Scalloped Tesla Disc Turbines with Supercritical CO2: A New Approach to Drag Reduction and Efficiency

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https://infinityturbine.com/infinity-turbine-turbucles-foil-design-tesla-disc-rotor.html

Explore the innovative application of tubercle-inspired scallop patterns on Tesla disc turbines using supercritical CO2. Discover how biomimicry and sCO2 density can enhance efficiency in next-generation power systems.

This webpage QR code

PDF Version of the webpage (maximum 10 pages)

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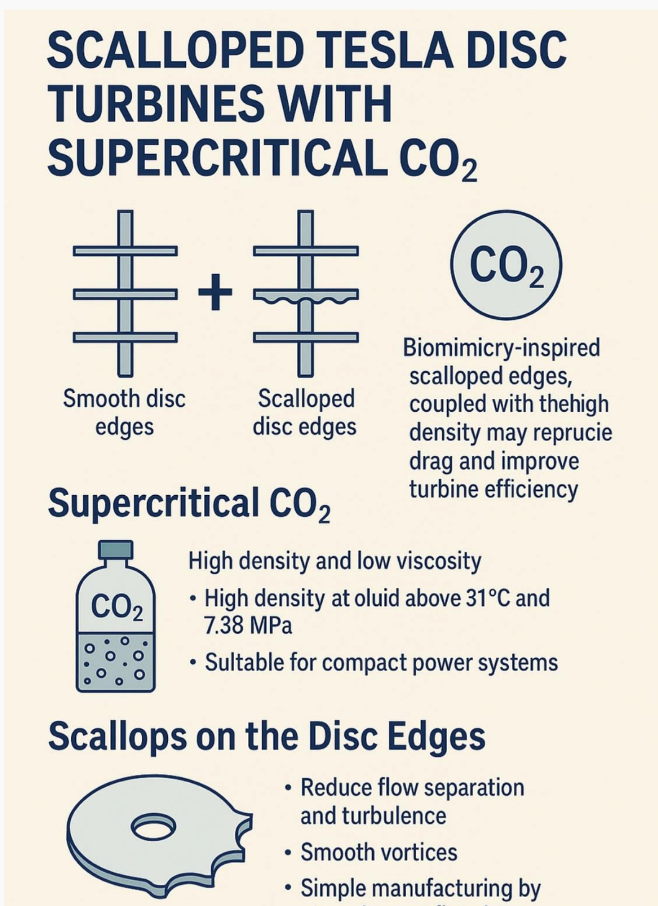
Could a simple scallop pattern make Tesla disc turbines more efficient? By combining supercritical CO2 and bio-inspired blade design, a new frontier in turbine optimization is taking shape.



Scalloped Tesla Disc Turbines with Supercritical CO2: A New Approach to Drag Reduction and Efficiency

The Tesla disc turbine, known for its simplicity and low-cost construction, uses smooth, parallel discs to transfer energy from a working fluid via boundary layer adhesion and viscosity. While elegant in theory, real-world efficiency can be hindered by turbulence, inefficient flow paths, and drag at high velocities. Enter the concept of biomimetic tubercles—specifically, scalloped patterns on the edges of the turbine discs—and the high-density properties of supercritical CO2 (sCO2) as a working fluid.

Leveraging Supercritical CO2

Supercritical CO2 is a dense, low-viscosity fluid that operates above its critical point of 31°C and 7.38 MPa. Unlike conventional steam or refrigerants, sCO2 offers high energy density, rapid thermal exchange, and a compact footprint for power systems. These properties make it ideal for use in closed-loop Organic Rankine Cycle (ORC) or Brayton-like turbine systems, including Tesla turbines where flow control is paramount.

Why Scallops on a Tesla Disc?

Inspired by tubercles on humpback whale fins, scallop-shaped protrusions or indentations on the edge of each disc could stabilize and direct the flow of sCO2 more efficiently through the narrow boundary layers between discs. These features are thought to:

Reduce flow separation and turbulence
Maintain smoother vortices and streamline flow paths
Improve torque transfer to the rotor shaft

Unlike traditional airfoil blades, Tesla discs are flat, and edge shaping is much easier to implement through stamping or laser cutting. The scallop geometry offers a simple, repeatable manufacturing method that does not disrupt the core architecture of the turbine.

