Supercritical CO2 Oil Separation Using Triboelectric Electrostatic Extraction by Infinity Turbine

Infinity Turbine LLC

[TEL] +1-608-238-6001 (Chicago

[Email] greg@infinityturbine.com

https://www.infinityturbine.com/oil-extraction-from-co2-power-stream-by-infinity-turbine.html

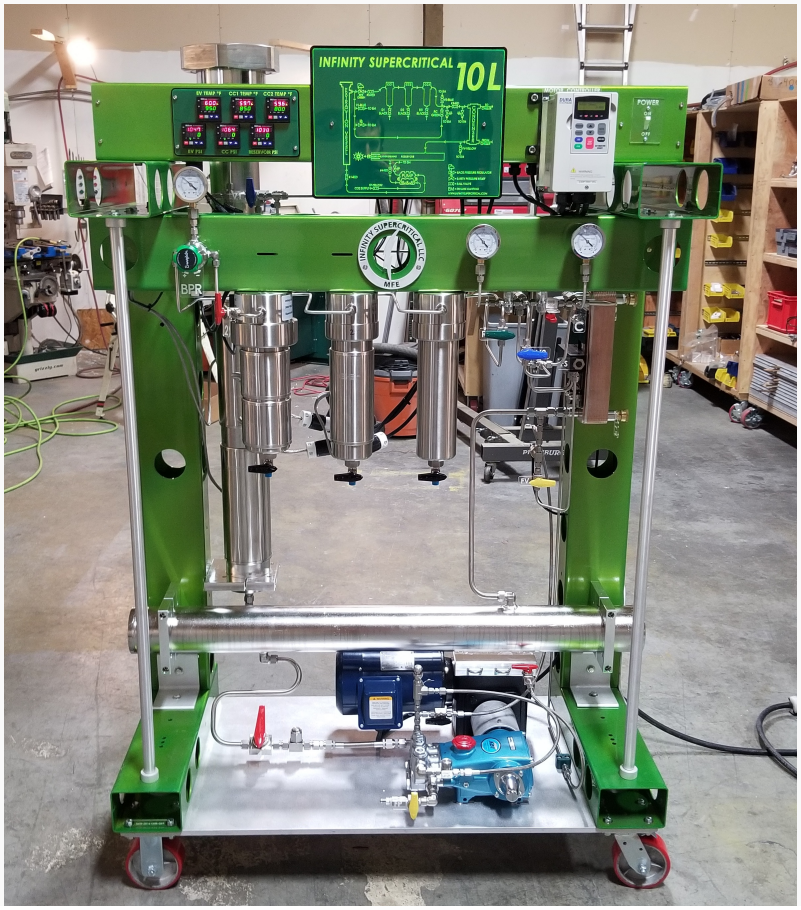
Learn how Infinity Turbine uses triboelectric charging and electrostatic precipitation to remove entrained oil from supercritical CO2 turbine systems without filters or pressure drop, improving efficiency and reliability.

This webpage QR code

PDF Version of the webpage (maximum 10 pages)

Electrostatic Separation for Closed-Loop CO2 Systems

Supercritical CO2 turbine systems rely on oil-lubricated bearings, but even trace oil contamination can degrade cycle efficiency and foul heat exchangers. Infinity Turbine introduces a novel CO2 extractor that removes entrained oil using triboelectric charge and electrostatic precipitation—without filters, membranes, or consumables.

