



# CANMET Pressurized Entrained Flow Gasifier

**Dr. E.J. Anthony**  
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# About CETC-Ottawa

- A key research arm of Natural Resources Canada
- One of Canada's premier organizations in the field of energy, science and technology
- Offers world-class laboratory facilities and an accomplished, energetic workforce



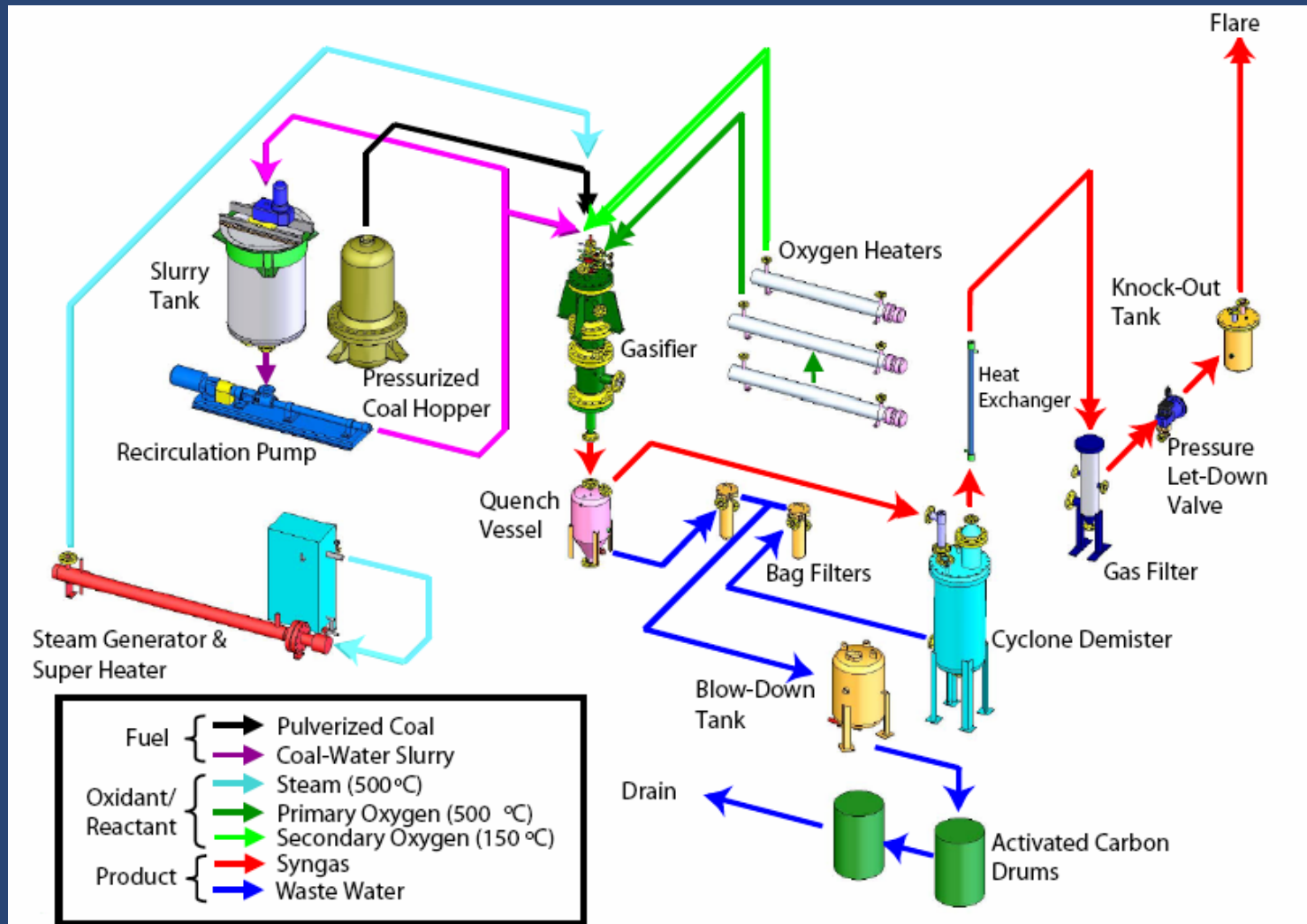


# FBC/Gasification Focus

- Fluidized Bed Combustion
  - Oxy-fuel circulating fluidized bed combustion
  - CO<sub>2</sub> looping cycles with lime-based sorbents
  - Sulphation, sorbent re-activation
- Gasification
  - Entrained flow gasification
  - Fluidized bed gasification



