

The Jolly Roger Oven (J-RO) – baking wood into biochar

Background: The Jolly Roger Oven, or J-RO, is a family of bigger-than-small but sub-commercial size units that individual operators can use to convert relatively large pieces of wood to biochar. This particular design uses a 100 to 120 liter drum inside a firebox made from one and one half 200 liter drums. The idea is to “bake” the wood into biochar inside the smaller drum while providing a hot but contained fire that last long enough to make sure the biochar is “well-done”. This design is intended for dry sticks, branches and scrap lumber. Other designs can use chipped wood. Google “Making Biochar in Jolly Roger Ovens (in the snow)” for some great videos on J-RO options.

Materials and Tools

The basic components of this J-RO unit are as follows:

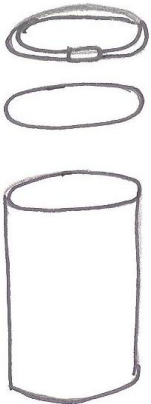
- One 100 to 120 liter open head steel drum with the clamping ring
- Two 200-liter steel drums – closed or open head
 - Note: the Drums can be new or used, but must be able to be cleaned out – no half drums of paint
- Three fire bricks – not Portland cement bricks, but the kind that are used inside fireplaces
- Two tin cans – the same size, about 4” in diameter, with both ends removed
- A second hand computer fan – 4” in diameter is best, or any small electric fan, blower, or hairdryer
- A 6” to 8” diameter by 60” stove pipe purchased from a local hardware store – or 2 x 24” sections
- A 4” diameter by 24” stove pipe or galvanized air duct from the same hardware store
- Rubbing alcohol (91% is best – from the Pharmacy First Aid section)
- Dry sticks, branches or scraps of cut lumber

The main tools required were

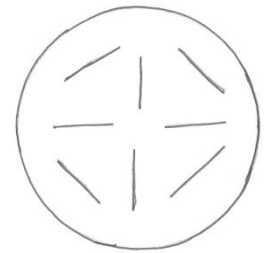
- An angle grinder with a metal cutting blade
- A “five-bladed crimper” or a pair of tin snips (may not be needed)
- A pair of pliers to bend the metal tabs that will be cut with the angle grinder
- A 12V battery or a power supply that provides 12V DC for the fan – 115V power if you are using a hairdryer

Construction

1. Begin with the 100 to 120 liter open head drum. Remove the lid.



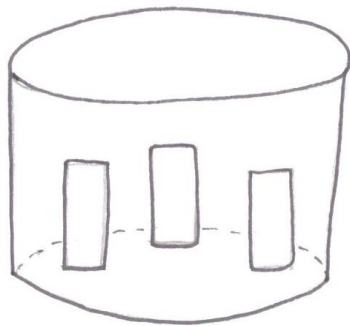
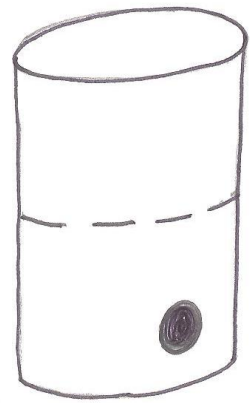
Using the angle grinder, make evenly spaced slashes in the lid’s surface. This will allow for the escape of gasses when wood inside the drum is pyrolyzed.



2. Fill the smaller drum with wood and twigs, oriented vertically to allow for the movement of gasses, and replace the lid. Secure the lid with the clamping ring, but not too tight.

3. Cut one 200-liter drum evenly in two, using the angle grinder. We will use the bottom half

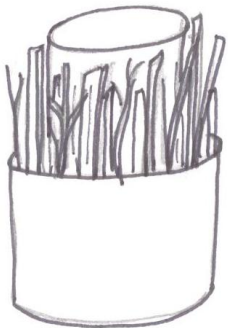
4. Trace the circumference of the 4" air duct on the curved side of the bottom 1/2 of the larger drum, just above the ground, and cut a hole of this size in the drum. The duct should slide through the hole and extend about 8" inside the drum – this is where we start the fire and insert for the blower can (see below).



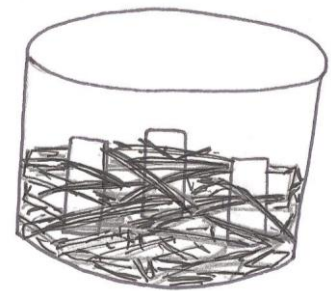
5. Place this 1/2 of the larger drum on the ground, with the open half facing upwards.

6. Place three fire bricks in the bottom of the drum, standing on their shortest sides, so that the length of the bricks are directed upwards. The bricks point out in a circle like the hands of a clock at noon, 4 and 8 – with the opening for the blower can at 6 o'clock.

7. Pack the bottom of the drum with sticks, dry wood or cordwood, to just below the top of the bricks. (Note that wood chips are not suitable because they will choke the fire.)

