2013 MEPEC
MIDDLE EAST PROCESS ENGINEERING
CONFERENCE & EXHIBITION

FRAMEWORK FOR SELECTING THIN-CAKE CANDLE FILTER TECHNOLOGY FOR REMOVING SOLID CONTAMINANT FINES FROM RECIRCULATING GAS SCRUBBING FLUIDS

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BHS Presentation Overview: Applications, Testing, Technologies & Installations

BHS Introduction
Clarification: Amine Scrubbing
Concentrating/Clarification: Grey Water & Gasification
Clarification: Glycol Scrubbing
Clarification: Downstream of Clarifiers
Clarification: Feed Shale Oil
Summary

BHS Problem Overview:

-Recirculating scrubbing fluids (amine, glycol, water, others) are used remove contaminants from gas streams.

-Various catalyst fines/particles are carried into the gas and captured by the scrubbing fluid.

-The particle fines are less than 1 micron and cause fouling in downstream equipment.

BHS Problem Overview:

Alternatives for Removing Catalyst Fines

- **Settling Tanks & Chemicals**
  - **Hydrocyclones**
  - **Centrifuges**
  - **Bag & Cartridge Filters**
  - **Filter presses**
- **The use of thin-cake (~15 mm) candle filter technology has been proven to be a cost-effective and reliable approach to removing the contaminant fines**

