BIOFORCETECH

Sigma-One Specs
2026 v3



Introduction

The Sigma-One Hybrid Pyrolysis System revolutionizes organic waste management. With its compact design, precise temperature control, and fully automated process, the **Sigma-One machine is set to be the most advanced pyrolysis system on the market**. The name “Sigma” refers to the strongest type of covalent bond, formed between carbon molecules during the pyrolysis process. These bonds are measurable, verifiable, and anchored, resulting in a securely fixed carbon product.

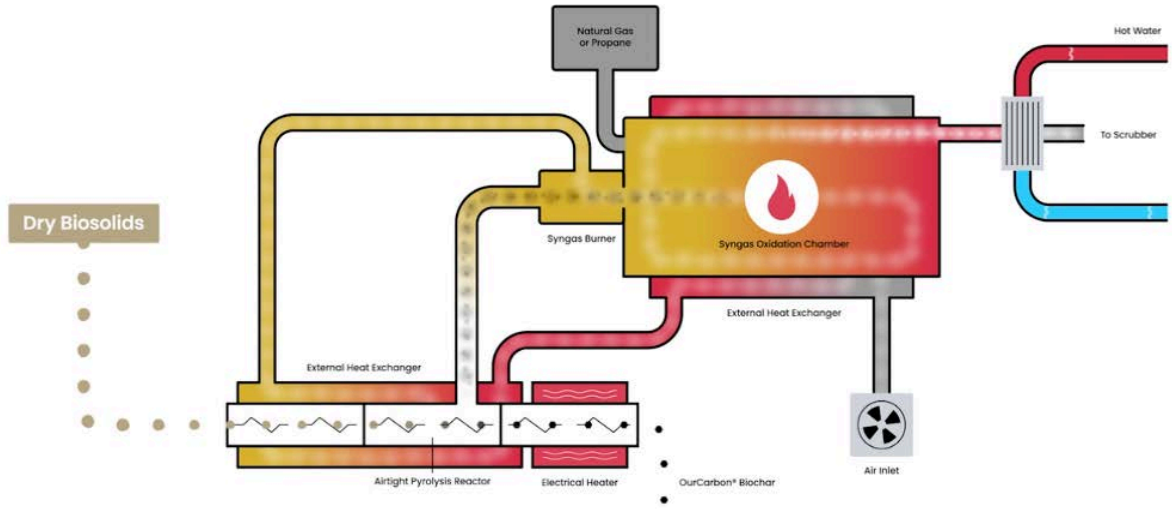
What is Hybrid Pyrolysis

Hybrid Pyrolysis is a proprietary technology by Bioforcetech that enables continuous organic waste carbonization at scale with scientific precision.

The reactor’s unique design receives heat from two sources: superheated fluid powered by exhaust gas and electrical resistors.

1. The **superheated fluid provides most of the heat** by recovering energy from the exhaust gas produced during pyrolysis, bringing the Sigma-One to its minimum operating temperature.
2. Electrical resistors elevate the temperature with **precision to maintain exact operating parameters**.

The combination of these two heating methods delivers consistent temperature and residence time without requiring high levels of external energy.



Advantages

Sigma-One has been designed to ensure continuous operation, simplicity of use, and effortless installation. The primary advantages include:

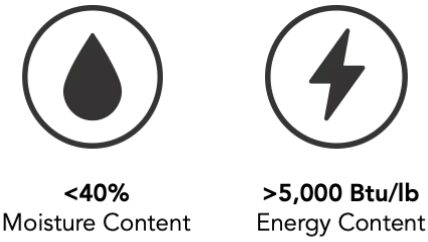
Design	Modular units
	Compact, Skid mounted design
	Multiple feedstock capability
Contaminants	Zero production of tars or bio-oil
	PFAS - CECs elimination
	High Quality Output
Operation	Fully automated system
	Automated feedstock variations adjustments
	+/- 2°C Pyrolysis temperature control
Energy	Low energy consumption
	Up to 150kW of hot water production
	Automated energy optimization