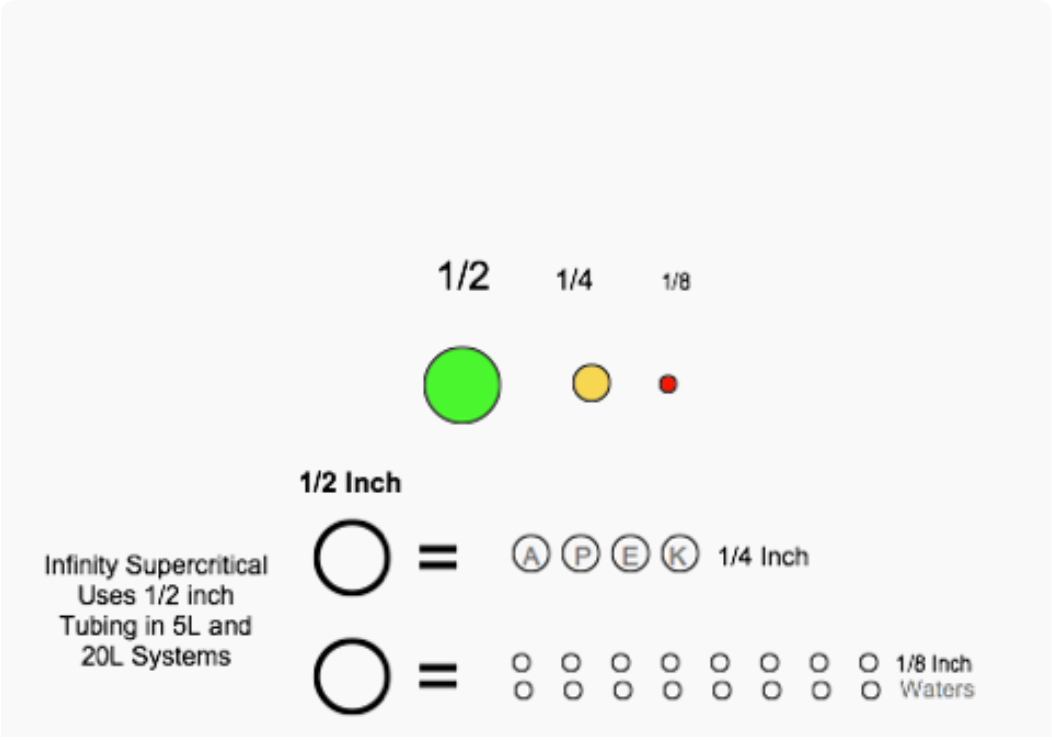


Larger Diameter Interconnection Tubing That Doesn’t Clog Using Supercritical CO2

In a closed-loop supercritical CO2 Brayton system, maintaining fluid purity is critical for long-term performance and reliability. Traditional oil separation methods, such as mechanical coalescers or filters, introduce pressure drops, maintenance cycles, and failure points. The Infinity Turbine CO2 extractor leverages triboelectric charging—generated by CO2 flow across engineered dielectric surfaces—to impart a charge differential between CO2 and oil droplets. This enables efficient electrostatic precipitation, continuously removing oil from the working fluid while preserving system pressure and flow continuity.

Larger Diameter Interconnection Tubing That Doesn’t Clog Using Supercritical CO2

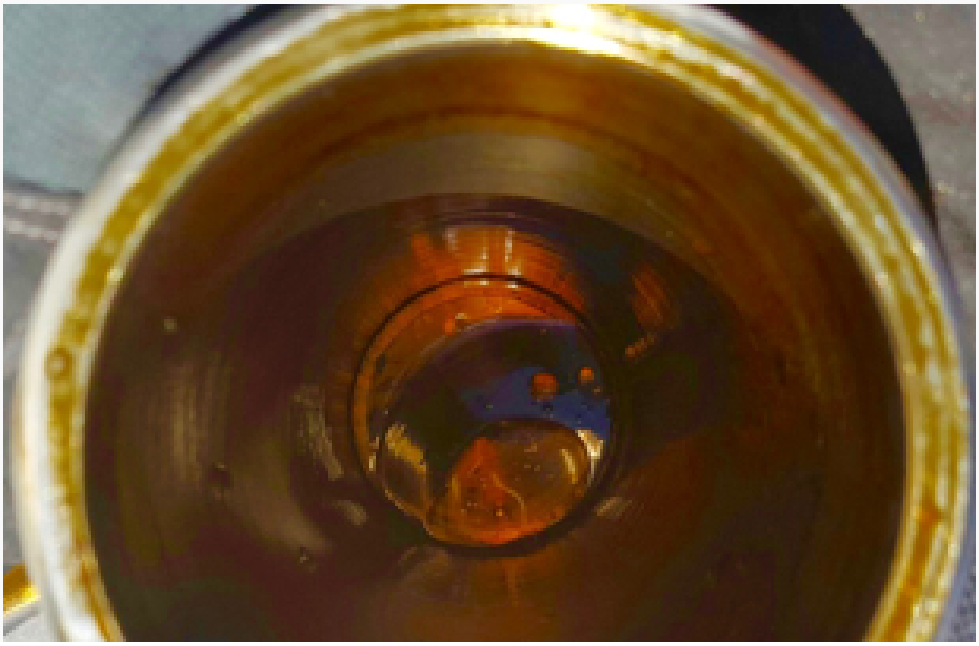
In a closed-loop supercritical CO2 Brayton system, maintaining fluid purity is critical for long-term performance and reliability. Traditional oil separation methods, such as mechanical coalescers or filters, introduce pressure drops, maintenance cycles, and failure points. The Infinity Turbine CO2 extractor leverages triboelectric charging—generated by CO2 flow across engineered dielectric surfaces—to impart a charge differential between CO2 and oil droplets. This enables efficient electrostatic precipitation, continuously removing oil from the working fluid while preserving system pressure and flow continuity.