BHS Lab Testing for Amine Scrubbing

BHS-Pocket Filter

20 cm² filter area

400 ml content

BHS Lab Testing for Amine Scrubbing

BHS Lab Testing for Amine Scrubbing

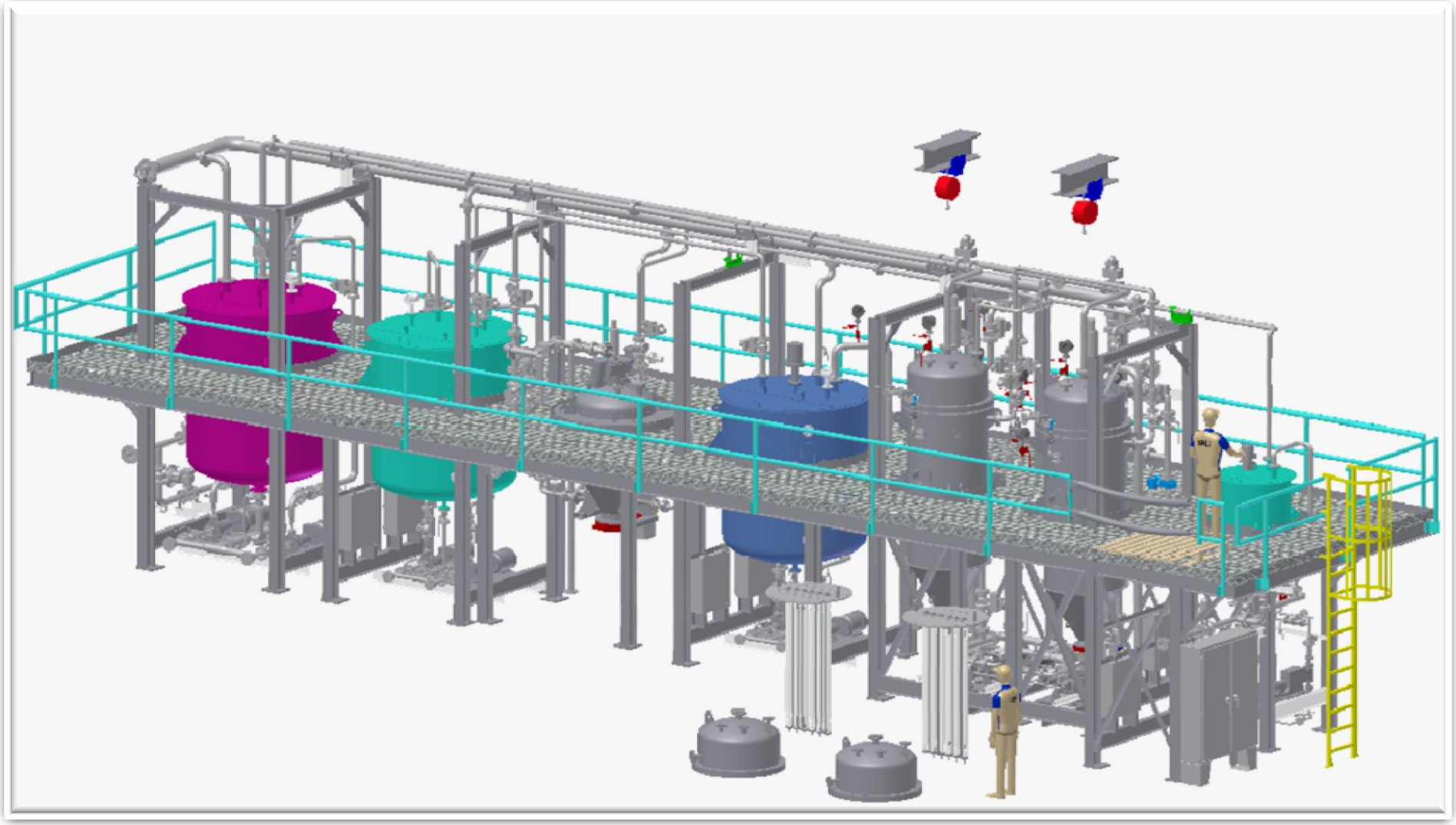
Feed Rate: 100 gpm at 600 ppm solids

Specification: 0.5 um filtration
Washing to remove and recover amine
Dry cake (no free liquids) for non-hazardous disposal

Result:

2 x 20 m2 Concentrating Candle Filters
1 x Pressure Plate Filter (4 m2) for Filtration, Cake Washing & Drying