Feedstock requirements

The Sigma-One machine is designed to process many types of organic materials including biosolids, nut shells, wood chips, yard waste, paper waste, industrial sludges, manure, agricultural residues, and more. To ensure successful carbonization, input materials must meet the following characteristics:

Max particle size	max 15mm in any direction*
Min particle size	90% shall be > 1mm
Energy content (LHV)	> 9.5 MJ/kg (5,000 Btu/lb) **
Sulfur content	< 4% on dry basis
Max moisture content	< 40%* (< 25% for Biosolids)



* These parameters may vary depending on the feedstock. Different dimensions can be evaluated by our engineering team.
** Lower values might be accepted. Contact our engineering team for a personalized evaluation

Allowed feedstocks can include:

- Digested municipal sludge / biosolids
- Undigested municipal sludge / biosolids
- Industrial digestate / sludge
- Paper mill sludge
- Nut shells
- Wood chips
- Agricultural waste

To verify product compatibility, please contact our engineering team for a personalized evaluation.



Process specs

Process type	Continuous process (24/7)
Input capacity	Up to 100 kg/h* (220 lb/h)
Max Biochar production	Up to 45 kg/h* (100 lb/h)
Output Biochar temperature	< 65°C (< 150°F)
Bio-oil production	None
Expected yearly operating hours	Up to 6,800 hours/year

**Dependent on feedstock energy and moisture content*

Energy production	Up to 150kW (hot water at max 93°C)
Reactor set-point	500 - 650°C (930 - 1200°F)
Residence time	Can be set between 8 to 30 minutes
Electrical Heaters Consumption	0.8 - 0.16 kWh/kg of input material (0.04 / 0.8 kWh/lb)
Startup fuel	Natural gas or propane
Startup fuel usage	~20,000 kWh / year (~70 MMBTU/year)

