Sulfur Recovery Units: Application, Products, Competition

Stephen Karns

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HWI
HarbisonWalker International™

Stephen Karns
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
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
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

Checker Wall, Choke Ring, Burner Throat
- Good creep resistance
- Excellent thermal shock resistance
- Higher alumina content to meet some specifications

/C options are available for custom designs
Various precast monolithic options
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