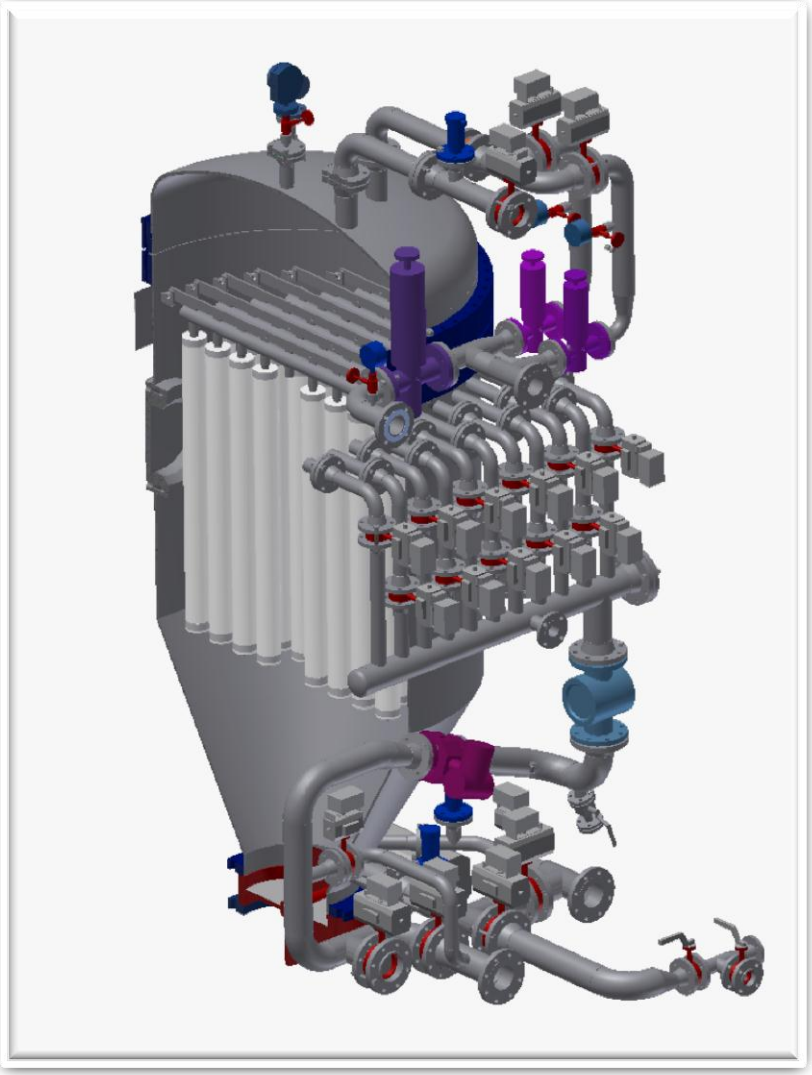
BHS Installation for Amine Scrubbing



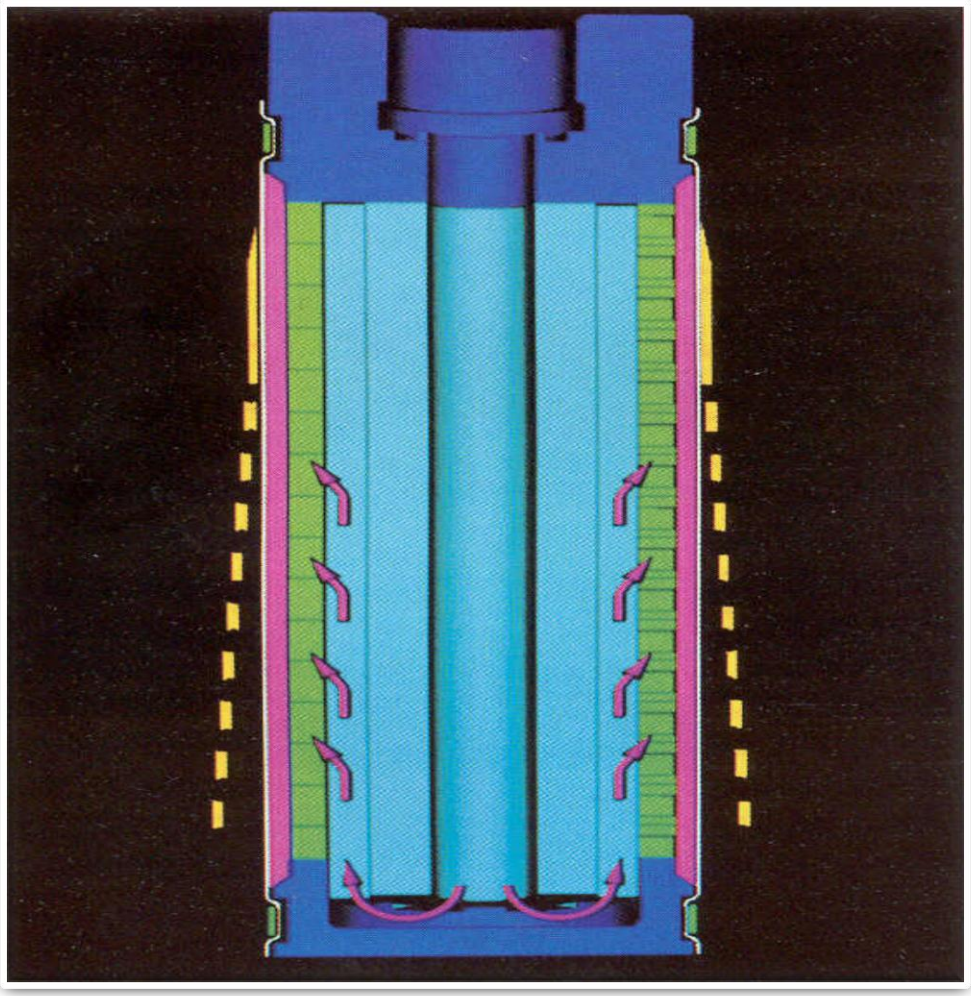
BHS Installation for Amine Scrubbing

BHS Installation for Amine Scrubbing Candle Filters with Activated Carbon

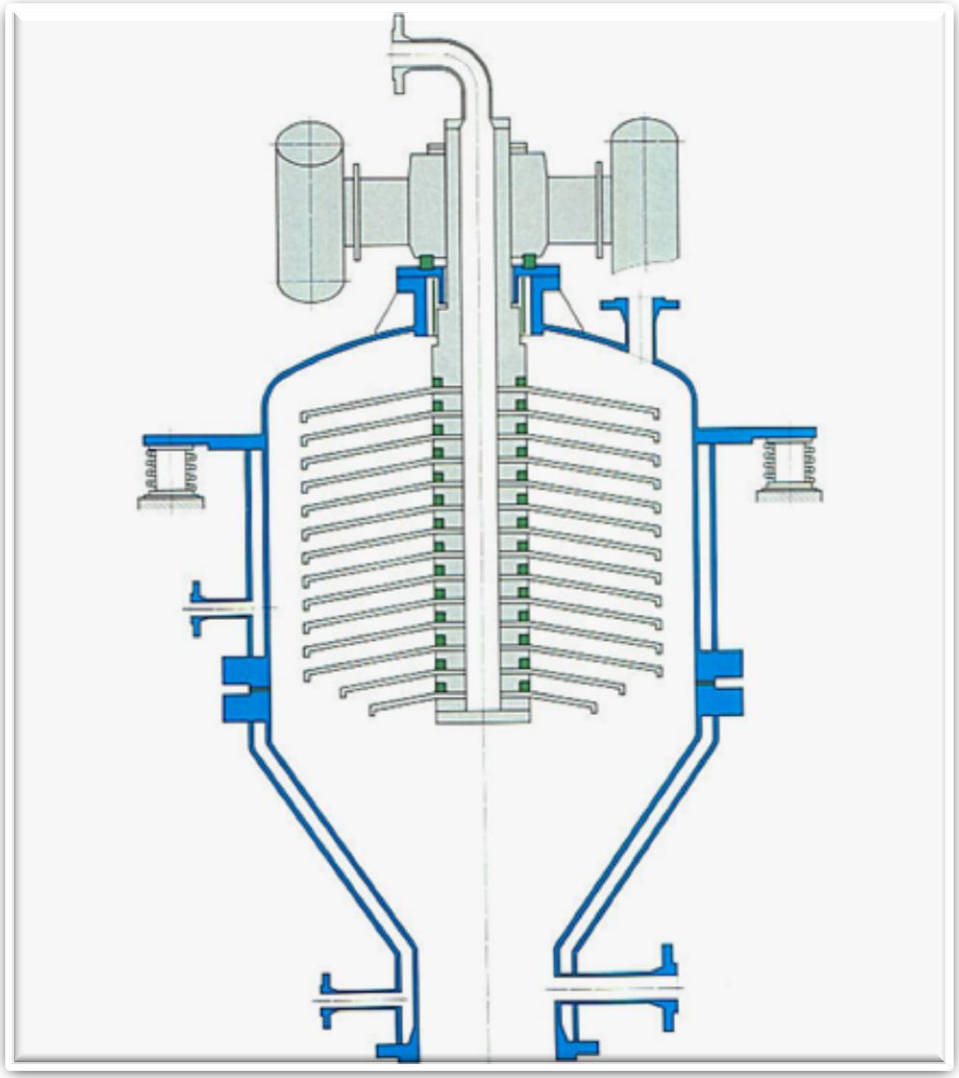
BHS Candle Filter Technology

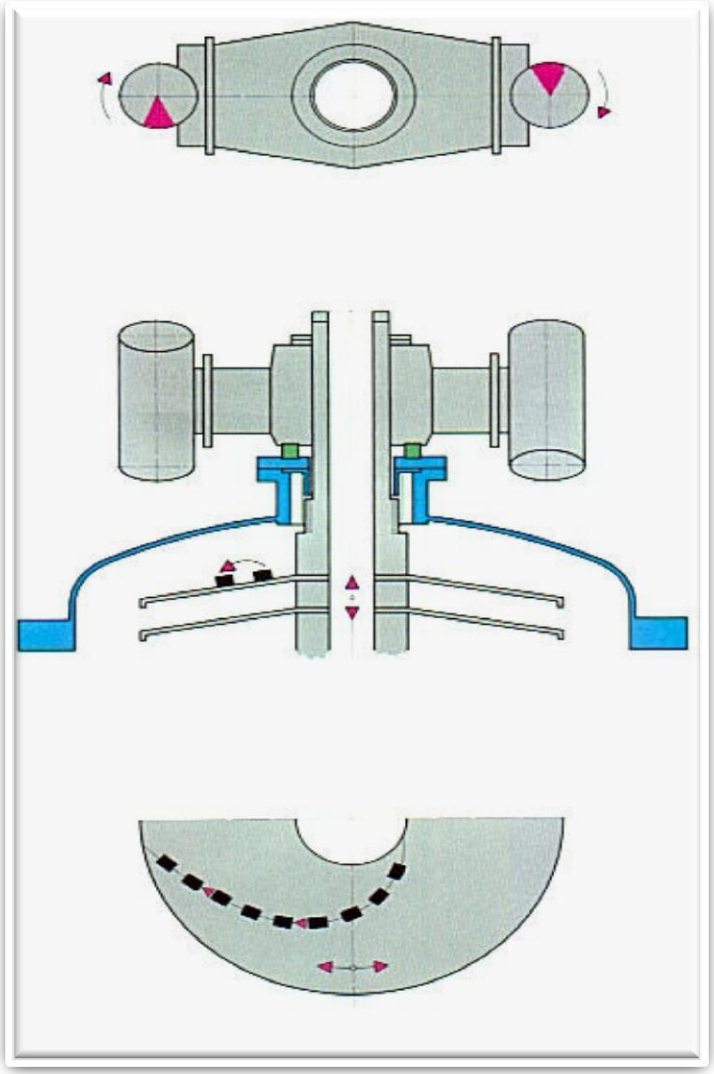


BHS Candle Filter Technology

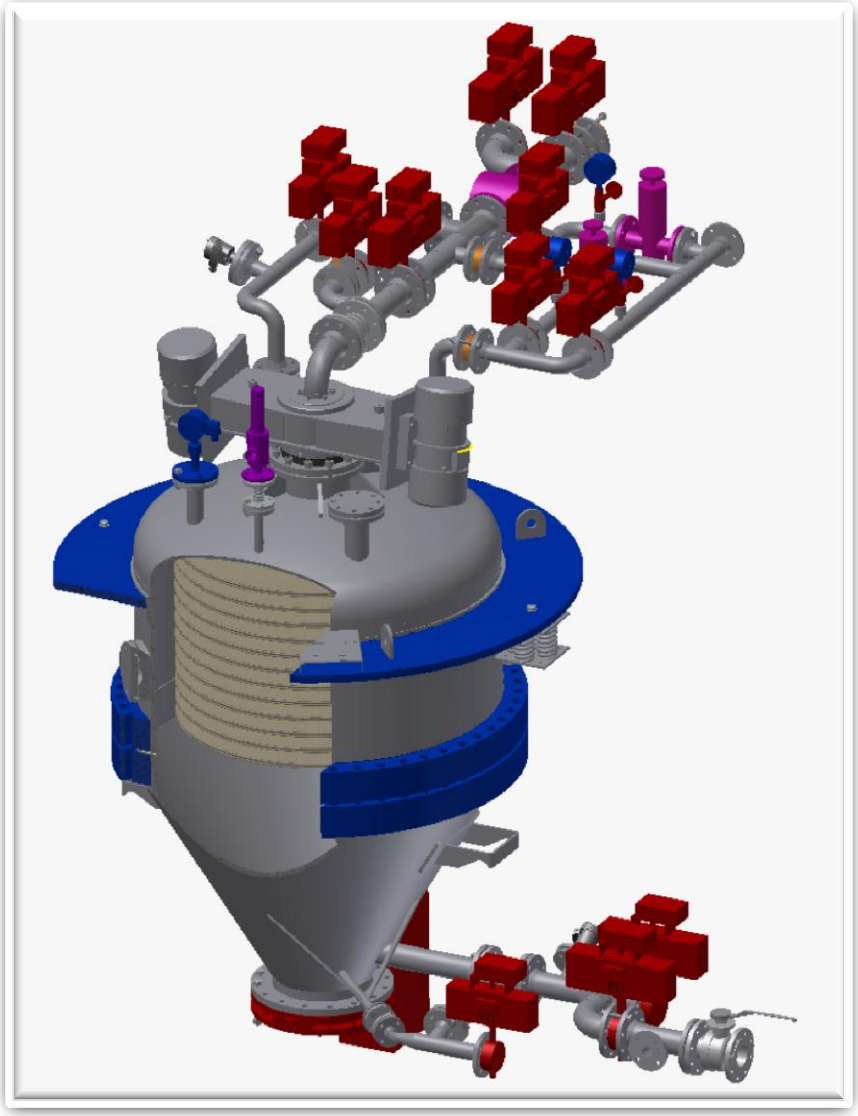


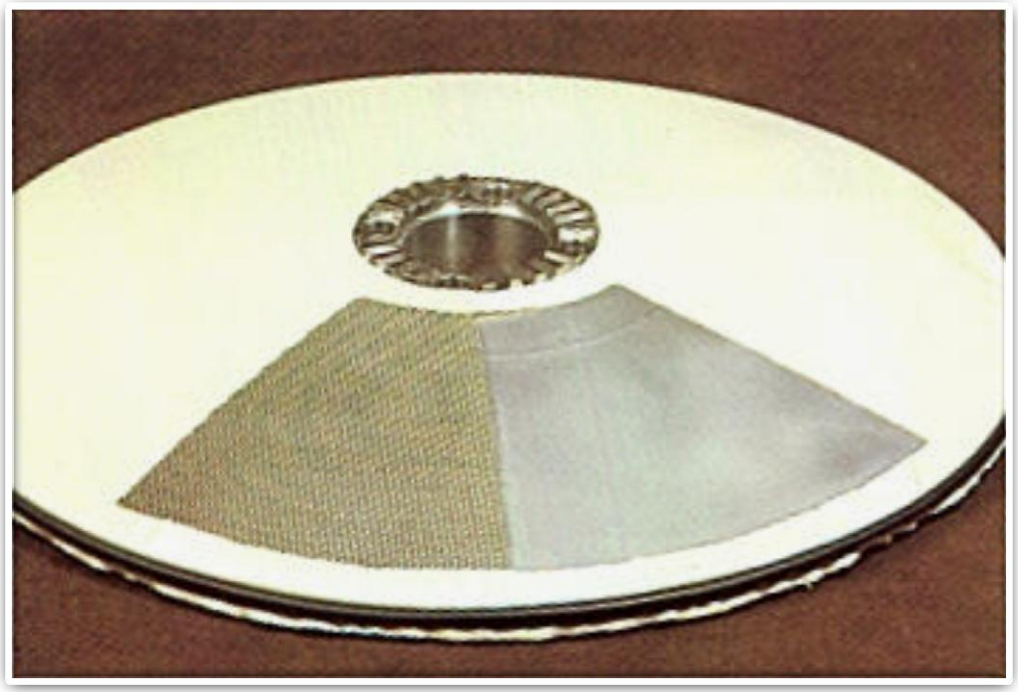
BHS Pressure Plate Filter Technology





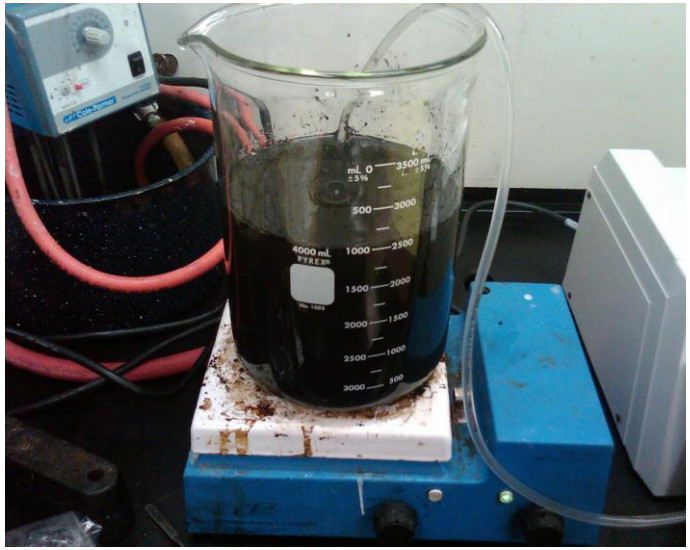
