents a pound, is it really worth the effort?

Well, anyone who has ever put 4-5 hours into fabricating an 8" ball shell that could simply be purchased for $20 is obviously motivated by something other than saving time and money. It's the nature of any good hobby to provide the hobbyist with ever increasing avenues of exploration. Activities such as making black powder, making charcoal, making raw match and even making your own chemicals are all challenging endeavors within the overall field of pyrotechnics. Persuing these specialties will not only increase your knowledge of the finer details of firework making, they will give you increased control over those details.

Once you see a spider web shell or gold comet made with your own hand-crafted pine charcoal, you may never want to go back to commercial "air float." If you desire to make your own BP for lift and burst charges, then it becomes even more important to use the specialty charcoals such as willow, maple or grapevine to get the most force per ounce out of your powder.

More...

Making Your Own Charcoal...

Figure 1: Pine 2x2s packed into the drum.

Figure 2: Drum loaded into the furnace.

Figure 3: Fired up!

Building the Kiln:

The basic idea behind the method of charcoal making shown here is to isolate some sticks of wood in a fireproof container that is minimally vented to allow gases to escape during carbonization. A fire is built around the container until the internal temperatures reach between 600-1000 degrees where the carbonization process begins. Heat is maintained around the barrel until the carbonization process has completed, which takes about 3-4 hours depending on how dense the wood is packed and how quickly the reaction temperature is reached.

The size of the system described here will allow batches of charcoal ranging from 10-15 lbs, depending on what kind of wood is used and how densely the drum is packed. The design is based around the widely available steel drums used to ship oil, transmission fluids and other lubricants. Both a 50 gallon and a 20 gallon steel drum are required, which are often obtainable from your local oil distributor for around $10 and $5 respectively. Make sure that you get the lid that goes on the 20 gallon drum.

Once you have acquired the two drums, the first step is to cut the top out of the 50 gallon drum. I did this using a saber saw with a metal cutting blade, while some people use a cutting torch, air chisel etc. Make sure to cut inside the lip the way a can-opener would, since cutting the side would leave a hazardously jagged lip on the barrel. On completing the circumference of your cut, the lid will drop to the bottom of the barrel, which is as good a place for it as any.

You will also need to punch four or five 1/4" vent holes in the top of the 20 gal. drum lid. This is not exactly necessary, since the gasses will be able to escape from around the sides of the lid, but the yellow flames that will fire from the top holes make a good indicator for the progress of the carbonization process. You can drill them or simply hammer a center punch through the lid.

Next you will want to clean the oil and other debris from the insides of both barrels, as well as cut some vent holes at the bottom of the 50 gal. drum. You may use the same cutting tool you used on the lid to cut some large holes at the bottom of the barrel, or you can simply make several cuts in the side using an ax when the barrel is red hot (see Figure 3. for the ax-cut results). Keep in mind that larger holes will reduce the strength of the drum and cause it to buckle from rust and heat damage quicker than several smaller holes.

The quickest way to clean both barrels is to build a fire in the 50 gal. drum until it is blazing hot, then remove the lid from the 20 gal. drum and invert it into the fire. This will burn away all the oil residue from both barrels (along with the paint). Remove the gasket from the 20 gal. lid and toss it into the fire for cleaning as well. If you are are using the ax method to vent the 50 gal.

Figure 4: Volatile gases burn bright yellow as they exit the drum.

Figure 5: Finished product ready for grinding.

drum, now is the time to start gashing the sides. The red-hot metal will allow the ax to slice through much easier than if the barrel was cold.

The final step in completing the furnace is to place a few fire bricks in the bottom of the 50 gal. drum in order to hold the 20 gal. drum up off the bottom. Do not use cinder blocks or other porous type brick, as they will crumble after the first burn. Using sticks of rebar inserted through holes in the sides of the 50 gal. drum to form a platform for the 20 gal. drum will result in the rebar bending under the weight as it heats up and loses it's strength. The simplest and most reliable method is the use of fire bricks placed in the bottom to hold the drum about six inches off the floor so that hot coals will settle underneath of it.

More...

Making Your Own Charcoal...

Selecting the Wood:
Now that you have a furnace for making charcoal, you have any kind of charcoal you want at your disposal. Willow, paulownia, grape vine, maple and plum are all very excellent for making black powder. However, obtaining these types of wood in any usable quantity for making charcoal can be difficult. Varieties of willow can be found growing wild in some areas, but there is a bit of work involved in cutting them down, stripping the bark, splitting them into thinner sticks and then drying them out. Maple can sometimes be found by dumpster diving around cabinet shops, if you are lucky enough to find one nearby that allows such activity on their property.

I have personally found that spruce, a white pine commonly used for house framing materials like 2x2s up to 2x8s, make excellent spark producing charcoal as well as suitable lift and burst charge. The abundant supply of "white wood" scraps at lumber yards, construction sites and even cabinet shops makes this an ideal source of charcoal fodder. Home improvement stores like Home Depot and Lowes will often bundle up their unusable lumber stock of warped wood and sell it very cheap. The larger lumber yards tend to put aside all their scraps and sell them to commercial mulch manufacturers, and they are usually not interested in selling small quantities to individuals.

