COMBINATION FILTRATION FOR REMOVING DIVALENT SALTS AND CONTAMINANTS FROM MONOETHYLENE GLYCOL (MEG) RECLAMATION UNITS

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BHS Introduction & Experience

- Amine Filtration for $\text{SO}_2$ Scrubbing
- Amine Filtration for $\text{CO}_2$ Scrubbing
- Water Scrubbing-Downstream of Clarifiers
- Grey Water Filtration
- Gasification
- Bioenergy / Biochemical
- MEG Filtration
BHS Concentrating Candle Filters & Pressure Plate Filter: Amine Filtration
BHS Candle Filters with Activated Carbon for Amine Filtration
BHS Candle Filters for Amine Sweetening
Downstream of Clarifiers for Water Scrubbing
Downstream of Clarifiers for Water Scrubbing
BHS Candle Filters-Amine Sweetening from Coker & Cracker Streams
BHS Concentrating Candle Filters for Grey Water from Coal Gasification
In the natural gas industry, hydrate formation is a well-known problem which requires close attention and follow-up. It may cause slower gas flow and finally block the gas pipe flow and stop the production. It may also damage equipment and create safety issues and extra cost.
Presentation Overview

Hydrate control methods

Hydraulic methods:
- Fluid displacement
- Gas sweep
- Depressurisation
- Compression
- Dense phase

Water removal:
- Gas dehydration
- Water cut reduction

Chemical methods:
- Methanol
- Ethylene glycol
- Low dosage inhibitors
- Salt
- Natural inhibition
- Hydrate region operation

Heating methods:
- Bundles
- Heat tracing

No hydrate control measures
Introduction

- MEG (Mono Ethylene Glycol) is used as a hydrate and corrosion inhibitor in natural gas pipelines.
- After separation of the gas, “rich MEG” (MEG and formation water) is treated in reclamation units to recover the MEG.
- The rich MEG is regenerated into a lean, high purity, salt-free MEG for reuse.
- Carbonates and Hydroxides from mono and divalent cations precipitate during evaporation of the water.
- The precipitated salts lead to clogging in pipes and heat exchangers.

Particles have to be precipitated prior to thermal regeneration and removed from the rich MEG.
Typical Process Parameters for MEG Reclamation

- Suspended Solids Content in Rich MEG: 50-1000 ppm (divalent salts, corrosion products, debris and other solids)
- Particle size distribution: 5-50 µm
- Temperature: 50 - 80 °C
SELECTION OF FILTRATION TECHNOLOGY FOR MEG PROCESS

- Filtration of the Rich MEG for Regeneration
- Filtration of the Salt Brine

- **Candle Filtration** with Precoat for Varying Process Conditions & Hydrocarbons

- Combination of Alternative Concentrating Technologies (static thickeners, disc stack centrifuges, decanter centrifuges) followed by **Pressure Plate Filtration**

- **New BHS Option:** Combination of Concentrating Candle Filtration and Pressure Plate Filtration
BHS Candles Filters with Precoat: Offshore in South China Sea

- Three Candle Filters
- Mono Ethylene Glycol
- Filtration for Regeneration
Conventional Single-Stage Process: Precoat Filtration with Candle Filters

- **Candle filters**: Displace MEG from the solids by drying with compressed gas (typically N₂).

- Due to the low solid content a precoat layer (Perlite) is applied before filtration.

- The separated salts and precoat can be discharged as a dry filtercake.
Combination Process: Concentrating and Filtration

- Combination of Alternative Concentrating Technologies (static thickeners, disc stack centrifuges, decanter centrifuges) followed by Pressure Plate Filtration
Combination Process: Concentrating and Filtration

- **Pressure Plate Filters:** Maximum efficiency for cake wash due to the horizontal filter plates.

- MEG is displaced by water.

- The separated and washed salts can be discharged as a dry filtercake.

- A further significant reduction of MEG in the filter cake is possible.
Combination Process: Concentrating and Filtration

- Combination of Alternative Concentrating Technologies (static thickeners, disc stack centrifuges, decanter centrifuges) followed by **Pressure Plate Filtration**

- Problem: High-speed separators and centrifuges have high wear due to the abrasive salts; high costs and energy usage; & dynamic loads.
BHS Objective is to Improve the Filtration, Washing & Drying

- Solving a filtration problem for divalent salts based upon BHS amine experience:
  - Lab testing, Pilot testing & Scale-Up,
  - Performance Guarantees
- Lab Testing Results
  - Cake Thickness and Filtration
  - Filter Media
  - Cake Washing
  - Cake Drying
  - Cake Discharge
BHS Laboratory Tests
BHS Process Development: Combination Process Based Upon Amine Filtration Experience

- Concentrating Candle Filtration
- Followed By
- Pressure Plate Filtration for
  - Final Washing for MEG removal
  - Final Drying for Salt Disposal
  - No Free Liquid
Combination Process: Concentrating and Filtration

The Process Operation

- **Candle Filter Plant**
  - Prethickening
  - Slurry → Filtrate → Sludge discharge

- **Homogenisation and Buffering**
  - Transport

- **Pressure Plate Filter Plant**
  - Filtration and cake wash
  - Filtrate
  - Solids (washed and predried)

- **Wash Water Tank**
  - H₂O → Cake wash
Combination Process: Concentrating and Filtration

Concentrating Candle Filters (60 m²) to Pressure Plate Filtration (8 m²) - Typical Reduction
Comparison of Capital and Operating Costs

- Investment costs are about 30% less than the Conventional Single Stage Process with Precoat
- Operating Costs are about 80% less
  - No filter aid (no Perlite consumption)
  - Lower MEG replacement
  - Low energy usage (Low Nitrogen consumption)
  - Low wash water usage
- Finally, the Combination Process
  - Reduces MEG loss by a factor of 30 (High MEG Recovery)
  - Provides dry salt for discharge
Combination Process: Concentrating and Filtration

Breakdown of operational costs

Proportion of costs in relation to the conventional single-step process (in %)

<table>
<thead>
<tr>
<th>Material</th>
<th>Conventional Single-Step Precoat Filtration</th>
<th>BHS Combination Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perlite</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>MEG</td>
<td>0%</td>
<td>50%</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>0%</td>
<td>20%</td>
</tr>
<tr>
<td>Power</td>
<td>0%</td>
<td>10%</td>
</tr>
<tr>
<td>Water</td>
<td>0%</td>
<td>5%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
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- **New BHS Option:** Combination of Concentrating Candle Filtration and Pressure Plate Filtration
THANK YOU!

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