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El Carbonero the do-it-yourself pyrolysis cooker

1. OUR INTENTIONS

We wish that we humans could manage to live in harmony with nature and perhaps this guide can contribute in a small way to this. We only have one planet and it would make sense to protect it instead of exploiting it more and more. We also wish that people would stop

exploiting other people, and this guide can also make a small contribution to human self-sufficiency. Therefore, this manual serves two main purposes.

1.) Our wish is that you cook, produce vegetable charcoal or barbecue charcoal in an environmentally friendly way.

2.) We would like you to cook, produce charcoal or grill effectively with little wood, especially in poorer countries where wood is precious.

2. WHAT ARE THE ADVANTAGES OF PYROLYSIS?

2.1. Its environmental friendliness

With pyrolysis you can cook in an environmentally friendly way and you get high-quality barbecue or vegetable charcoal as a waste product. During the conversion process from wood to charcoal, about half of the CO₂ stored in the wood is released again. If you want to use the charcoal for barbecuing, the CO₂ balance is neutral. However, if you want to use the charcoal as plant fertiliser, the CO₂ balance is even negative. Negative is positive in this case, because half of the CO₂ contained in the wood is still in the coal and, according to studies, will remain stored there for at least the next 5,000 years.¹

2.2. Its efficiency

With the El Carbonero M cooker you can cook, for example, noodles or rice in 20 min with only 1 kg of wood. With an open fire, you would need significantly more wood. The El Carbonero L cooker with its capacity of 3.5 kg of wood provides a cooking time of at least 45 min. With the El Carbonero XL you can't cook with the XL because the flames are too big, but you can produce about 10 kg of vegetable charcoal with it.

3. USABILITY OF THE CHARCOAL PRODUCED FOR TERRA PRETA

Terra Preta - that is the name of the black soil of the Amazon Indians. This is very fertile soil in a region where it should not actually exist because of severe erosion.

¹ The oldest pyro-coal that has been studied is 5000 years old. Whether the CO₂ is perhaps stored for much longer cannot be said at present.

The Amazon Indians discovered thousands of years ago that their soil becomes much more fertile when it is enriched with plant charcoal. By composting their organic waste with plant charcoal, they created a soil that still

produces rich yields today. This is happening 400 years after the last black earth soils were created! Unlike charcoal, plant charcoal is baked at higher temperatures. As a result, it is more porous and can thus store more water on the one hand and provide a broader habitat for microorganisms on the other.

The creation of the black soils removes CO₂ from the atmosphere: when wood is converted into plant charcoal, only about half of the CO₂ that the plants bind during growth is released again. The other half enriches the soil as plant carbon and remains there for a very, very long time. Research results have shown that the oldest Terra Preta soils are 5000 years old.

So Terra Preta achieves two goals at the same time: greater fertility and a reduced CO₂ content in the atmosphere.

4. WHAT IS PYROLYSIS?

TLUD

Top-lit updraft - this means that the cooker is lit at the top and the fire creates a flow of air from the bottom to the top. After lighting, a "normal" fire is initially created on the surface of the fuel. This fire generates the air flow in the cooker - from the holes in the bottom upwards into the flame. If the fire now "eats its way" downwards, you have two fires in the cooker. One is at the bottom - on its way to the bottom of the cooker - and the other is the flame you see at the top. At the same time, the fire at the bottom of the cooker is a smouldering fire - that is, the combustion takes place in the absence of oxygen and is not complete. This creates wood gas, which is transported upwards by the air current ("up draft") and supplies the visible flame with gas. It is therefore gas combustion.

5. HOW WOOD BECOMES CHARCOAL

The fuel above the smouldering fire has already been converted into charcoal. In a normal fire, this charcoal would now burn. But in the cooker this does not work because the smouldering fire under the charcoal has completely consumed the oxygen. Wi-

thout oxygen, there is no combustion and the charcoal remains. When the smouldering fire has reached the bottom of the cooker and all the wood has been converted into charcoal, the wood gas flame at the top collapses and you know that you now have to extinguish the charcoal because otherwise it would start to burn.

6. WHAT MUST BE OBSERVED DURING PYROLYSIS?

It is of crucial importance for the success of pyrolysis that the wood is dry. With the diameter of 1 inch (2,5cm) and a length of 3.5 inches (8 cm), dead wood should dry for about 6 months and freshly cut wood should dry for about 9 months. The wood used is decisive for the burning time. Different types of wood have different densities and this determines the burning time.