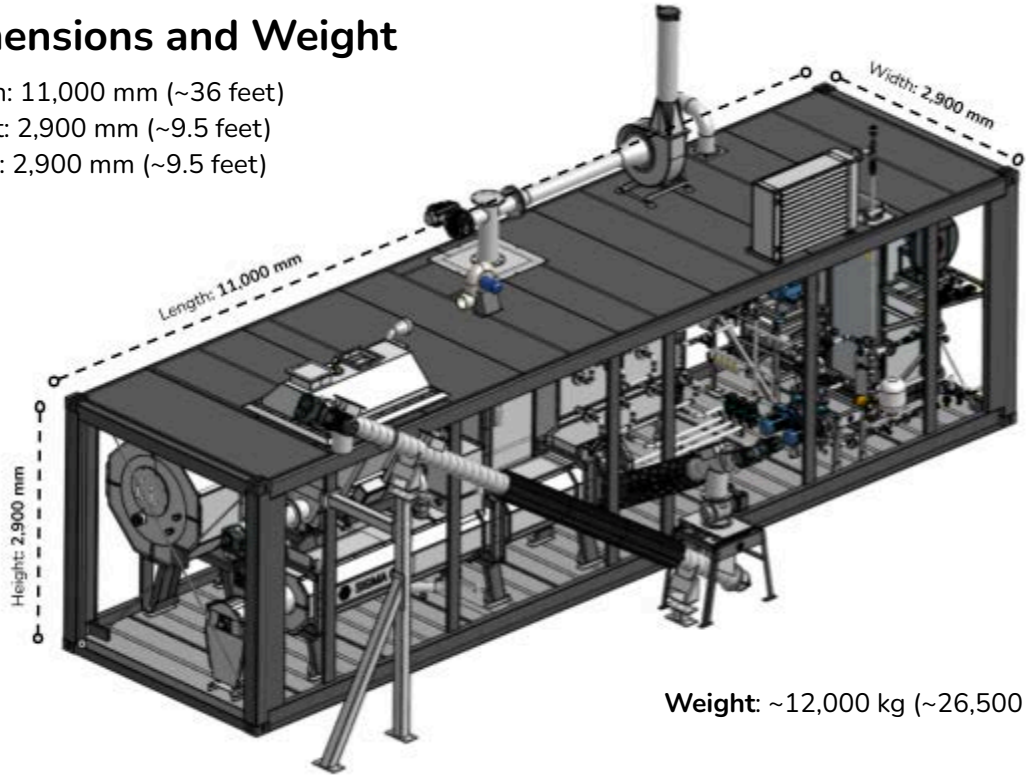
Utilities required

All utility connections are conveniently located in one area of the unit, simplifying integration.
Required utilities:

Electricity	3 Ph, 400-480V, 50-60Hz, 125A Braker
Water	3/4 inch, between 2 and 5 Bar (30 and 70 psi) with guaranteed peak flow of 37 lpm (10 gpm)
Compressed air	1/2 inch. Dry compressed air with pressure between 7 to 8 bar (100 - 115 psi)
Waste water discharge	2 inch pipe. Max discharge flow rate 100 lpm (26 gpm)
Natural gas or propane connection	3/4 inch NPT. Pressure between 75 and 150mBar (30 to 60 inch of water) Nominal power 90kw (0.4 MMBtu)

Dimensions and Weight

Length: 11,000 mm (~36 feet)
Height: 2,900 mm (~9.5 feet)
Width: 2,900 mm (~9.5 feet)

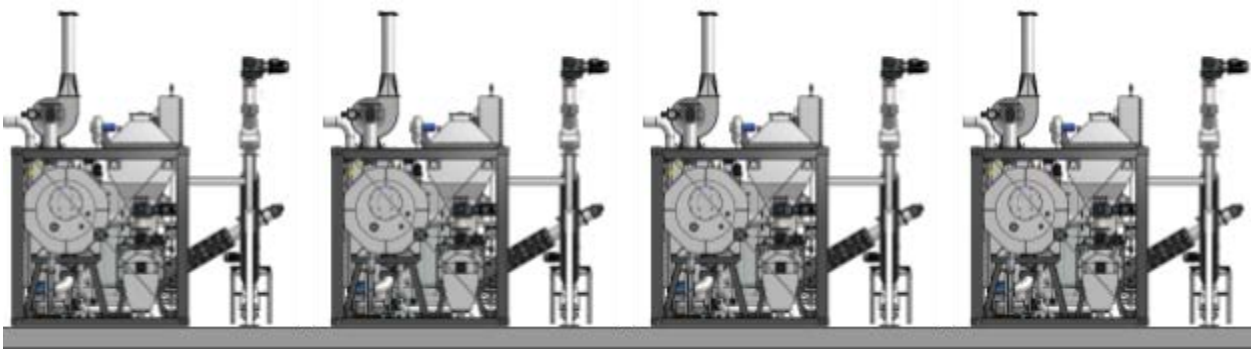


Weight: ~12,000 kg (~26,500 lbs)

Site installation

The Sigma-One unit is designed with modularity and ease of integration in mind, allowing for straightforward installation within existing facilities. No major civil infrastructure is required beyond a basic cement pad and a light protective cover to shield the equipment from rain, snow, and direct sunlight.

The system is engineered to operate in outdoor environments with temperatures ranging from –5 °C to 35 °C, eliminating the need for an enclosed building under most conditions.



Automation and process control

The Sigma-One integrates advanced Industry 4.0 automation with IIoT. With more than 40 sensors, the system is controlled with **scientific precision to ensure maximum performance**. The automation HMI is accessible via web browser with secure local and remote access, enabling control from smartphones, tablets, PCs, or Macs.

A built-in data-logging system records process data every second, **generating charts and reports for efficiency analysis and predictive maintenance**. For facility integration, the system supports SCADA connections through standard protocols such as Modbus, and also provides a modern RESTful API with JSON output.