It is important not to mistake yellow pine for spruce, as the yellow pine is denser, heavier, sappier and does not work as well. The yellow pine can be recognized by a yellower color, more distinct grain and heavier weight. It is usually employed for trusses and larger framing materials such as 2x10s and 2x12s.

While some people go through the effort of removing all knot holes from their wood before turning it into charcoal, I have not found this to be worth the trouble. If you simply avoid wood with large knots and ignore the small ones, the ratio of knots to wood is so low that it does not effect the final charcoal performance. What is important, however, is to try and get the wood stock into thinner sticks not much larger than two inches in diameter. The thinner the wood stock is, the faster it will convert to charcoal. Placing large chunks of 2x4 into the barrel will result in long burn times and possible incomplete carbonization due to the insulating property of wood.

If your source of scrap wood comes in larger sizes like 2x4s and up, then it is easiest to cut them into foot long segments and then use an ax to split them into smaller pieces. It takes 50 lbs of wood to generate 15 lbs of charcoal, so the more wood you can fit into your drum the better. However, very dense arrangements like that shown in Figure 1 will result in longer burn times to reach complete carbonization. The drum in this case was loaded with three rows of 2x2s cut to about 7 inch lengths. This required about thirteen 8 ft long 2x2s to fill the drum, so if you would rather just go buy the wood in a convienent size rather than spend the time searching for scraps and cutting them up, your cost would be roughly one dollar per pound of finished charcoal.

Fire Up the Furnace:
Once you have your drum loaded up with the wood of your choice, snap the lid on and place it into the center of the furnace barrel as shown in Figure 2. It is not necessary to bend the tabs down on the lid, as you want a rather loose fit for the gases to escape. The space around the center drum is then filled with wood scraps, cardboard, leaves or anything else that will burn. A pile of leaves or other fine, dry material helps get the initial fire going, after which larger chunks of scrap wood can be added to keep the fire going with less maintenance.

Another method to getting started is to build a blazing fire in the large drum before inserting the smaller drum. Let the fire burn down to glowing coals, then throw the small barrel in on top of them. This makes it easier to get the initial fire going and provides a nice hot coal bed under the wood drum. Scraps that are dropped around the sides of the inner barrel will then easily ignite on their own.

If the fire appears to have ghostly thin, dark orange flames that get sucked down into the fire space, then there is not enough ventilation to feed the fire. Take your ax and make more holes, twisting the ax head in order to open up the slices wider so more oxygen can feed in. You will need bright orange flames around the entire peripheral of the drum to ensure even heating.

It will take about 30 to 60 minutes of a roaring fire before the pyrolysis of the wood will begin. The first indication of the reaction will be white smoke pouring out from the lid of the drum. This will then give way to the hissing of volatile gases that ignite on exit to form bright yellow flames as seen in Figure 4. Once these flames are seen coming from the top of the drum, the carbonization process is under way. This process actually generates heat on its own, so once it starts you can cut back on the amount of wood fed to the furnace. Simply keep enough wood to keep a moderate fire going until the yellow flames are no longer seen coming from the drum lid, which should take around three hours.

Once the yellow flames disappear, douse the furnace fire with water and allow the drum to cool for about six hours. If you are worried about oxygen getting into the drum and turning your new charcoal to ash, you may cover up the holes with a wet piece of wood, but I've never had a problem with the charcoal igniting inside the drum unless the lid is opened right after the burn is complete.

Processing the Results:
So now you have a nice drum full of charcoal sticks that should look something like Figure 5. The sticks should easily snap in half if they are fully carbonized. You may notice that the sticks at the edges of the drum are a little more crumbly than those at the center, due to hotter temperatures at the sides. If you can't break some of the sticks in the center, then the carbonization process did not complete and there is still wood at their core.

Now there is only one problem left to surmount: how to get these big chunks into a useable powder! This is a messy process no matter how you do it, but the easiest way is to use a large cement-mixer type ball mill with baseball size media in it. The balls do not need to be too heavy, as the charcoal is very easy to crush. My own method involves the use of a home made stamp mill (to be documented in a future issue) that repeatedly drops a round-bottom boat anchor into a metal bowl set in concrete. The bowl is filled with the raw charcoal and beat on for 15 minutes, which is all that is required to turn 90% of it into a fine dust of various particle sizes. I save whatever passes a 30 mesh screen, then return the coarse leftovers back into the next stamp mill load. A standard gallon size ball mill can even be used to break up coarse chunks. Some people even pound the coals by hand, but that would be quite tedious and even more messy than the automated methods. You just have to get creative here, depending on what your mechanical skills are. One could even try putting all the charcoal in a garbage bag and stomping it into powder!

Using the 30 mesh screened charcoal as-is to make comets and streamer stars result in very long tails due to all the various mesh sizes contained in the mix. Ball milling the streamer mixes will result in very dense and bushy tails. When used to make black powder, this charcoal will produce superb meal for use in black match, star primes, driver compositions and grain powder compareable to commercial lift. It's great stuff!