7. INTRODUCTORY NOTE TO THE CONSTRUCTION OF THE EL CARBONERO COOKERS

The two descriptions are to be understood as suggestions. For example, our outer can supports the cooking pot. The cooking pot may be placed over the combustion chamber by other means. However, the outer can we suggest also serves as a windbreak and as a preheater. This becomes interesting for regions with a lot of wind. But here, too, there are different solutions.

8. HOW TO BUILD AN EL CARBONERO M

To build the pyrolytic cooker you need:

An inner can: 4250ml tinsplate can, approx. 24 cm high, Ø approx. 16 cm.
(Italian restaurants get tomatoes, peppers etc. in such tins).

One outer can: 12l tinsplate bucket with handle, approx. 33 cm high, Ø approx. 24 cm (Bakeries sometimes get ingredients in such tins, or order them on the internet).

2 circular cake racks (for cooling pastries and cakes) Diameter approx. 30 cm, approx. 2 cm high (Can be bought in supermarkets)

Tools

3 corner brackets 80mm X 40mm, 30 mm wide 6 screws M4 10mm with washer and nut (Can be bought at a DIY or hardware store)

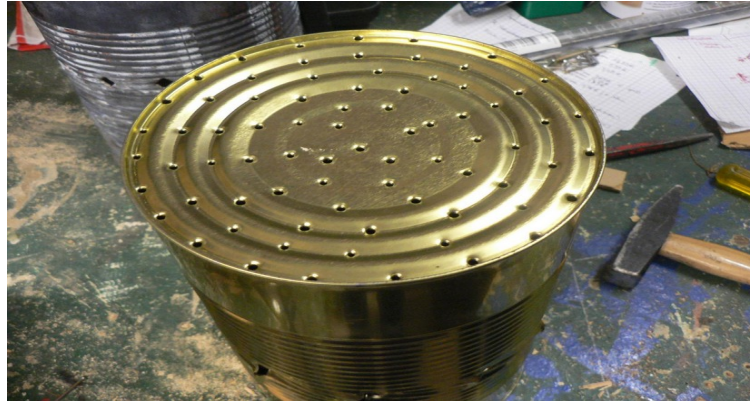
Inner can:

Secondary air holes:

The inner can has holes with a diameter of approx. 8mm, spaced approx. 3cm apart from each other, and 14 cm from the base of the can. You can drill these holes or tap them into the can with a mandrel/sharp chisel. The burrs that are created when the holes are punched, if they all point in one direction, improve the air turbulence in the combustion chamber (the area above these secondary air holes).



Primary Air Holes: Punch holes in the base of the can with a spike or a nail so that it looks something like this at first:



The size of these holes is decisive for how the pyrolytic cooker functions later on: If the holes are too small, there will not be a good air flow when firing. This makes firing very difficult. If the holes are too large, more ash than necessary is produced and the burning time is shortened. The optimal size also depends on the fuel that will be used later. Denser fuel will require larger holes. Therefore it is best, at first, to make small holes and to test these. If lighting takes too long and the flame is subsequently too small, enlarge the holes slightly until the cooker works satisfactorily.

The outer can:

Use the can opener to cut the bottom out of the outer can. Not all 12l tin cans are suitable for all can openers. Some cans can only be opened with a safety can opener, that leaves a smooth edge. Others can only be opened with a conventional can opener.

Attach the three brackets with 2 screws, washers and nuts each to the upper edge of the outer can so that they protrude by 3cm. I pre-drill the holes with a 2mm drill.

Now the El Carbonero is ready for the first cooking!

How to cook with the El Carbonero

Warning:

Please always operate the cooker outdoors! It is not suitable for use indoors!

Beware of the sharp edges inside the inner can – the combustion chamber. These edges enable better combustion, but you should therefore not reach into the inner can without protective gloves!

Construction:

The cooker consists of a grate as a base and an inner can:



and an outer can with a rack to support the cooking pot:



8.1. Preparation and how to operate the El Carbonero M

Fill the inner can with the fuel to just below the level of the upper air holes. The following principle applies: The more material in the inner can, the longer the cooker will operate, but the worse the air flow will be. Therefore, mix larger pieces with smaller ones if necessary to achieve an optimal air flow in the cooker.



In the picture, the inner box is primarily filled with dried horse chestnut wood. At the very bottom and at the very top there is a thin layer of wood pellets. This sandwich facilitates lighting and extends the burning time.

