Carbon Zero®

Biochar Production Technology

Hello,

Thanks for your inquiry.

We currently offer both small to medium scale biochar batch kilns, as well as engineering services to design and manufacture larger capacity biochar production facilities.

The smaller scale batch kilns come in 3 models, 100-MK1, 100-MK2, and 500-MK1, producing from about 100 kgs of biochar per batch up to 750 kgs per batch if wood is used as the feedstock. The 100-MK1 can process only split wood, whereas the other models can process a much wider variety of feedstocks. Prices for these batch kilns range from about 7500 Swiss francs to 75,000 Swiss francs, excluding shipping. On-site training is also offered.

We can also develop customized manufacturing plans to your specification for larger capacity biochar production facilities from one of the models listed below, specifically either the horizontal bed unit, intended for continuous operation 24/7, or the tilting batch kiln, intended for larger capacity batch processing. Either plant can be scaled in terms of capacity, and the horizontal bed unit can be configured to produced a wide variety of co-products, including wood vinegar, essential oils, terpenes, and energy, either in the form of clean burnable syngas that can act as a replacement for natural gas for heating or manufacturing processes, or electricity produced by a genset that burns the syngas. The horizontal bed unit offers the highest potential for financial feasibility and profitability, even if revenue from biochar is uncertain, or the local market for biochar would need to be developed.

Details of the kilns and engineered biochar production facilities follow:

Pre-manufactured Kilns

Batch Kiln 100-MK 1

Batch time – around 8 hours
Moisture content – up to 40%
Feedstock size – logs, up to 30cm in length and 10cm in diameter
Feedstock type – Wood
Feedstock volume – 1.5m3
Fuel source – logs, up to 15cm in length and 5cm in diameter
Char yield – up to 100kg per burn
Infrastructure used – handheld leaf blower (provided with the kiln)
Price: ~ 7500 Swiss francs

Simple and easy to use, this kiln has a cylindrical body 1.2 meters high and 1.5 meters in diameter. The kiln has an internal combustor (firebox) which hangs from the lid and provides heat to convert the feedstock to biochar. It takes about 8 hours for a batch to be processed, depending on the moisture content, type and size of the feedstock.

The kiln is loaded from the top, and unloaded through a door at the bottom. A hand-driven winch is used to remove the lid for loading. After a burn, the kiln is left overnight to cool before unloading. A single batch can produce up to 100 kg of biochar.

The kiln runs on a two stage cycle. First the feedstock is dried, then it is charred. The design relies on air convection to distribute heat throughout the feedstock bed.

It is for this reason that feedstock is limited to split or small diameter wood. During the drying stage small logs are burned in the firebox to provide heat. As temperatures within the kiln rise to around 450 C, the feedstock releases syngas. Once syngas is available, it is burned in the combustor to maintain suitable charring temperatures.

The kiln is transportable on a small trailer. It is therefore likely that in most areas, planning permission would not be needed. It does however produce some steam and smoke, so it is advisable to locate it away from buildings and people. The kiln does not need electricity to run. It uses a leaf blower included with the kiln to supply air to the internal combustor.

Batch Kiln 100-MK 2

Batch time – from 3 to 10 hours
Moisture content – up to 60%
Feedstock size – wood shavings or rice husk, up to 30cm length logs
Feedstock type – most biomass
Feedstock volume – 1.5m3
Fuel source – logs, up to 15cm in length and 8cm in diameter
Char yield – up to 100kg per burn
Infrastructure used – 3 electric fans and a generator (provided with the kiln)
Price: ~ 25,500 Swiss francs

The MK 2 is a small-scale biochar kiln capable of processing a wide range of different materials. Process temperatures can be controller to an accuracy of within 25 degrees C. These 2 factors combined make it an excellent choice for trials and research. As with the MK 1, the cylindrical body is 1.2 meters high and 1.5 meters in diameter, and it has an internal combustor (firebox) to provide the heat necessary to convert the feedstock to biochar.

The MK 2 has been tested on a wide range of feedstocks including wood shavings, woodchip, logs, rice husks, coffee husks, rush and wetland reed. The kiln can process feedstocks up to 60% moisture content. The length of a given batch varies significantly, depending on the moisture content, type and size of the feedstock used.

The kiln is loaded from the top, and unloaded through a door at the bottom. An electric winch is used to remove the lid for loading. After a burn, the kiln is left

overnight to cool before unloading. A single batch can produce up to 100 kg of biochar.

