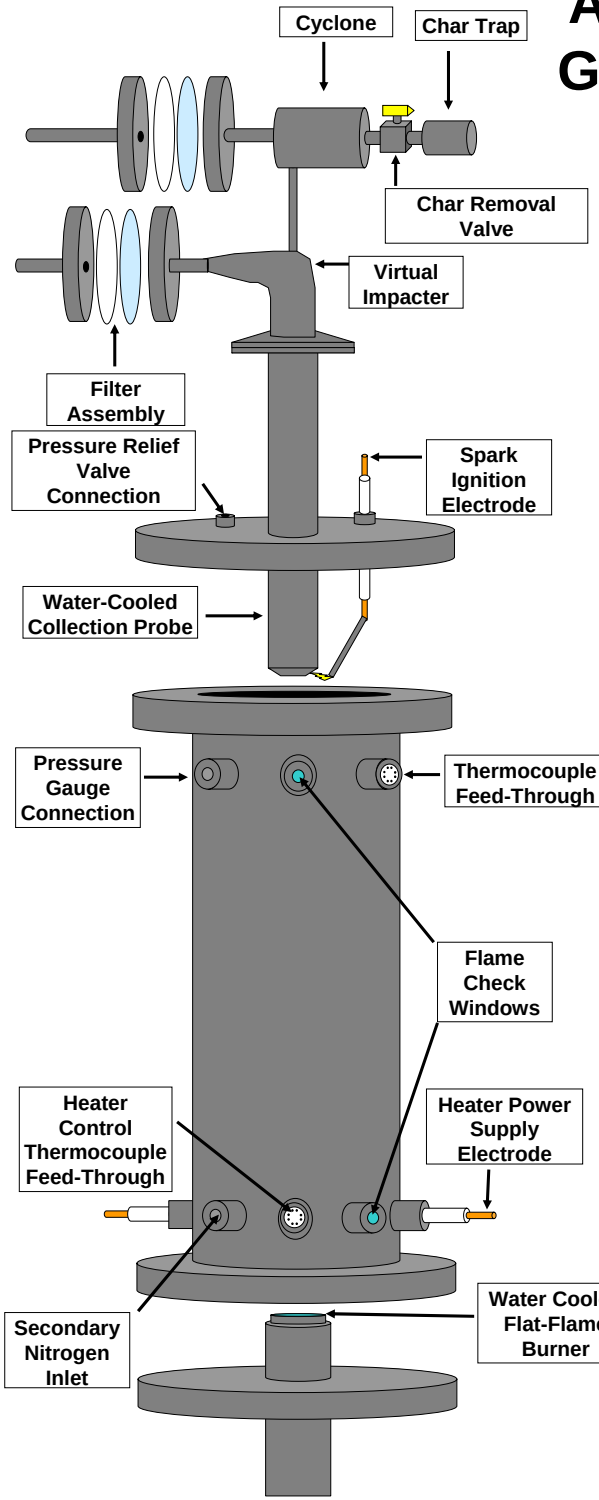
A Pressurized Flat-Flame Burner For Gasification and Combustion Studies

Randy Shurtz, David Johnson, Thomas H. Fletcher



Purpose

Investigation of single particle combustion characteristics at high pressure and high heating rates for either coal or biomass

Primary Pyrolysis	Secondary Pyrolysis
•Mass release/distribution •Tar structure	•Gas phase chemistry •Soot formation
Char Formation	**Char Oxidation/Gasification**
•Structure •Composition	•Reaction Kinetics

Capabilities and Dimensions

Residence times of 12-250 ms for 1 section and up to 500 ms for 2 sections

Feedback control system measures vessel pressure and adjusts outlet valve

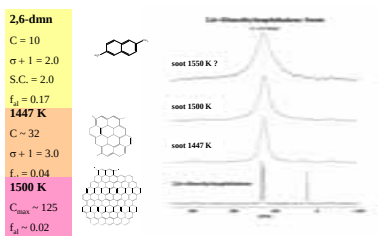
- 6-inch ID Vessel capable of 30 atm
- All required systems proven at pressures of up to 15 atm

Heating rates of up to ~10^5 K; close to industrial condition of ~10^6 K

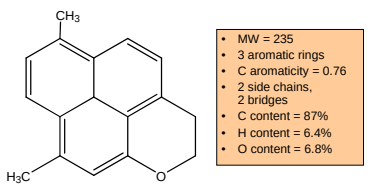
Current Research on Soot Formation from Coal Tar Surrogates

Coal tar contains polycyclic aromatic hydrocarbons (PAH) with a variety of functional groups. Hence, soot formation proceeds by kinetic pathways not observed in light hydrocarbon flames. Soot formation is enhanced at high pressure.

NMR Spectra of Soots Produced on an Atmospheric Flat-Flame Burner from 2,6-dimethylnaphthalene

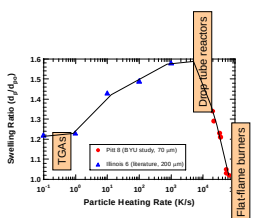


Suggested Average Tar Molecule



- MW = 235
- 3 aromatic rings
- C aromaticity = 0.76
- 2 side chains, 2 bridges
- C content = 87%
- H content = 6.4%
- O content = 6.8%

Effect of Heating Rate on Swelling Ratio[1]



1) Gale, T. K., C. H. Bartholomew, and T. H. Fletcher, "Decreases in the Swelling and Porosity of Bituminous Coals During Devolatilization at High Heating Rates," *Combustion and Flame* , **100**, 94-100 (1995).

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