Lighting:

Newspaper placed in the combustion chamber may be used as lighting fuel. Before the outer can is placed around the inner can, you may light the fire through the secondary air holes:



When the flame burns stably, the outer can is placed around the inner can. A temperature of 270 degrees Celsius must be reached on the top layer for pyrolysis to start there. You can see that this has happened by the "jets", which are flash flames that go from the holes that supply the combustion chamber with air to the centre of the combustion chamber.



When lighting the fire, make sure that these air holes remain free! As a rule - depending on the fuel and wind conditions - pyrolysis starts after 1-2 minutes. Chips of very dry kindling or a few candle remnants under the newspaper can help to reach the pyrolysis temperature quickly.

Now you can cook!

Normally, the power of the cooker increases during operation. Towards the end of pyrolysis, when the smouldering fire that has started under the upper air holes reaches the bottom of the can, the flame becomes smaller again and then goes out. If you want to cook vegetables, for example, it may be worthwhile to throw in thin twigs while you are bringing the water to the boil to increase the power of the cooker for a short time. However, throw in only one twig at a time! Too much cold wood on the flame can disturb the draught and then the pyrolysis gases will not be burnt completely. Then, when the water is boiling and only a lower power is needed to keep the water boiling, stop.

Finally: How to extinguish the cooker

Since you want to produce charcoal with the cooker, you must not extinguish the flame when you have already finished cooking, e.g. because your water is boiling or the potatoes are cooked. If you do so then there would still be uncharred pieces of wood in the cooker. Let the flame go out by itself. Then remove the outer can and extinguish the glowing charcoal by pouring a little water into the inner can. Then spread out the charcoal - e.g. on a metal plate - and extinguish any remaining embers with a little water. If you don't want the charcoal to get too wet, this can be done very well with a spray bottle. Caution: The inner can is very hot after cooking! So use gloves when you touch the cooker

and only touch the inner can with gloves after the glowing charcoal has been extinguished.

Depending on the intended use of the charcoal produced, you may then need to dry it a little.

If you want to use the charcoal produced as vegetable charcoal, it is recommended to quench it with water. It then becomes more porous, has more inner surface area and is also easier to crush. If you want to use the charcoal as barbecue charcoal, it is better to let it cool slowly under oxygen exclusion and not to use water. However, you must then ensure that virtually no air gets to the glowing charcoal for a longer period of time, otherwise it will burn.

Use of charcoal for terra preta

You should chop the charcoal so that the largest pieces are less than one centimetre in diameter. This can be done quite quickly with the charcoal from single cooking session.

The charcoal can then either be put into the compost as an additive or - after "loading" with nutrients - churned directly into the soil. Charging can be done e.g. with nettle liquid manure, in which you soak the charcoal for a day. It is important that the charcoal absorbs nutrients before it enters the soil, so that it does not compete with the plants for nutrients in the soil. In this case, the yield of your garden soil would actually decrease in the first year!

To convert one square metre of soil into terra preta, you need at least 2kg - or more accurately, as the weight varies more - 7 litres of plant carbon. Since the El-Carbonero produces 1 litre of charcoal in one session pass, you will quickly reach the limit for larger plots. If you use the El Carbonero once a day for a whole year, your charcoal will only be enough for 52 square metres.

Contact details:

E-Mail: info@el-carbonero.de

9. HOW TO BUILD AN EL CARBONERO L

Materials:

To build a pyrolysis cooker you need the following materials:

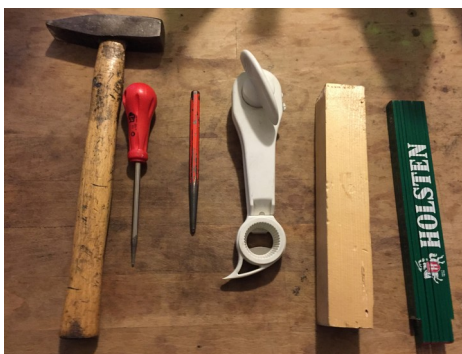
Inner can: a 12 L tinplate bucket approx. 33 cm high; approx. 24 cm diameter.

Outer can: a 30 L tinplate bucket approx. 41 cm high; approx. 31.5 cm diameter.

2 circular cake racks: approx. 44.5 X 34 cm; 2 cm high.

Tools:

A hammer, a thorn, a mandrel, a safety can opener, a length of wood 23 cm long, 4x4 cm square.



Inner can:

Secondary air holes:

The holes are made at a height of approx 25 cm measured from the base of the can. The distance between the holes around the inner box should be approx 5 cm. Use the length of wood as reinforcement when you punch the holes. Place slightly below the holes to be punched to avoid going directly into the wood.