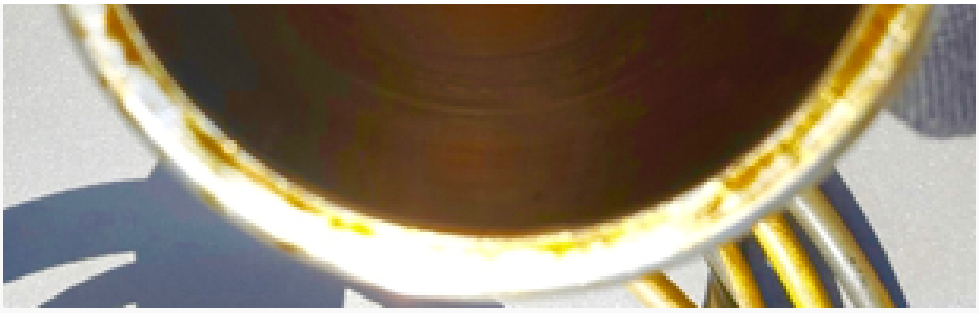


Eliminating Oil Contamination Using Pressure Drop Dynamics

A breakthrough in turbomachinery support systems: remove oil from supercritical CO2 without adding parasitic load or maintenance-intensive filtration.

Oil entrainment in supercritical CO2 loops originates from bearing systems, seals, and transient operating conditions. Even micron-scale oil droplets can accumulate in heat exchangers, reducing thermal transfer efficiency and increasing fouling risk. The Infinity Turbine electrostatic extraction process operates inline, using induced charge fields to attract and collect oil droplets onto charged surfaces. Unlike mechanical separators, this approach introduces negligible pressure drop and operates continuously, making it ideal for high-efficiency, high-uptime applications such as AI data centers and modular power blocks.





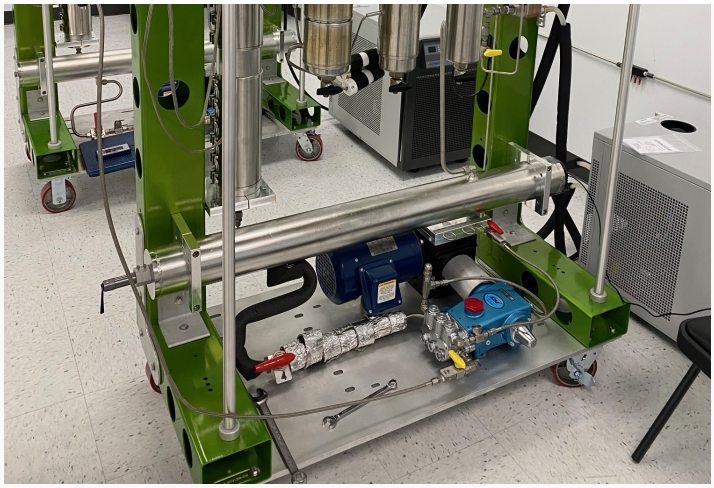
Triboelectric CO2 Charging as a Separation Mechanism

Using the physics of charge transfer, CO2 flow becomes the driver of its own purification.
The triboelectric effect—commonly observed in static electricity—is harnessed within the CO2 extractor to create a charge imbalance between the working fluid and entrained oil particles. As supercritical CO2 passes through specially designed surfaces, electrons are transferred, charging the fluid stream and suspended oil droplets differently. This differential charge allows for targeted electrostatic precipitation, where oil is drawn out of the flow and captured in a collection chamber. The process is passive, scalable, and inherently aligned with the high-velocity conditions found in supercritical CO2 turbine systems.

Designed for Supercritical CO2 Environments

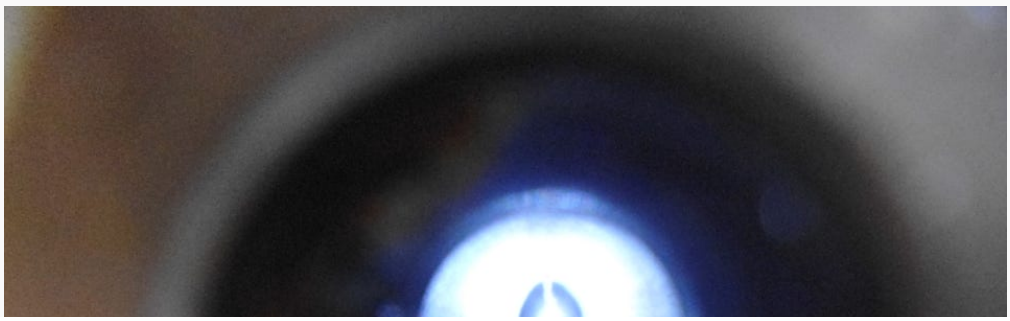
Built specifically for high-pressure, high-density CO2 cycles, where conventional separation fails.