BHS Pressure Plate Filter Technology





BHS Lab Testing for Grey Water Concentrating Candle Filters

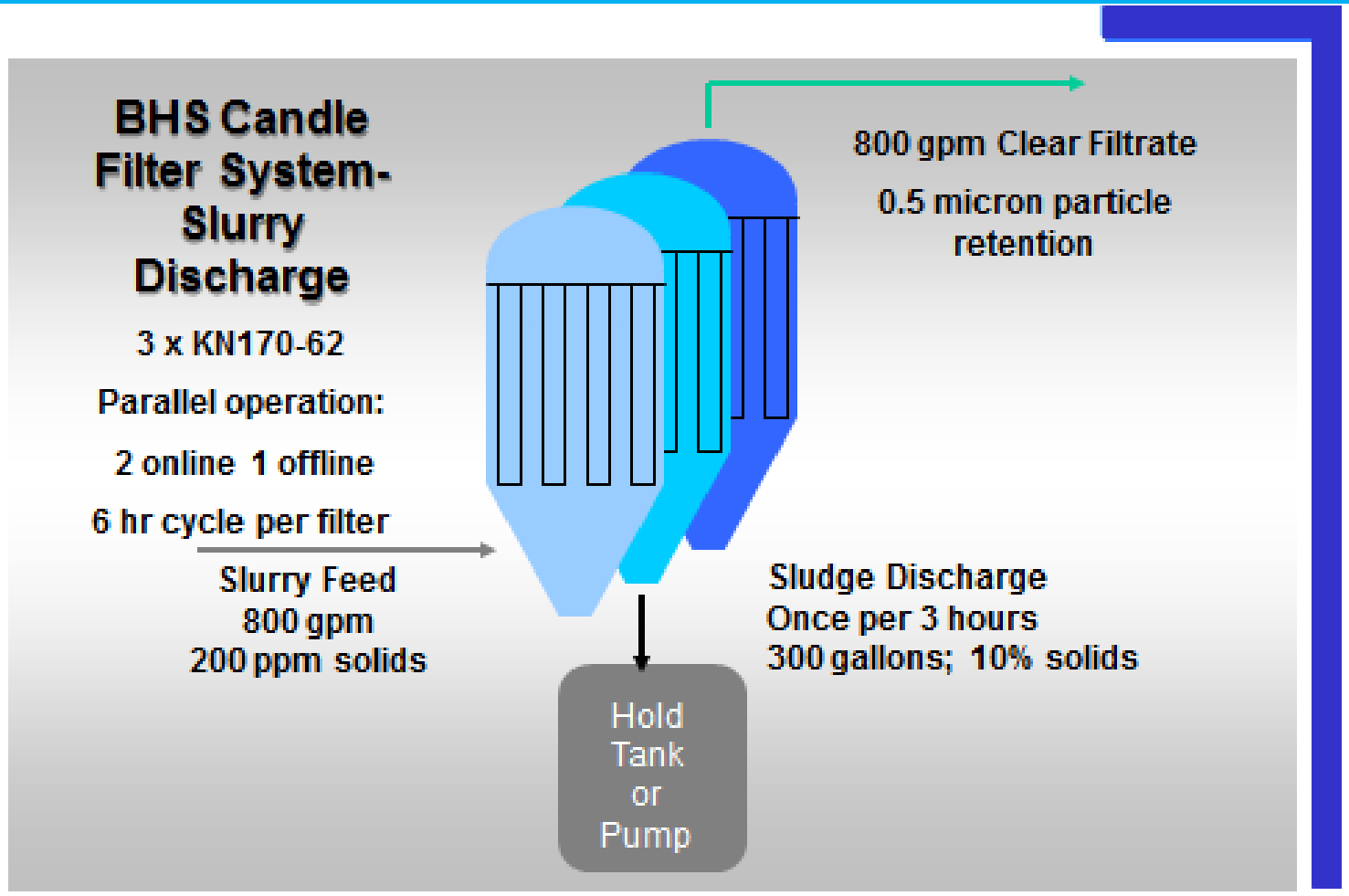
Fines Slurry at 200 PPM



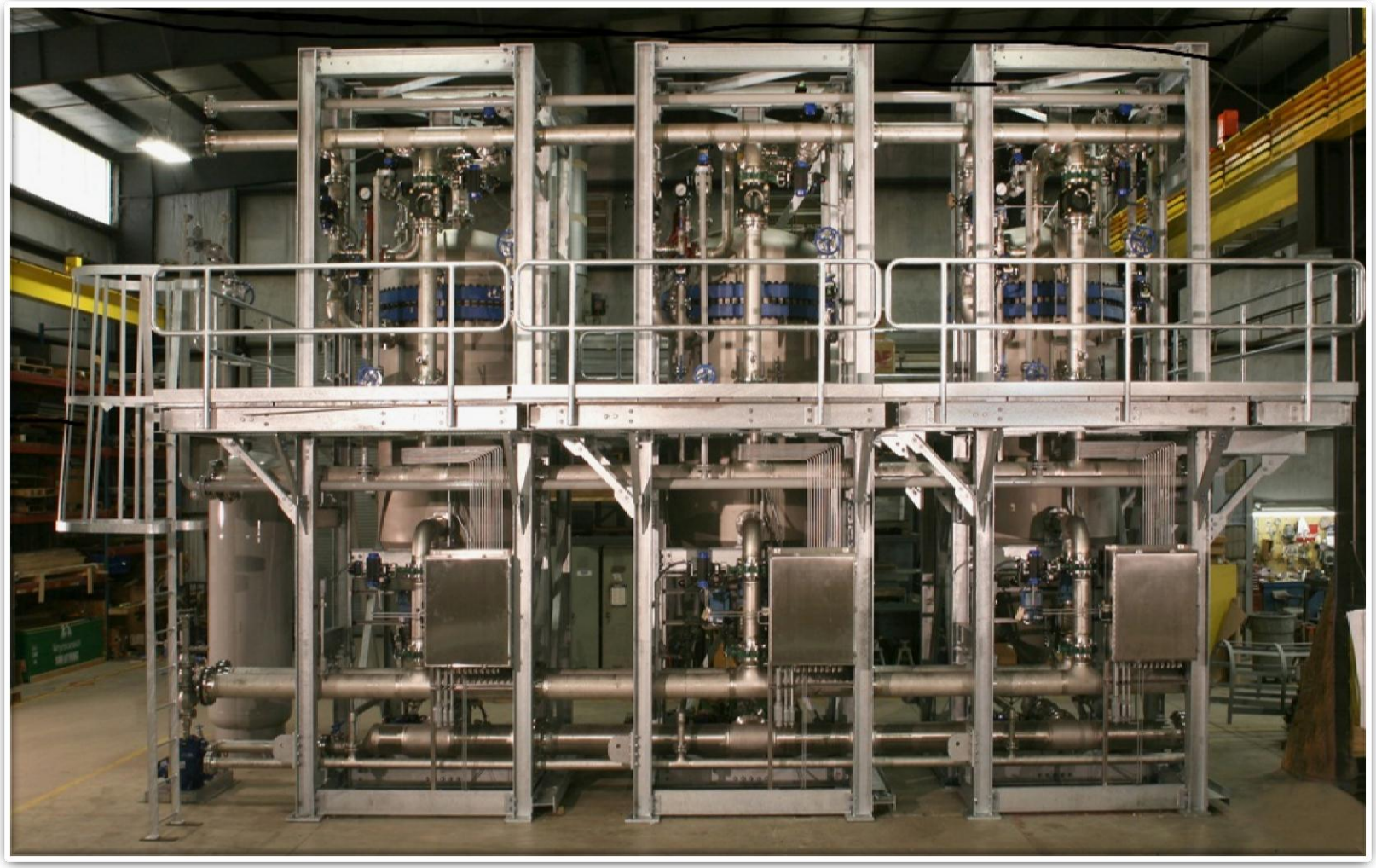
BHS Pocket Leaf Filter

Clarified Water (0.5 um)

BHS Installation for Grey Water Concentrating Candle Filters



BHS Installation for Grey Water Concentrating Candle Filters



Glycol Scrubbing Offshore:
BHS One-Stage Process Replaces Two Stages

- Three Candle Filters for offshore gas platform replaces centrifuges and filter presses