Emissions control

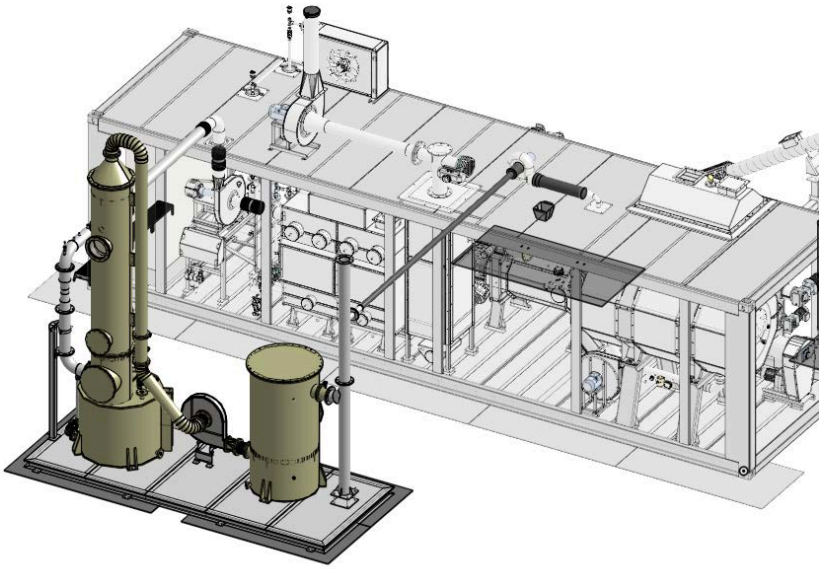
Ensuring clean emissions is crucial. The Sigma-One efficient syngas oxidizer is designed for CO and NOx control, while the integrated high-temperature HyperCyclone ensures low particulate emissions. If other emissions control devices are needed (for example for biosolids sulfur treatment), an additional treatment unit can be added to the machine.

Add-on emissions control unit for biosolids

Bioforcetech offers a treatment unit design specifically for municipal biosolids which includes a venturi evaporator, a caustic soda scrubber and an activated carbon filter. This abatement system comes on a skid and can be integrated seamlessly with the Sigma-One unit.

The add-on filter unit contains:

- Venturi scrubber
- Caustic Soda Wet Scrubber
- Activated Carbon Filter

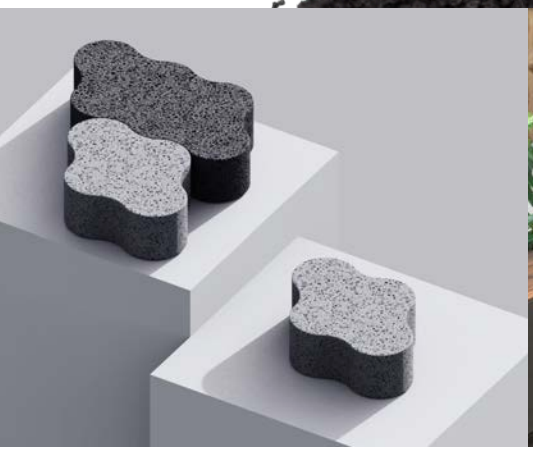


Output Material: Premium, OurCarbon® Biochar

The precision and intelligent control system results in a premium carbon material we call OurCarbon®. Markets for OurCarbon® have been built and developed by Bioforcetech's team so that our clients can enjoy 100% off-take for all of the biochar produced by a BFT Sigma-One machine.

With applications ranging from building materials to high fashion, OurCarbon® is utilized to replace fossil based materials in industry. For more info visit: https://ourcarbon.co









Contact

Reach out to receive more information on our technology at : info@bioforcetech.com

Bioforcetech HQ

938 Linden Avenue
South San Francisco, CA
94080
USA



Bioforcetech S.r.l.

Via Rio Vallone 17
Mezzago (MB)
20883
Italy