Use the mandrel to punch the holes. First, straight from top to bottom.



In a second step, knock the holes at an angle (all holes in the same direction), which improves the guidance of the flame by means of the degree produced, creates the attractive play of flames typical of the El Carbonero.

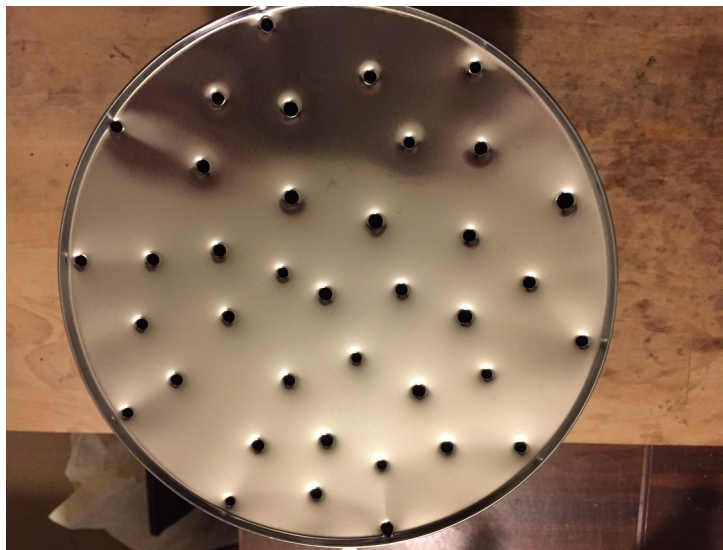


Now take the centre punch and widen the holes to about 8mm.



Primary air holes:

Punch holes in the floor with the spike or a nail so that it looks something like this:



The size of these holes is crucial for how the pyrolytic cooker will function later. If the holes are too small, there will not be a good air flow when you light the stove. This makes firing very difficult. If the holes are too large, more ash than necessary is produced and the burning time is shortened. The optimal size also depends on the fuel

that will be used later: The denser the fuel used in the cooker, the larger the holes should be, the larger the holes should be. Denser fuel will require larger holes. Therefore it is best, at first, to make small holes and to test these. If lighting takes too long to light the cooker and the flame is too small afterwards, enlarge the holes a little until the cooker works satisfactorily.

Outer can:

For some cans, the bottom can be cut out with a conventional can opener, for others you need a safety can opener, it all depends on the height of the edge. A safety can opener is needed from about 7mm.

Take the safety can opener and use it to cut out the bottom. The important thing is: hold the opener firmly together and finish the process in one go. This requires a little strength, but if you interrupt the process there is a risk that you will not be able to re-apply the can opener at the place where you left off.

The cake racks:

One cake rack supports the cooking pot. The other cake rake ensures that the cooker draws air from below.

Warning:

Please always operate the cooker outdoors! It is not suitable for use indoors.

Please pay attention to the sharp edges on the holes for the combustion chamber. These edges enable better combustion, but you should therefore not reach into the inner can without protective gloves!

Structure of the cooker:



9.1. Preparation and how to operate the El Carbonero L

First, fill the cooker below the secondary air holes with wood. Always make sure that these holes remain free.

Afterwards, thinner branches can be placed on top of the wood. These promote ignition, as we need a surface heat of 270 degrees.



Then add candle wax, which has proven to be a good material for kindling. Finally, complete the combination of combustive material with newspaper. To achieve a higher temperature, we crumple up half a page of newspaper. Now the cooker can be lit.



Also make sure that the secondary air holes do not get clogged with newspaper. A tip: A tip: use a stick to compress the newspaper below the level of the holes.

Light the fire:

Now light the newspaper, depending on the type of wood and wind conditions, the pyrolysis should start after 2-4 min. You will recognise pyrolysis when jets of flame come out of the secondary air holes.

When the pyrolysis is stable, the outer can is placed over the inner can.



Cooking:

Now you can start cooking.

Place the second cake rack on the outer can and place a pot, pan, etc. on the cake wire. Please note, whatever pots, etc. you use, should not have a non-stick layer as this will melt.

Extinguish:

Since you want to create charcoal with the cooking process, only extinguish the cooker when the pyrolysis breaks down. Do not extinguish the stove when you have finished cooking. This would result in uncharred pieces of wood remaining in the cooker. Let the flame go out by itself. When it does, use gloves to remove the outer can.