# CETC-O Entrained Flow Gasifier





# Specifications

- Max. operating pressure: 1.5 MPa
- Max. operating temperature: 1600°C
- Gasifier internal diameter: 127 mm
- Gasifier height: 1524 mm
- Feedstock size: 50-75  $\mu\text{m}$
- Dry coal feed rate: 10-20 kg/h
- Max. steam flow rate: 60 kg/h
- Slurry feed rate: 20-40 kg/h
- Solid/water ratio in slurry: up to 65%





# Gasification Mission

## Clean Energy Products for Canadians:

- Develop *clean energy* technologies to improve the environmental and economic well-being of Canadians
- To achieve sustainable energy sources for Canada and the international community
- Work together with private and other public sector partners





# Gasification R&D Focus

## Research Efforts:

- Enabling gasification technology in Canada
- Developing advanced, polygeneration gasification plants with integrated CO<sub>2</sub> capture

## Barriers:

- Higher cost of gasification processes and lower availability than for conventional units
- Perceived process risk
- Lack of operating experience in gasifying Canadian fuels



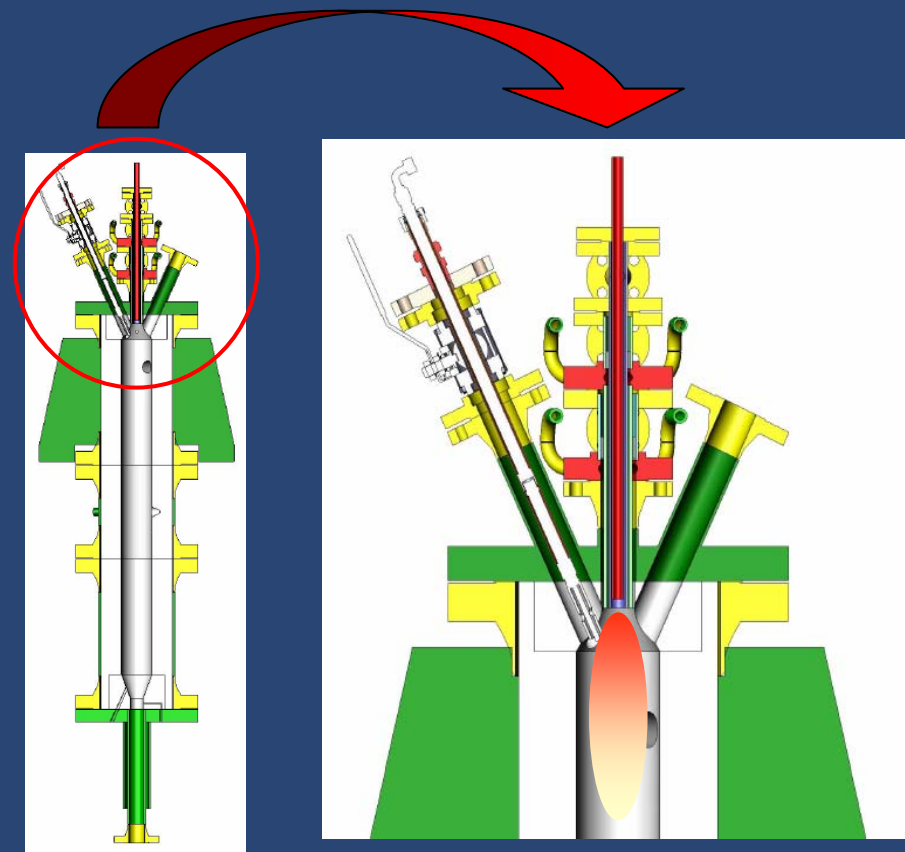
# Potential Feedstocks

## Solids:

- Coal
- Petroleum coke
- Biomass
- Wastes

## Liquids:

- Refinery resid
- Oils sands bitumen
- Spent lubrication oil
- Black liquor
- Hazardous wastes





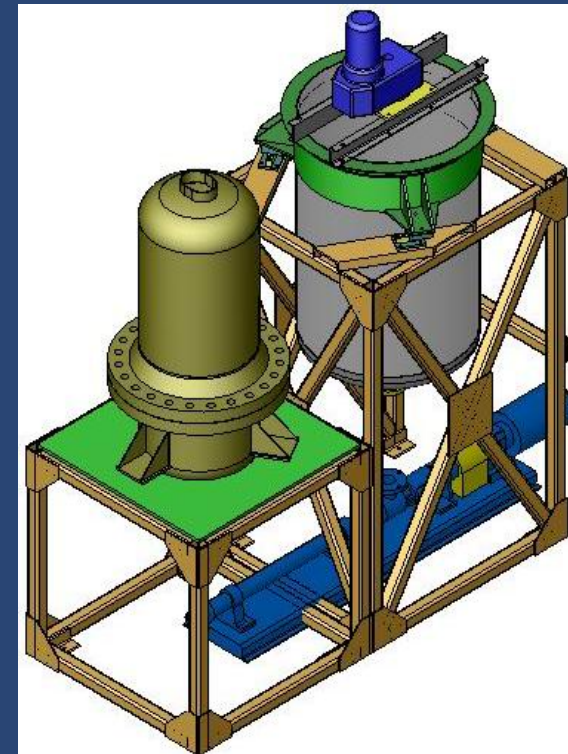
# Solids Feed Vessels

## Dry Hopper:

- Higher gasification temperatures
- Higher heating value of the product gas
- Feed rate 20 kg/h @1500 kPa, 20°C

