FIGHTING CLIMATE CHANGE WITH FOOD

A carbon negative protein solution achieved with biochar

SCOPE AND TAKEAWAYS

- Can we make carbon negative plant protein?
- Oregon Dulse plans to upscale to 400 million pounds of protein production annually, leaving 400 million pounds of waste biomass available.
- Carbon sequestration achieved via slow pyrolysis of biomass; a variable reaction with controlled outputs.
- Pyrocal CCT 18 reactor configuration is the heart of the process, providing variable operation bias for carbon product or heat yield.
- Preliminary designs show the process is carbon negative and produces excess energy.
- Sustainable protein produced holds high market value ensuring large scale economic viability.
- Special thank you to Chuck Toombs, project sponsor.
- More Questions? Feel free to ask us privately!

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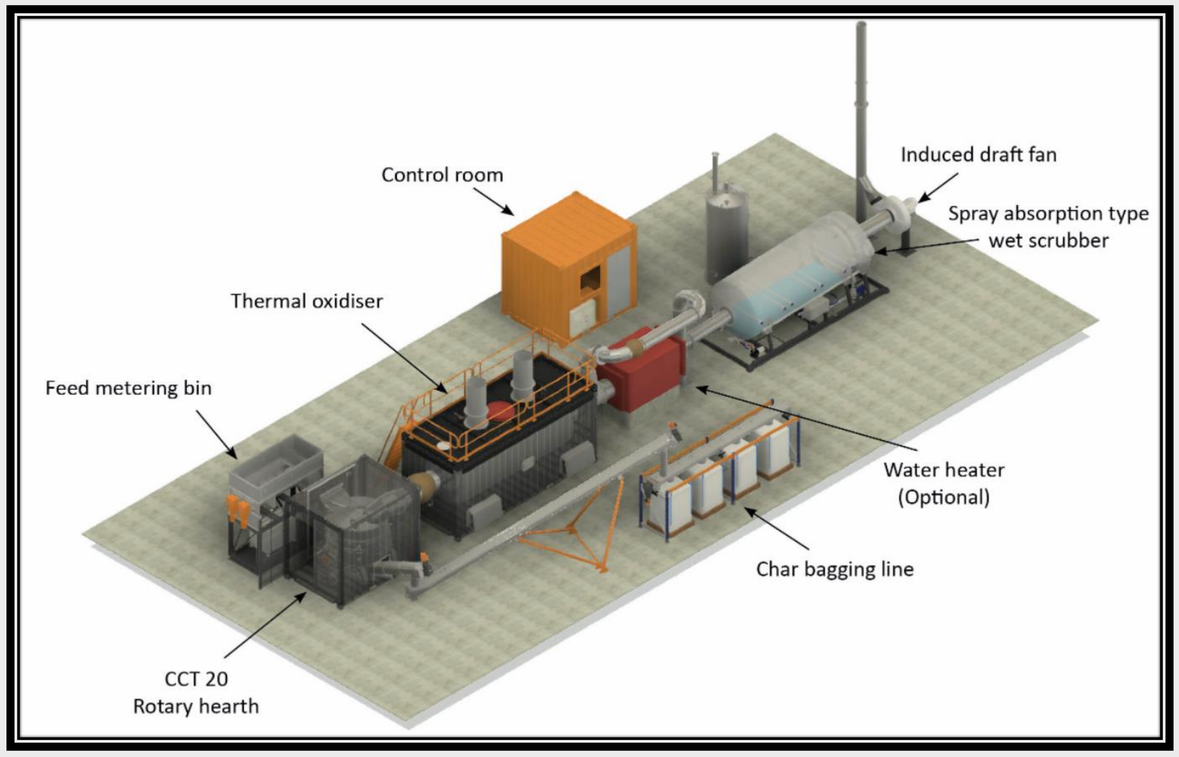

BIOCHAR: WHAT IS IT?

- Biochar is a porous and carbon rich material produced from burning organic waste under low oxygen conditions. Biochar is a possible solution to global waste issues, while also having potential as a commercial product.
- Biochar improves plant growth when added to fertilizer, giving it economic viability in the agricultural industry. Furthermore, the bio-oil and gasses produced in the pyrolysis reaction are combusted to produce energy.
- Biochar production is a promising operation which combats climate change by sequestering carbon. Carbon sequestration is a process by which carbon dioxide is removed from the atmosphere and contained in a stable form.

OUR PROCESS

- The team proposes slow pyrolysis with a temperature of 450°C, a dry wood to dry seaweed feed ratio of 4:1, and a residence time of one hour. These conditions produce a high yield of carbon rich biochar, ensuring significant carbon sequestration and high energy output.
- A three-stage autothermal kiln reactor automatically transfers biomass through all stages during pyrolysis, producing biochar and biofuel.
- Following the reactor is a thermal oxidizer which combusts remaining biofuels producing excess energy.
- Combusted gas travels to a heat exchanger to produce steam for use throughout the plant. Finally, gas is cleaned in a wet scrubber then exhausted to atmosphere.

ENERGY AND CARBON BALANCE

- The pyrolysis process feed uses a ratio of 1 kg dry seaweed to 4 kg dry wood, input at moisture contents of 80% and 27% respectively. The resulting bio-oil and gas products-carbon monoxide, methane, and hydrogen-are combusted with stochiometric air.
- This feed ratio results in a 1.2:1.0 kg carbon sequestered to kg carbon emitted ratio, a net negative result.
- The life cycle carbon dioxide emission equivalent is 77 grams CO_2 per kWh, which is competitive with solar and significantly better than coal.
- The energetic process involves heating, reacting, combusting, and cooling biomass feed and pyrolysis products.
- The process produces an excess of 69,000 kJ per kilogram of dry seaweed feed.

The figure below depicts energy values in kJ as determined by the team