Sulfur Recovery Units: Application, Products, Competition

Stephen Karns

Unit Design

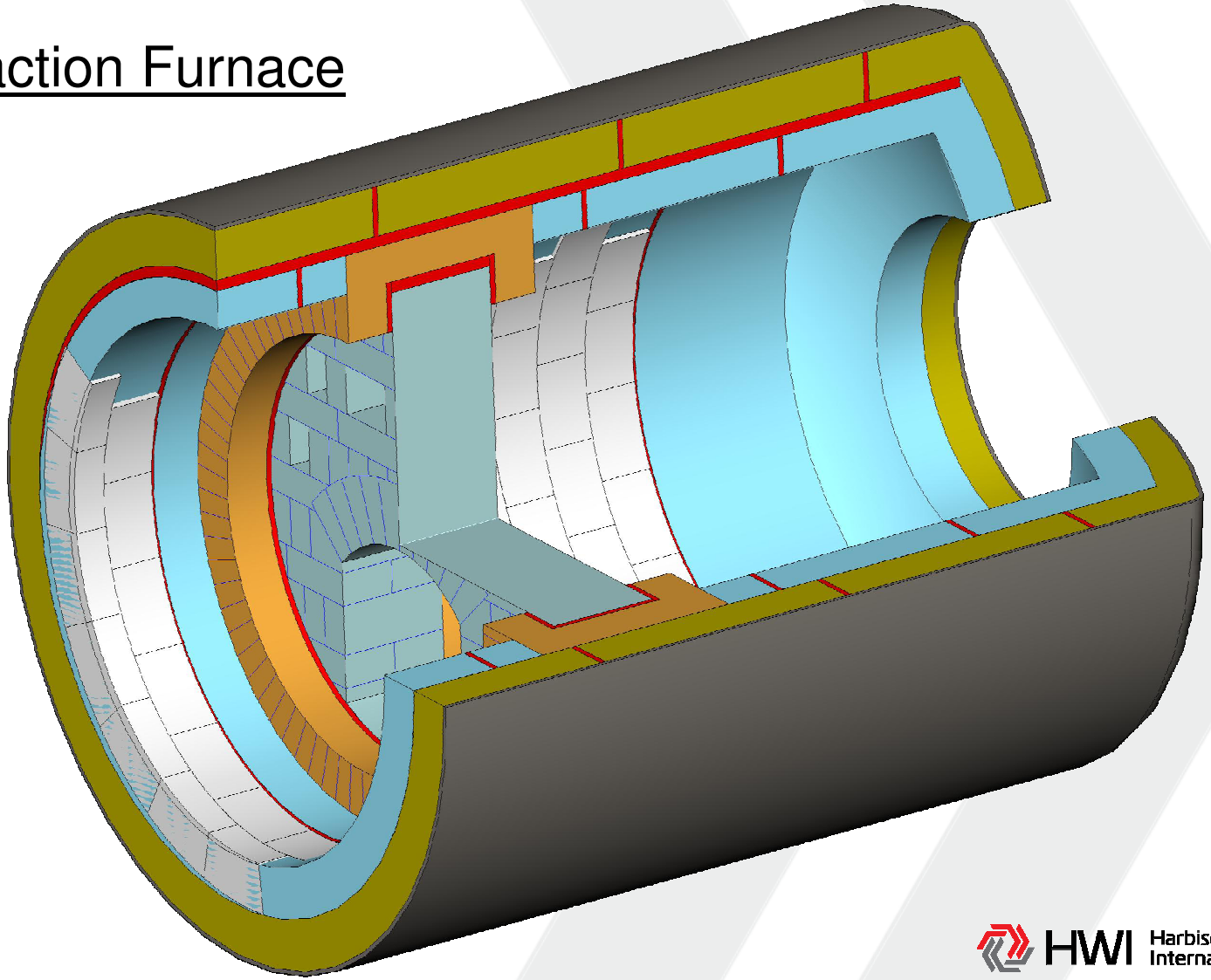
The Reaction Furnace (RF) is the main focus for refractories

Consists of:

- Hotface Lining
- Checker Wall and/or Choke Ring
- Backup Lining
- Burner Throat
- Tubesheet

Unit Design

The Reaction Furnace



HWI HarbisonWalker International™

Unit Design

Other Vessels with Refractory Lining:

- Waste Heat Boiler
- Reactors
- Condensers
- Sulfur Pit

Design Factors

All vessel materials are specified by the designer or owner.