Design and Manufacturing Simplicity

Standard Tesla turbines rely on stacking multiple flat discs on a central shaft. By pre-stamping each disc with a sinusoidal or scalloped edge, the entire turbine can be produced with minimal added complexity. Manufacturing can be done using CNC stamping, waterjet cutting, or die-forming techniques, particularly in high-temperature steels or titanium alloys suitable for sCO2 environments.

Key Advantages

Enhanced Efficiency: Flow conditioning reduces energy losses and increases rotational force.
Compact Design: Scalloping may allow fewer discs to achieve the same power output.
Low-Cost Fabrication: No precision blades or castings are required.
Compatibility with sCO2: High fluid density improves boundary layer adhesion.

Applications

This concept holds promise for:

Waste heat recovery systems in data centers and industry

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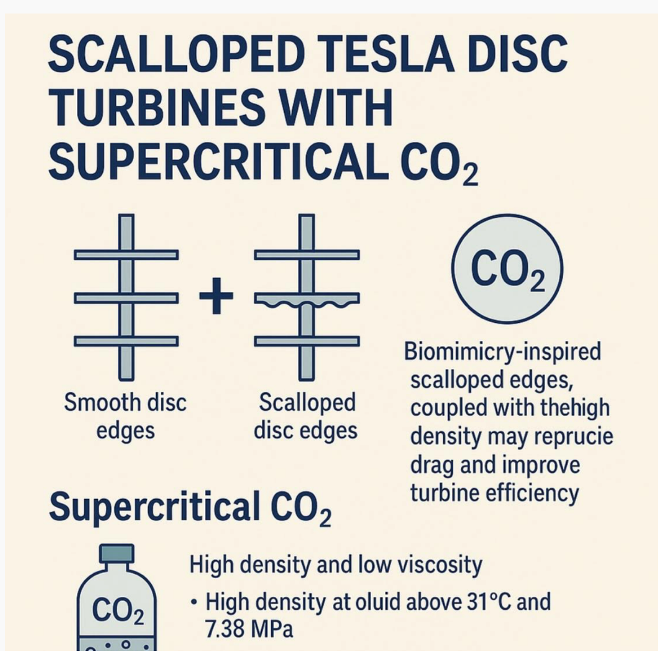
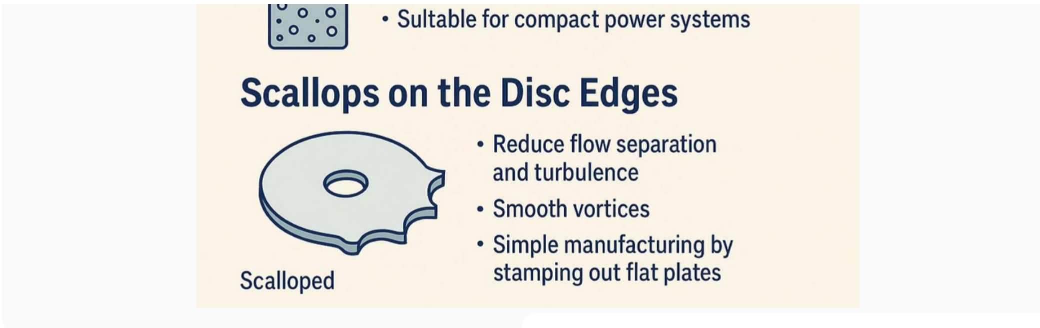
Compact geothermal or solar thermal power units


SCALLOPED TESLA DISC TURBINES WITH SUPERCRITICAL CO_2
Smooth disc edges
Scalloped disc edges
CO_2
Biomimicry-inspired scalloped edges, coupled with thehigh density may reprucie drag and improve turbine efficiency
Supercritical CO_2
CO_2
High density and low viscosity
• High density at oluid above 31°C and 7.38 MPa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Scallops on the Disc Edges
• Reduce flow separation and turbulence
• Smooth vortices
• Simple manufacturing by stamping out flat plates
Scalloped