E-Z Adsorption Char Drum Oven

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This drum pyrolyzer can be used to generate high temperature char from chopped woody biomass for use in water treatment.

The parts are inexpensive and widely available, and it can be constructed using only a few simple hand tools – no need for electricity.

Parts list:

- 2 x 200 L (55-gal) metal drums (one with a removable lid)
- 20 L (5-gal) metal bucket
- 2 m (6 ft) of 5 cm (2 in.) angle iron or 4 cm (1 ½ in.) square tubestock cut into four 0.5 m lengths
- 60 x 120 cm (2 x 4 ft) sheet of heavy gauge expanded metal
- Optional: 60 x 60 cm (2 x 2 ft) sheet of holey metal grate
- 0.6 x 2.4 m (2 x 8 ft) corrugated tin sheet
- 80 x 80 cm (30 x 20 in.) piece of plastic mesh screen with openings about 1 mm (1/25 in.)

Tools needed:
machete and mallet, work gloves, measuring tape, marker

Use the machete and mallet to cut a tabbed hole in the top of the chimney drum. Cut the bottom out of the 5-gal bucket and install it onto the tabs.

Use the machete and mallet to cut a hole out of the center of the pyrolyzer drum lid – leave a ring approx. 13 cm (5 in.) wide.

Cut out the bottom of the pyrolyzer drum leaving a 3-4 cm (1-1½ in.) lip as shown left and bottom-left.

Cut two round pieces of expanded metal and place them in the bottom of the pyrolyzer drum. (Feasibility test pictured below: if a couple of Western guys can cut parts this way then the locals should have no problem.)

Option: a piece of holey metal can be placed on top of expanded metal grates to provide additional draft control. 1 cm (3/8 in.) holes shown here.

Cut the tin to fit inside the pyrolyzer drum as shown left.

The tin liner provides a small insulating air gap, extending the life of the drum. It also provides some pre-heated secondary air into the combustion zone.

Fill the pyrolyzer drum with chopped scrap wood or tree prunings.

Wood should be dry (not fresh or “green”).

Pieces should be approximately 3-5 cm (1-2 in.) in diameter and 7-12 cm (3-5 in.) in length.

The feedstock should be packed tightly and uniformly. Use small pieces of wood or bamboo on top as kindling.

Stack the chimney drum on top of the pyrolyzer drum as shown below-left. Use the pieces of angle iron or square tubestock to create air gaps (1) between the pyrolyzer drum and the ground, and (2) between the drums.

Light the kindling at the top of the pyrolyzer drum. After a few minutes, it should begin to burn very strongly. Orange flames appear in the gap between the drums, and no smoke should be emitted from the chimney, as shown below-right.

During the burn, the flames will appear bright orange, like a typical campfire (a).

Near the end of the burn, the flames between the drums will appear more bluish (b).

Also, the bottom of the drum will begin to glow as the bottom layer of wood converts to char (c).

When all orange flames have disappeared from between the drums leaving only faint blue flames, it's time to quench the char.

From the start of the burn until only blue flames appear is typically about 2 hours for woody feedstocks.

Use plenty of water to quench the char and cool the drums. When the upper drum is cool enough to handle, remove it and continue pouring water on char until there's no steam and all char has been thoroughly cooled.

Wet-quench is the preferred method for making water treatment char as the steam generated might help to open char pores and increase adsorption capacity. Pre-rinsing out ash and fines, keeping down the dust during char processing, and more rapid wetting of the char upon installation in the water system are also benefits.

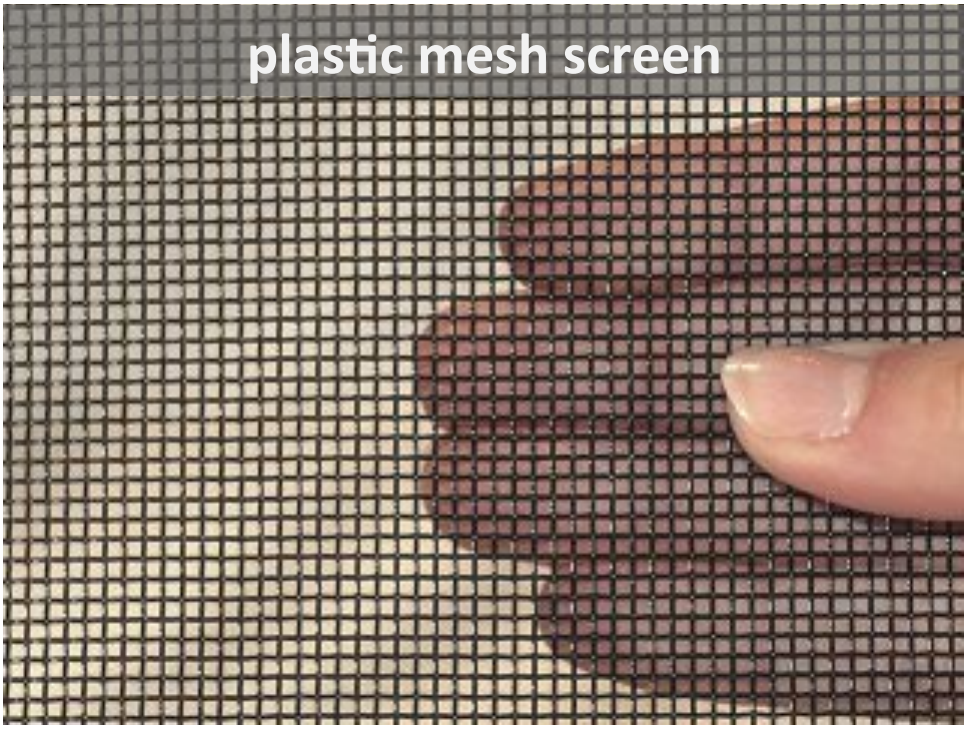
An important factor influencing the effectiveness of water treatment char is particle size. Small char particles exhibit better adsorption of dissolved contaminants than large particles owing to their greater exposed surface area and shorter distance of travel for contaminants diffusing into char pores.

Thus char for use in water treatment should be crushed and sieved, ideally retaining the approximately 1-5 mm (1/25 – 1/5 in.) size fraction.

Very fine char particles (powder) can lead to clogging and so should be removed by sieving and put to other uses (e.g. soil amendment, eco-sanitation cover material, etc.).

A simple way to crush and sieve char to obtain the desired size range is to use plastic mesh screen with approximately 1 mm (1/25 in.) openings (see image below). Such screens are sold widely for windows and poultry enclosures. Cut a piece approximately 80 x 80 cm (30 x 30 in.). Place 2-3 handfuls of char onto the screen and gather it into a bag. Use a wooden mallet to crush the char, turning the bag frequently to give an even treatment. Wash away the fines with ample water into a collection trough and save for other uses. Visually inspect the char and continue crushing until all pieces are less than about 5 mm (1/5 in.).

Continue until the desired amount of char in the proper size range is obtained. This process can be tedious, so invite some friends to help!



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