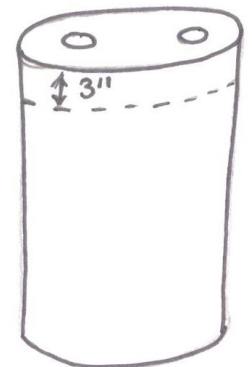


8. Rest the smaller drum filled with wood so that the top with the slits is facing downwards, and so that the drum is resting solidly on the bricks, (not resting on the wood, in case the wood shifts while burning.)

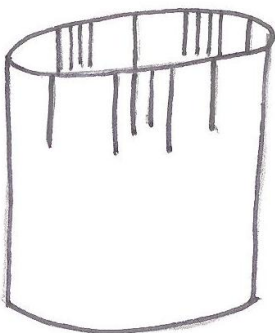


9. Pack more wood and twigs in the larger drum, all around the smaller drum, running lengthwise up and down.

10. Using the angle grinder, cut all around the curved surface of the second 200-liter drum, 3" from the end which contains the two spouts, so that that flat end of the drum is removed. Discard this section.



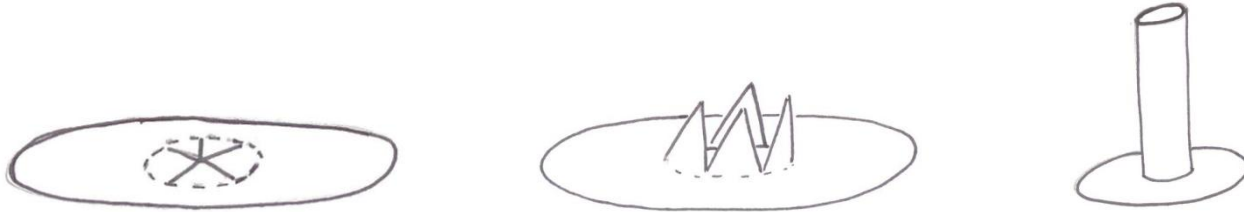
11. On the remaining section of the drum, make 16 evenly spaced vertical incisions with the angle grinder, about 6" long, all around the cut edge. This creates 'flaps' all along the edge of this portion of the barrel.



12. In three flaps, roughly in triangulation with each other, cut two more 3" incisions. Bend the middle one slightly in and the outer two slightly out, so that when the barrel is turned over, these three flaps can slip over the top edge of the bottom half. All the other flaps can be bent 30 degree outwards to allow air into the barrels and make for a fire along the sides of the inner drum.



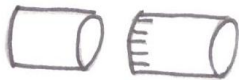
13. Before placing the bigger 200-liter drum on top of the other, trace the circle the size of the stove pipe in the center of the drum bottom. Cut slits with the angle grinder, radiating from the centre of the drum to the edge of the stove pipe, creating triangular sections that can be pulled back to create a roughly circular opening at the end of the drum. The flaps created by these cuts will create a rest for the stove pipe, which should press snugly to the flaps. If the stove pipe is not stable, add self-tapping screws or little nuts and bolts to secure the stove pipe to the drum. Small triangular openings between the drum top and stove pipe are actually desirable, since they add a bit more air and let one see if the fire is reaching that high up the top drum.



14. Now place this larger drum so that it covers the wood in the other drum, and rests upon the edge of the other drum using the stand created by the three flaps on the edge. Make sure it is stable before lighting the fire.

Building the blower can

1. Cut the ends off of one tin cans. The other is a spare in case you make a mistake.
2. One end of the can needs to fit snugly inside or outside the 4" air duct. If the air duct has a crimped end – try putting the can over that end. If that doesn't work, crimp one end of one tin can using the "five-bladed crimper", so that its edge will fit inside the 4" air duct. If a crimper cannot be found, a series of diagonal slits in one end, about 5 cm long, will allow the cut end to slip inside the uncut other can – but watch out for sharp edges, which is why we like the crimper.



3. Mount a computer fan to the other end of the can that mates up to the 4" air duct, and when ready to use the blower, connect the wires to the power supply.



Starting the fire

1. Tip the bottom air duct up slightly and pour ½ cup of alcohol down the 4" air duct into the bottom of the lower drum.
2. Light a newspaper, and QUICKLY insert through the hole, to set the fire.
3. As soon as the fire catches, insert the blower tube into the hole. This will get the fire moving upwards.

The burn

1. Soon, all of the wood packed around the outside of the smaller barrel will start burning.
2. Within a short time, the wood inside the smaller barrel will begin to bake. When this happens, the gases from the pyrolyzing wood will escape through the bottom of the smaller barrel, and ignite. Initially,

there is also quite a bit of water vapor, which makes a thick white smoke, as shown.

3. The gases from the inner drum keep the fire going, and continue to bake the wood inside.

4. As the inner drum gets hotter, more gases will be generated and the J-RO goes through a “burn cycle”, where it provides its own fuel. The fire may get quite intense, but eventually the inner drum will be fully converted to biochar and the off-gassing will cease.

5. Within about an hour, you have produced biochar!



Dr. McLaughlin also showed participants how to make two types of Toucan micro-retorts; the Toucan MR (micro-retort) and the Toucan TLUD (Top-Lit Up Draft). Please refer to attachments for detailed descriptions of construction of these units.