The kiln runs on a two stage cycle. First the feedstock is dried, then it is charred. The kiln acts as a steam drier during the first stage, using 3 electric fans to force steam through the feedstock. One key factor as to whether a feedstock is suitable for use in the kiln is the porosity of the feedstock bed. The fans must be able to force the steam to flow through the material. During the drying stage small logs are burned in the firebox to provide heat. As temperatures within the kiln rise to around 450 C, the feedstock releases syngas. Once syngas is available, it is burned in the combustor to maintain suitable charring temperatures.

The kiln is transportable on a small trailer. It is therefore likely that in most areas, planning permission would not be needed. It does however produce some steam and smoke, so it is advisable to locate it away from buildings and people. The kiln does need electricity to run, however it is supplied with a suitable generator in case supply from the electricity grid is not available.

Batch Kiln 500-MK 1

Cycle time – variable, up to 8 hours
Moisture content – up to 60%
Feedstock size – from rice husk, wood shavings and wood chip up 30cm length logs
Feedstock type – most types of biomass
Feedstock volume – two kiln bodies or retorts of 6 cubic meters each
Fuel source – woodchip
Char yield – up to 750 kg per cycle (per 6 m3 retort)
Infrastructure used – 4 electric fans and a generator (provided with the kiln)
Price: ~ 75,000 Swiss francs excluding shipping

The 500 series batch kiln is a commercial unit that produces up to 750 kg of biochar per burn. The kiln is built in to a 20 ft container which allows it to be transported anywhere a truck can reach.

The kiln consists of two kiln bodies (retorts) with a capacity of 6 cubic meters each, and a central combustor or burner that provides heat to both. The kiln uses a two stage process: the first stage dries the feedstock, while the second stage pyrolyzes the feedstock into biochar. The retorts are processed in alternate cycles so that excess heat from the active retort is used to dry the feedstock in the inactive retort (and possibly initiate pyrolysis if 24/7 operation is desired). In this way, the kiln

reduces the external fuel requirements for the drying of feedstock, thus making the processing of wet materials much more viable.

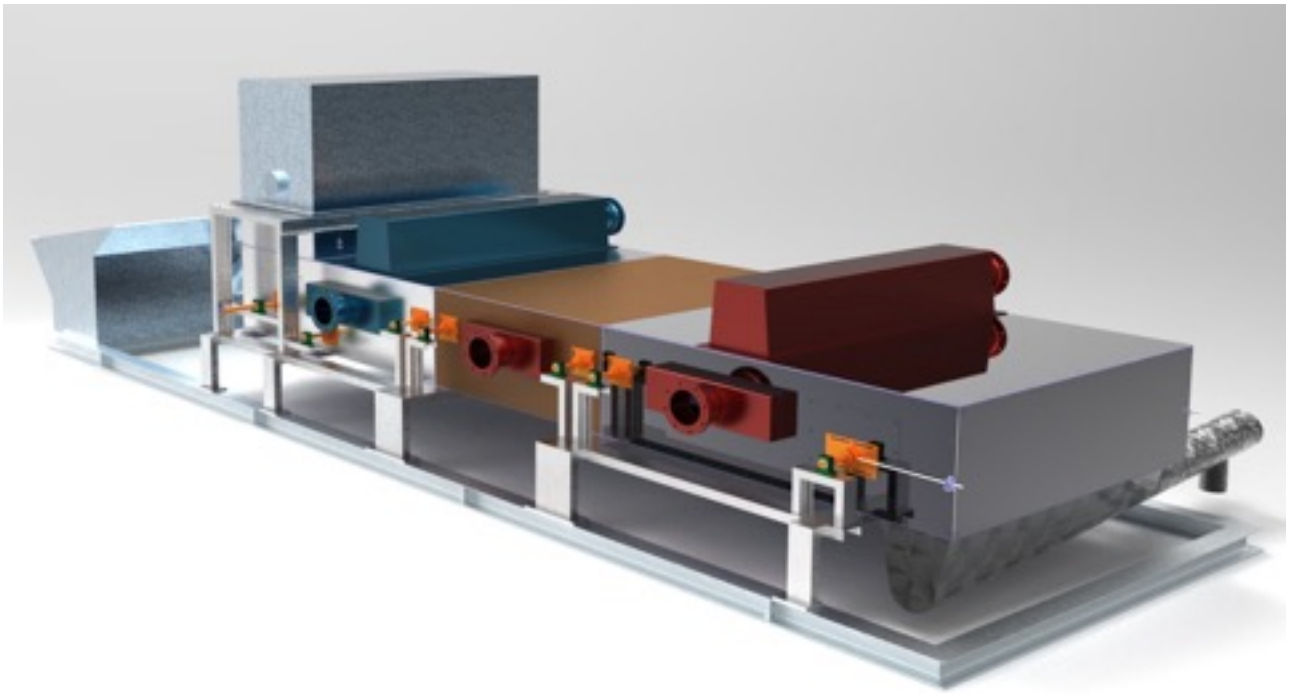
If there is a gap in the symmetry of the process in which syngas is not available to produce needed heat, the central burner automatically reverts to burning woodchip. The central burner also burns woodchip to perform a cold start of the kiln until there is sufficient syngas being produced.