Reaction Furnace Design

- 2500-2800°F; upsets can reach 3000°F, sometimes more.
- Thermal profile should provide a shell temp between 300-600°F. Below this temp sulfuric acid condenses on the shell, above causes sulfidation of the steel, both cause damage to the shell.
- Thermal shock from tube leaks or amine carryover is possible
- Hotface Lining
  - Hot Load @ 3000°F for 100hrs with 25psi ≤ 0.4% change
  - Usually >90% alumina, sometimes >94% alumina

Design Factors

- Checker Wall/Choke Ring and Burner Throat follow Hotface Lining guidelines
- Backup Lining
  - Max temp of material should be at least 200°F higher than calculated interface temperature. Some designers recommend a max temp that can withstand the full operating temp in case of hotface loss
  - IFB design reasoning:
    - IFB provides a perfect lining depth and surface to build the hotface on
    - Lower K-factor than monolithic
    - Does not react with condensed acid

Design Factors

- Backup Lining (cont.)
  - Monolithic design reasoning:
    - CaO in mono reacts with condensed acids to neutralize before it damages the shell and blocks off porosity to prevent further condensation.
    - Higher strength; monolithic linings are found to be in better shape than IFB during turnarounds.

Design Factors

- Tubesheet
  - Refractory covering (~3” thick) deflects direct flame from burner on opposite end.
  - Ferrules used for tube openings, monolithic refractory is used to fill in around. HWI does not currently manufacture ferrules.

Design Factors

Reactor and Condenser Design

- Usually a set of 3 of each contained within a single vessel
- Operating temp varies from 300-600°F
- Thin lining designed to retain heat in the vessel, 2-4” thick
- Reactor is filled with catalyst. These can damage soft insulating refractory, so some strength is needed.

Sulfur Pits

- Typically 6-12” refractory lining
- Temperatures are usually around 300°F
- Thermal shock can be a problem in some cases

HWI Products

Hotface Linings

- KORUNDAL XD
  - Excellent creep resistance
  - Good thermal shock resistance
  - 90% alumina
- TUFLINE 90
  - Good creep resistance
  - Excellent thermal shock resistance
  - 90% alumina
- TUFLINE 95 or 98 DM
  - Good creep resistance
  - Excellent thermal shock resistance
  - Higher alumina content to meet some specifications

Checker Wall, Choke Ring, Burner Throat

- Use same materials as hot face lining
- /C options are available for custom designs
- Various precast monolithic options

HWI Products

Backup Linings

- GREENTHERM family
  - Determine temp rating according to thermal profile calculation
- KAST-O-LITE family
  - Determine temp rating according to thermal profile calculation
- WM-7630 Castable, WM-7697 Gun Mix
  - Monolithic material with properties of an IFB
  - This can be a game-changer

HWI Products

Tubesheet

- GREENCAST 94 family
  - Dense for high turbulence resistance
  - This is the most common
- KAST-O-LITE 97 L PLUS
  - Insulating for better thermal protection

HWI Products

Reactors & Condensers

- KAST-O-LITE family of lightweight monolithics
- GREENLITE-45-L family is common
  - Great strength to K-factor ratio

Sulfur Pit

- SENTINEL RC
  - Low temperature, cost effective refractory concrete
- SHOTKAST FS
  - Great thermal shock resistance
  - Large quantities can be applied via pumping or shotcrete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