There are various possibilities for extinguishing the fire. Three should be mentioned here. The first two options are particularly suitable if you want to use the charcoal as vegetable charcoal. It then becomes more porous, has more inner surface and is easier to crush.

1.) You can extinguish the charcoal by pouring water directly into the inner can. This is convenient, but puts a lot of strain on the inner can. Then you empty the cooled charcoal onto a baking tray and spread the charcoal out on it. Make sure that no pieces of charcoal are glowing.

Caution: The inner can is very hot after cooking! So use gloves when handling the outer can and only handle the inner can with gloves after the charcoal has been extinguished.

2.) You can use tongs to grab the inner can and pour it out onto a baking tray. Then extinguish the charcoal on the baking tray and spread the charcoal on it. Make sure that no pieces of charcoal are still glowing.

Caution: The inner can becomes very hot! Do not touch the inner tin until it has cooled down.

3.) If you want to use the charcoal for barbecuing or to heat something, empty the contents of the inner can into another can using tongs. Close the can securely with a lid (no oxygen should get to the charcoal).

Contact details: E-Mail: info@el-carbonero.de

10. HOW TO BUILD AN EL CARBONERO XL

Materials:

To build a pyrolysis cooker you need the following materials:

can: a 30 L tinfoil bucket approx. 41 cm high; approx. 31.5 cm diameter.

2 circular cake racks: approx. 44.5 X 34 cm; 2 cm high.

Tools:

A hammer, a thorn, a mandrel, a length of wood 32,5 cm long, 4x4 cm square.

You can't cook with the XL because the flames are too big, but you can produce about 10 kg of vegetable charcoal with it.

can:

Secondary air holes:

The holes are made at a height of approx 32 cm measured from the base of the can. The distance between the holes around the inner box should be approx 5 cm. Use the length of wood as reinforcement when you punch the holes. Place slightly below the holes to be punched to avoid going directly into the wood.



Use the mandrel to punch the holes. First, straight from top to bottom.



In a second step, knock the holes at an angle (all holes in the same direction), which improves the guidance of the flame by means of the degree produced, creates the attractive play of flames typical of the El Carbonero.

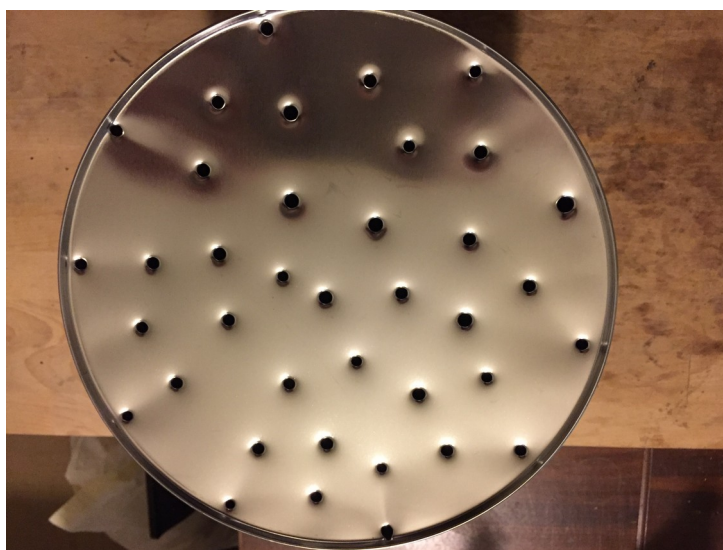


Now take the centre punch and widen the holes to about 8mm.



Primary air holes:

Punch holes in the floor with the spike or a nail so that it looks something like this:



The size of these holes is crucial for how the pyrolytic cooker will function later. If the holes are too small, there will not be a good air flow when you light the stove. This makes firing very difficult. If the holes are too large, more ash than necessary is produced and the burning time is shortened. The optimal size also depends on the fuel that will be used later: The denser the fuel used in the cooker, the larger the holes should be, the larger the holes should be. Denser fuel will require larger holes. Therefore it is

best, at first, to make small holes and to test these. If lighting takes too long to light the cooker and the flame is too small afterwards, enlarge the holes a little until the cooker works satisfactorily.

Warning:

Please always operate the cooker outdoors! It is not suitable for use indoors.

Please pay attention to the sharp edges on the holes for the combustion chamber. These edges enable better combustion, but you should therefore not reach into the inner can without protective gloves!

Structure of the cooker:



The cake rack is placed under the combustion chamber to supply the combustion chamber with air from below.

For commissioning see the description of El Carbonero L.

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