This kiln can process a wide range of feedstocks including wood shavings, woodchip, logs, rice husks, coffee husks, rush and wetland reed, up to 60% moisture content. The burn time can vary dependent on the moisture content, type and size of the feedstock used. Process temperatures can be controlled to an accuracy of within 25 degrees C.

Large Capacity Biochar Production / Bio-Refineries

Engineered manufacturing plans are developed to your specification of feedstock, throughput and accessory processes requested. This approach allows us the flexibility to develop a solution that will meet your unique needs. We can also have units manufactured, and provide general consulting or assistance in the commissioning phase, but it should be understood that only a local engineer would be licensed to commission the unit, and your local engineering firm will need to review and perhaps modify the plans before you go ahead with manufacture to ensure the unit will meet local regulations. We have 2 designs that are developed and engineered to the stage that they are ready to manufacture:

1) a horizontal bed continuous feed unit:



The above unit can be used for a variety of feedstocks, it has a pre-dryer, incorporates the ability to closely control process parameters of temperature and residence time. It will a) produce biochar from nearly any feedstock b) condense wood vinegar from the raw syngas stream, c) crack and filter the raw syngas remaining after the condensation step to produce a clean mixture of hydrogen and carbon monoxide, known as syngas, and d) optionally burn the syngas to generate electricity. Syngas can also be used as a replacement for natural gas or propane for heating purposes.

The challenge we are attempting to address with this system is to maximize the potential for profitability, in particular by monetizing the gas stream in the most economical way possible. In this regard, we have developed a very inexpensive catalyst to crack the syngas for this device. We estimate that the revenue from the combined products of biochar, wood vinegar and electricity should recoup the investment cost for this unit within approximately 4 - 6 months of operation.

This biochar kiln is manufactured in a modular fashion, in 3 main sections, and its throughput capacity can be easily increased by adding units to the mid-section to make it longer. Its functional capacity can be enhanced by adding sections to fractionate the condensate yield, producing essential oils or chemicals like terpenes for instance. A section can also be added to the end to convert the char to activated char. The feedstock stream required for the lowest capacity unit would be about 16 tonnes of wood chip (@ 20% moisture content) per day. The unit is intended to run 24/7. Once started, this kiln is self-sufficient in terms of energy. Startup is accomplished with either natural or bottled gas.

The lowest capacity plant will produce, per day, about 4 tonnes of biochar, 2500 liters of wood vinegar, and (optionally) 8400 kWh of electricity. We conservatively estimate revenue per day to be $150 x 4 for the biochar, $1 x 2500 for the wood vinegar, and $ 0.05 x 8400 for the electricity, 600 + 2500 + 420 = $3520 per day. Note that the rate paid for electricity is often at least double the above estimate. The kiln will cost, very approximately $300,000, and the optional motor genset designed to run on cracked syngas will cost approximately $450,000 - $550,000.

Heat energy to dry and pyrolyse the feedstock is provided by flaring a portion the syngas produced and/or recycling waste heat from the reactor and genset. The unit requires a relatively small amount of electricity to run the blowers, feed mechanisms and control electronics. Hence once it reaches operating conditions, it is entirely self-sufficient in terms of energy.

2) a tilting batch kiln designed to process sticks and split wood:

The above horizontal bed unit is designed to be run 24/7, like a manufacturing plant, whereas the batch kiln is designed to be run intermittently. The tilting mechanism allows for easy loading and unloading. It is also possible to configure 3 units in a round robin fashion so that the excess heat from one is used to start the pyrolysis process in another. These units require no electricity, but there is more manual labor involved in preparing the feedstock, loading and unloading the units.

If you have further questions, please contact me by email, phone or Skype.

Nando Breiter

CarbonZero
Via Rompada 40
6987 Caslano
Switzerland

+41 (0)91 600 9601
+41 (0)76 303 4477 cell
skype: ariamedia