## Slurry Tank:

- No coal dust safety problems during crushing and drying
- Utilize wastewater
- Feed rate 40 kg/h @ 1500 kPa





# Gas Supply Station

## Oxygen:

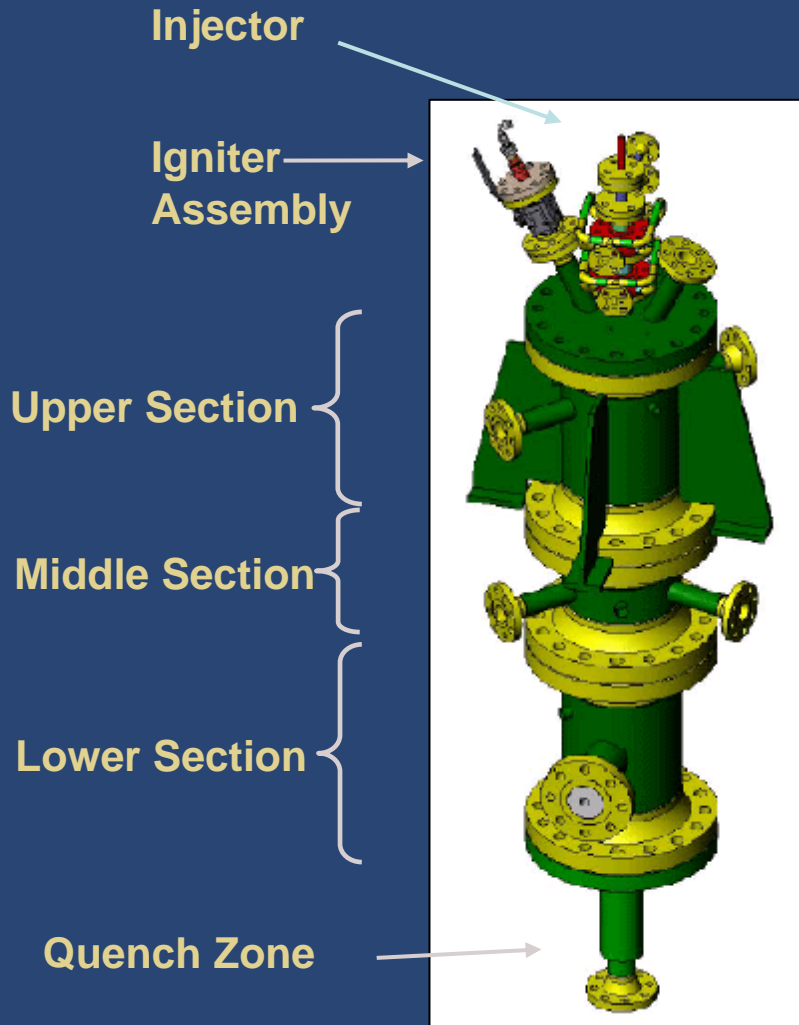
- Design rate: 185 kg/hr
- Filling capacity: 3800 kg
- Delivery condition: 2240 kPa @ up to 300°C

## Nitrogen:

- Design rate: 160 kg/hr
- Filling capacity: 4500 kg
- Delivery condition: 2240 kPa @ 20°C



# Entrained Flow Gasifier



- High temperatures are required for achieving slagging conditions
- Refractory-lined gasifier walls minimize heat loss and attack by hot gases
- Most common mode for coal gasification. Used by Shell (dry), Texaco (slurry)
- Operating condition – 1500 kPa, 1500°C



