Economical Long Campaign Cupola Operation
Partial Reference List

• Atlantic States
• Waupaca Foundry
• U.S. Pipe and Foundry
• Clow Water Systems
• Dalton Foundry
• Neenah Foundry
• TUPY S.A.
• Badger Foundry
• Osco Industries
• American Brass & Iron
• Bremen Foundry
• CWC Textron
• Westinghouse Plasma Corp.
• Tyler Pipe
• Honda of America
Considerations

- Design
- Operating Procedures
- Maintenance
- Raw Material Inputs
Design

- Cupola Sizing
- Blast Rate
- Tuyere Considerations
Cupola Sizing

- Critical to correctly size the cupola and blower to your iron demand. Most important aspect to efficiency

- Stack Velocity: Velocity of gases traveling up the cupola stack. Measured in SCFM per square inch of cross sectional area in melt zone
Stack Velocity Impact

- Conditions in cupola with low stack velocity:
  - Poor preheat, heat from coke bed not fully transferred to material to be melted
  - Inefficient coke conversion
  - Lowered melt rate, iron temperatures
  - Need for more coke and oxygen
  - Slagging problems
  - Lack of chemistry control
Stack Velocity Impact

- Conditions in cupola with high stack velocity:
  - Formation of skull
  - Bridging
  - Silicon loss
  - Emissions problems
Controlling Stack Velocity

- Only a change in blast air or effective cupola melt zone ID can alter the stack velocity
- Presents a real problem for foundries with changing iron demand
- Refractory lining to change ID
- Shell change if drastic increase / decrease in iron demand
- Importance of running cupola within design parameters
Tuyere Sizing Considerations

- Tuyere protrusion into melt zone
- Number of tuyeres
- Blower capabilities
- Tuyere velocity
Tuyere Protrusion

- Designed to deliver gases to center of melt zone
- Proper protrusion increases efficiency
- Too much protrusion can lead to cool shell and cause buildup of iron between tuyere locations
- Increased protrusion is not a proper compensation for lack of velocity

- Protrusion is measured past refractory if cupola is lined

7 to 15 inches of protrusion depending on size of cupola
Number of Tuyeres

- Even number NOT required
- More tuyeres than necessary only increases maintenance costs
Tuyere Velocity

- Determined by amount and temperature of blast air, ID and number of tuyeres
- Measure of blast velocity entering cupola melt zone thru tuyeres
- Critical to combustion and maximizing BTUs from coke
- Adjust with blast air changes: Tuyere sleeves
Maintenance / Refractory Issues

- Offset Well Bottom Material Installation
- Tap Hole Configuration
- Slag and Iron Trough / Front Slagger Construction
- Iron Dam Construction
- Shell Cooling
Offset Well Bottom Material Installation

- Avoid dramatic slope towards tap hole
- Slope should be 1-2 inches maximum

Too great of a slope towards the tap hole can cause slag and iron buildup and make tapping out difficult.
Tap Hole Configuration

- Rectangular gives a better flow with less erosion and obstructions / plugging
- Tap hole can be determining factor in campaign length, and changing to rectangular may lengthen campaign
Slag and Iron Trough / Front Slagger Construction
Iron Dam Construction

- 1 inch of iron dam height per 4-5 oz. of back pressure
- Too high of a dam causes excess slag and iron held in cupola, leading directly to silicon loss
- Adjust dam height with changes in blast
Cupola Shell Cooling

- Keep shell clear of buildup
- Importance of water distribution
- Water Gland
Operational Considerations

- **Oxygen Usage**
  - Increased melt rate & iron temperature, alloy recovery, carbon pickup, chemistry control.
  - Costly, can be reduced to a minimum with proper stack and tuyere velocities.
  - Used as a crutch, covers up underlying problems.
  - Wear on refractory.
  - Enrichment vs. Injection.
Operational Considerations

- Charge Makeup and Distribution
  - Size and weight
  - Clean scrap and coke
  - Level charge, even distribution
  - Bridging
Operational Considerations

- Bed Burn In, Cupola Start Up
  - Coke bed importance
  - Timeliness of startup
  - Closed tap hole
Operational Considerations

- Monitoring
  - Instrumentation
  - Leaks, Inefficiencies
  - Active Melt Department, System Awareness
  - Safety / Emergency Tuyere
Contact

- Please contact us to set up an appointment to review your current operation, or discuss a future project.

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