small particle carbon generator

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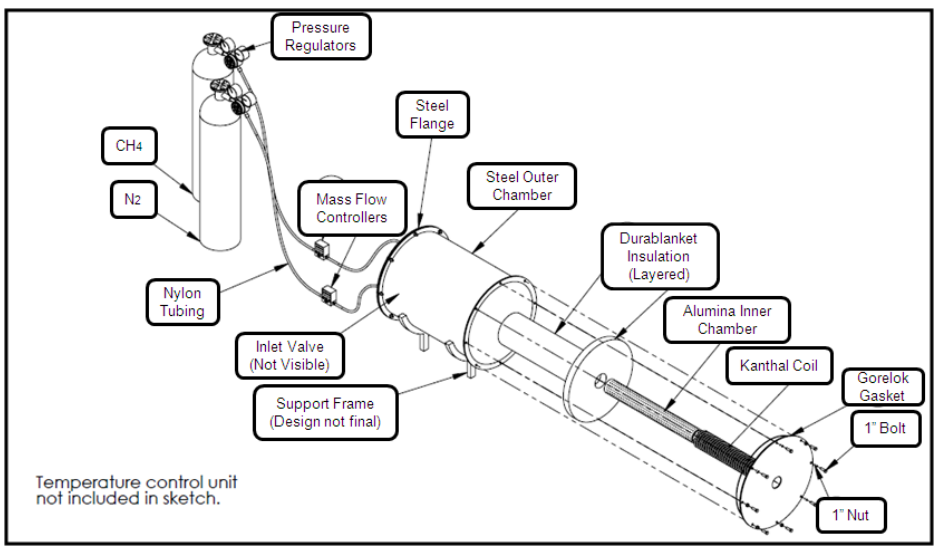


Q. what is a small particle carbon generator?

A small carbon particle generator pyrolizes methane gas, separating carbon and hydrogen molecules at high temperature under pressure.

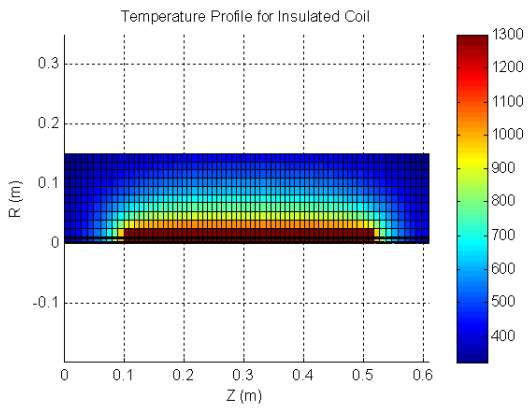
Q. what are the needs of the client?

Control of gas pressure and mass flow rates

Control of chamber temperature

Reaction must occur away from chamber walls

Minimal cleaning and maintenance under steady state operation



Temperature scale in Kelvin (Credit: Steve Ruther)

Q. for what is it used?

The carbon particles are suspended in pressurized air and used to absorb solar flux in a solar thermal power plant. As the carbon particles absorb energy they transfer heat to the surrounding gases, oxidizing in the process to form CO2 gases. The heated gases are expanded through a turbine in an open Brayton power cycle.

Q. why is this important?

ENERGY! With current growing global energy demands, new types of alternative energy production are need. Solar flux is most readily available and under-utilized energy source (1kw/m^2). A carbon particle Brayton power cycle has higher efficiency than current liquid-driven solar thermal systems.

final design description.

Inert gas (nitrogen) is pumped into an outer reaction chamber, passed over a heating element and diffused through an inner porous ceramic tube. Methane flows through this tube, reacting with the heated inert gas and creating a reaction away from walls.

design specifications.

Pressure: 5-10 atm (73.5 – 147 psi)

Temperature: 1000 °C (1832 °F)

Carbon Particle Density: 1 – 3 g/m^3

Residenc Time: ≤ 1 second

results.

A flow tunnel was fabricated to measure the pressure drop across various material samples for insulation and inner chamber material. 65 pores per inch, 92% Al_2O_3 porous ceramic chosen for inner chamber. Unifrax Durablanket S chosen for insulation. ASTM A106 Grade B carbon steel pipe donated with flanges, blinds, gaskets and hardware for outer reaction chamber. Kanthal heating element and Honeywell power supply and digital control unit were selected. Final assembly is being completed and testing will follow.