- Each Filter has 97 candles with 65 m^2
- Application is MEG reclamation/removal of divalent salts from rich MEG (~ 60 % water).
- BHS testing confirmed moisture level of 65%
- Flow rate = 175 gpm with 3% solids
  (CaCO3 / FeCO3 / MgOH2)

BHS Candle Filtration Downstream of Clarifier For Water Scrubbing

BHS Candle Filtration Downstream of Clarifier For Water Scrubbing

- Design
  - 368 gpm and 190 ppm solids
  - Solids removal to 40 ppm
  - Parallel operation (12 hour cycles)
- Actual Operation (at start-up)
  - 60 ppm solids in feed
  - 48 hour cycle
  - Less than 5 ppm solids in filtrate
  - Dry cake (no free liquids) for disposal

Feed Filtration System for Shale Oil

Required Filtration: Residual Inorganic Ash = < 10 wppm	
Liquid Properties	Solids Properties
Composition: cracked naphtha & distillate oils	Composition: Partly calcined limestone
Flow Rate: Out 22,000 BPSD / 3378 TPD	Content (ppm wt%):400 to 700 wppm
Specific Gravity or Density: 0.966 at 15°C	Particle Size: 70% less than 3.2 um
Viscosity: 17 cs @ 50°C / 4 cs @ 100°C	Preferred Disposition of Solids:
Operating Temperature: 80 °C	Recycled in backwash oil [Backwash Ash content = 3 wt% max] or combustion
Operating Pressure: 11 barg inlet	Batch Size: Continuous
Maximum ΔP: 3 bar, delta	
Design Temperature: 150°C to 40°C [-30C]	Design Pressure (Min): 20 barg

Feed Filtration System for Shale Oil

- With precoating, filter media =12 um PEEK
- At 150 degrees C, filtration without dilution
- BHS Candle filter is an optimum solution
- The filtration flux rates varied from
  2 liters/m2/hour to 0.5 liters/m2/hour
- This could indicate a wide variability of the samples and would impact the sizing
- Additional pilot testing is required

SUMMARY

- There are many choices for process filtration
- Technical evaluation and laboratory testing are critical for successful decisions-projects.
- Engineers must evaluate all outcomes to make an informed and successful decision
- The take-away is that close collaboration between the operating company and the vendor will allow for creative problem-solving and process filtration solutions to achieve the desired quality and production requirements

THANK YOU !

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