Continuous Injection of Solid Fuels into Advanced Combustion and Gasification System Pressures

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Using the “Posimetric Feeder” concept:

• Solve solid materials handling at high pressures.
• Reduce complexity of existing batch process handling systems.
• Enhance acceptance of advanced combustion technology.
• Maintain the U.S. lead in advanced combustion system design and supply.
Posimetric Feeder Will:

- Provide a simple, accurate and reliable feed system.
- Establish controlled, continuous level delivery of coal.
- Minimize gas losses.
- Eliminate high maintenance costs and substantial risks of downtime.
Feeder History
Parachute Creek
Oil Shale Project – Tosco/Exxon JV

Feeding Requirements:

• Continuous Feed into Pressure
• Resistance to Abrasion
• Provide Gas Seal
“FIRTH” Solids Pump

- First Prototype
Solids Transport And METering

• First Full-scale Test Feeder, Peabody Coal Company 1988
STAMET Model 0926

- First Commercial Feeder
  1990 - Powergen Plc.
  High Marnham Station

- Now nearly 200 feeders in over 30 plants
The Posimetric® Pump Technology

- Unique concept named for “Positive Metering” of solids.

- One simple continuously rotating element, providing precise flow control.

- The machine can deliver solids directly into a pressurized environment.
Solids Pump Feed Capability
Low Pressure Feeder Arrangement
Principle of Pressure Operation

The “Posimetric” Feeder uses:

- Internal and external friction coefficients of the solids
- Forces solids into a “solids Lock” condition
- Solids “key” with the rotating discs
- Discs drive solids into the discharge duct.
- Solids form a “solids seal” in the discharge duct, to prevent back flow of gas
STAMET “Posimetric” Solids Pressure Pump

Solids enter at atmospheric pressure

Solids locked in rotor

Solids Discharge into 210 psi Air

Solids seal in outlet duct

Rotor
Stamet Coal Feeding System, Model PCO 0226

- Developed for US DOE Clean Coal Program
- Feeder achieved record coal injection pressure - over 250 PSI gas environment
STAMET HIGH PRESSURE SOLIDS FEEDER
Gravimetric Output vs. Discharge Pressure

- Pressure, PSI
- Receiver Weight, LBS

Gross Receiver Weight, Pounds

HPSF Revolutions

HPSF Discharge Pressure, PSI
Current Research Program

- Two year schedule

- Two-Phased approach:
  1. Semi-scale intermediate pressure unit
  2. Semi-scale full pressure unit
Phase 1 Scope

- Extend Posimetric® Pump technology for injection of coal into 300 PSI.

- Design & build a machine for injection of coal into 300 PSI.

- Test & develop machine confirming coal injection into 300 PSI.
Phase 2 Scope

- Extend Posimetric® Pump technology for injection of coal into 500 PSI.
- Design & build a machine for injection of coal into 500 PSI.
- Test & develop a machine confirming coal injection into 500 PSI.
- Outline commercial Posimetric® Pump design for coal injection up to 500 PSI.
Phase 1 Material Evaluation and Selection

- PFBC and Gasifier Visits
- Collect Fuel Samples
- Test Fuel Handleability For Feeder Sizing
- Test Fuel Porosity and Permeability
- Select Test Fuel
Feeder Sizing/ Hopper Testing

- Multiple hopper Outlet sizes tested
- Results allow smallest feeder inlet sizing to be identified
Hopper Loading

- Require uniform fill for repeatable tests of material.
- Rapid testing to minimize moisture changes.
Flow Rate Testing

- Determination of flow rate for each hopper and fuel as received
- Evaluation of fuel handleability with varying size distribution and moisture
Permeability Testing

- “Stameter”

- Allows evaluation of porosity/ permeability and wall friction under varying compaction levels
Phase I - Feeder Design

- Review full feeder design history

- Apply innovative ideas from other fields

- Address two-phase program to minimize machine costs
Spool Arrangement

- Shaft
- Discs
- Hub
- Disc OD seals
Feeder Body

- Pressure Casing
- Bearings
- Bearing carriers
Inlet and Outlet

- Insert for inlet
- Inlet abutment
- Insert for outlet
- Outlet abutment
Assembled Inserts

- Ease modification
- Feeder Flexibility
Feeder

- Flexible
- Compact
- Simple design
Rig Arrangement

- Inlet pressure vessel
- Outlet pressure vessel
- Test frame
Phase 1 Progress

- Materials testing and selection completed
- Machine design completed
- Manufacturing delays extended phase 1
- Assembly Completed, some rework
- Shake-down runs in progress
Shaft

• 6” Diameter to handle high torque expected in Phase 2 machine
Disc

- 20” Diameter
- Active area 1.25”
Spool Assembly

- Shaft
- 2 Discs
- Hub Spacer
- 1 Bearing (of 2)
Body

- Side view showing seal and bearing location
Feeder Inlet

- Showing Inlet Insert and Inlet Abutment Penetrating Discs
Feeder-Drive Assembly

- Motor-gearbox unit sized for Phase 2 drive
- Chain drive allows torque and gearing adjustment
Active Hopper

- Stamet Patented “Live Wall” system
- Provides insurance against hang-ups and flow interruptions
Receiving Pressure Vessel

- Rated above 600PSI
- Electrical pass through’s
- Insert basket for recycling coal
Test Rig Assembly

- Compact for portability
- Testing will be at multiple locations
- Pressure level makes for heavy components!
Current Program Schedule

- Complete feeder in October
- Shake-down tests complete mid October
- Move to test facility end October
- Phase 1 tests November/December
- Phase 1 results late December