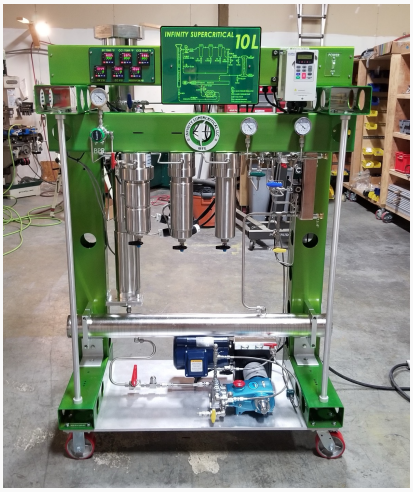
Supercritical CO2 operates at pressures often exceeding 20 MPa and exhibits unique fluid properties that challenge conventional oil separation technologies. The Infinity Turbine CO2 extractor is engineered for these conditions, using materials and geometries compatible with dense-phase CO2 flow. The electrostatic precipitation chamber is optimized to maintain laminar flow zones where charged oil droplets can be efficiently captured without disrupting the primary turbine cycle. This ensures compatibility with both compact modular turbines and large-scale cluster mesh architectures.



Sight Glass to View Supercritical CO2 in Action

Our systems use high pressure stainless steel sight glass viewports which allow you to see the CO2 in liquid or gas phase.

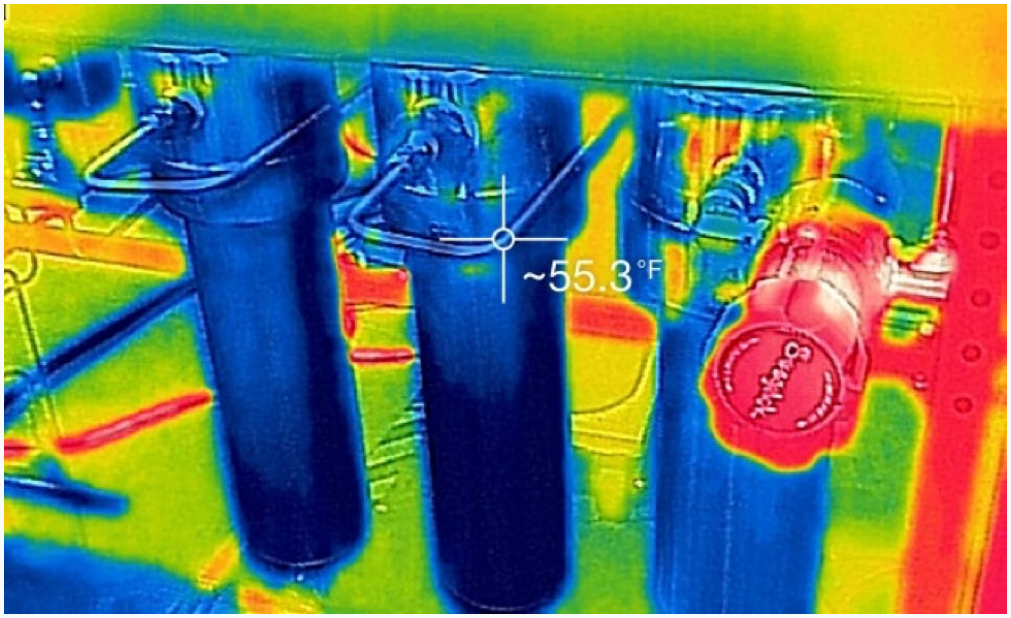




Maintenance-Free Oil Removal for Continuous Operation

No filters. No downtime. No consumables. Just continuous purification.

Traditional oil separation systems require periodic replacement of filters or coalescing elements, introducing downtime and operational costs. The Infinity Turbine electrostatic extractor eliminates these requirements by using a solid-state separation mechanism. Collected oil can be drained or recirculated without interrupting system operation. This makes it particularly advantageous for remote installations, containerized power systems, and data center environments where uptime and reliability are paramount.



Enhancing Efficiency and Extending Equipment Life

Cleaner CO2 means better heat transfer, higher efficiency, and longer component lifespan.

Oil contamination in a supercritical CO2 cycle reduces heat exchanger effectiveness, increases fouling, and can degrade turbine blade performance over time. By continuously removing entrained oil, the Infinity Turbine CO2 extractor preserves the thermodynamic integrity of the cycle. This results in improved heat transfer coefficients, reduced maintenance intervals, and extended equipment life. For high-performance applications such as AI data centers or combined-cycle systems, this translates directly into improved ROI and operational stability.

Scalable for Modular and Grid-Scale Systems

From kilowatt modules to multi-megawatt cluster mesh systems, electrostatic oil extraction scales with your architecture.
The modular design of the Infinity Turbine CO2 extractor allows it to be integrated into a wide range of system sizes, from small distributed generators to large-scale cluster mesh turbine arrays. Multiple extraction units can be deployed in parallel or staged configurations to handle increasing flow rates and oil loading conditions. This scalability aligns with the evolving architecture of supercritical CO2 systems, particularly in applications where distributed power generation and thermal management are combined.