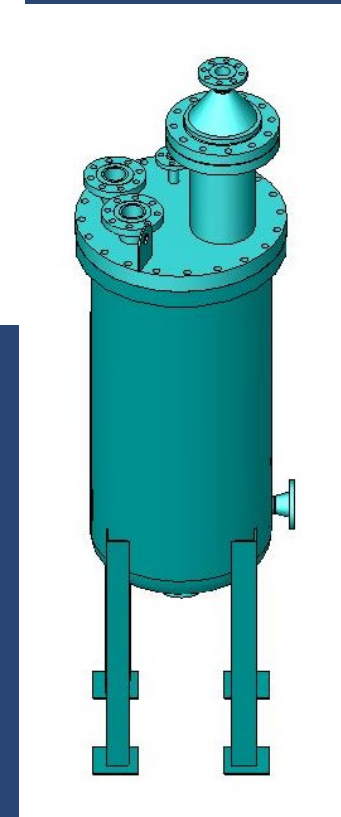
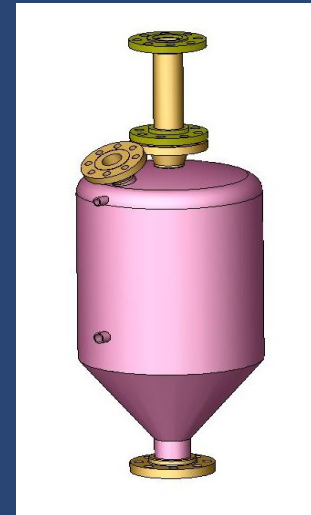
# Hot Syngas Quench

## Quench Vessel:

- Removes slag
- Exit temperature  $< 220^{\circ}\text{C}$
- Cooling water 10 L/min

## Venturi Scrubber:

- Combined with cyclone demister to remove particulates
- Exit temperature  $< 50^{\circ}\text{C}$
- Exit particle size  $< 10$  microns



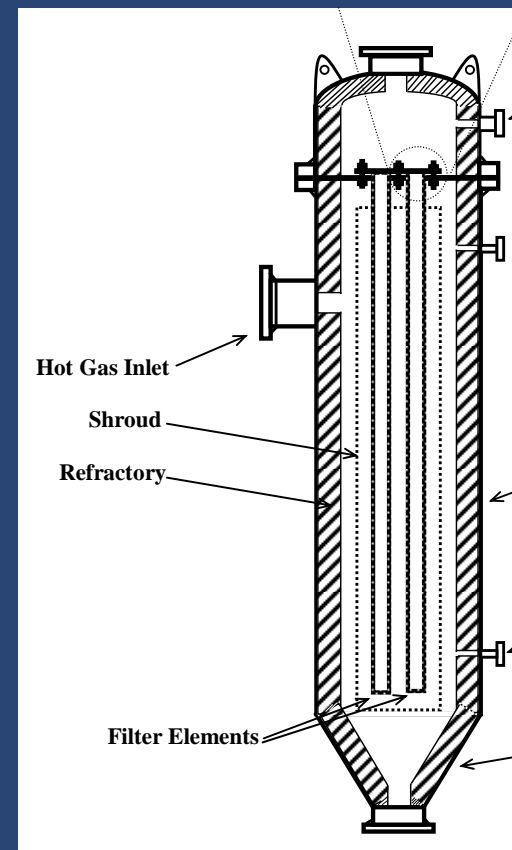
# Alternative Hot Gas Cleanup

## Particulate Removal:

- A particulate removal module has been constructed
- Ceramic barrier filters and metallic filters are planned to be tested at high temperature and high pressure

## Alkaline Metal Capture:

- Evaluation of Canadian solid fuels and sorbents for use in the process.
- Bench-scale tests will be conducted to develop high-temperature sorbents.





# Other Major Vessels

## Product Gas :

- Product gas cooler, gas filter, knockout tank, flare

## Gasification Streams:

- Oxygen heaters, steam generator, steam super heater

## Waste water processing:

- High-pressure water pump, bag filters, blow-down tank, activated carbon



# Market Focus



Gasifier



Steam



O<sub>2</sub> Heater



Quench



# Current Client Needs

## Boeing-Rocketdyne:

- Testing an advanced gasifier membrane wall to improve reliability and economics of gasification processes

## Gas Technology Institute:

- Spectroscopic system for flame radiant emission analysis

## LxSix:

- Develop and debug a fibre optics-based measuring system to monitor shell temperatures of gasifier







# Internal PERD&TI Projects

## Environment Canada:

- Establish protocol for Hg speciation in gasification

## Canadian Clean Power Coalition (CCPC):

- Blending studies for a variety of Canadian feedstocks

## T&I Hot Gas Clean-up:

- Particulate and alkali species removal

## T&I Increasing Gasifier Availability:

- Develop gasifier CFD modeling and simulation for aiding in the design of injector, gasifier and refractory





# Research Services

- **Developing gasification, syngas treating, and hydrogen production technologies**
- **Testing gasification-related instrumentation**
- **Validating mathematical models with pilot-scale gasification tests**
- **Generating gasification performance data**
- **Performing feasibility studies for the application of gasification technologies**
- **Determining chemical species partitioning in effluent streams**





# Collaborative Accomplishments

- A variety of arrangements are available to assist industry in the application of this technology. At CETC-O, development of gasification technology is supported by contract research at both fundamental and pilot-scale levels, and by technical support of major demonstration projects
- The CETC-O gasifier has been identified as the foremost gasification research facility at the small pilot-scale



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