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MATERIALS
INTO VALUE

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

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BHS Introduction & Experience

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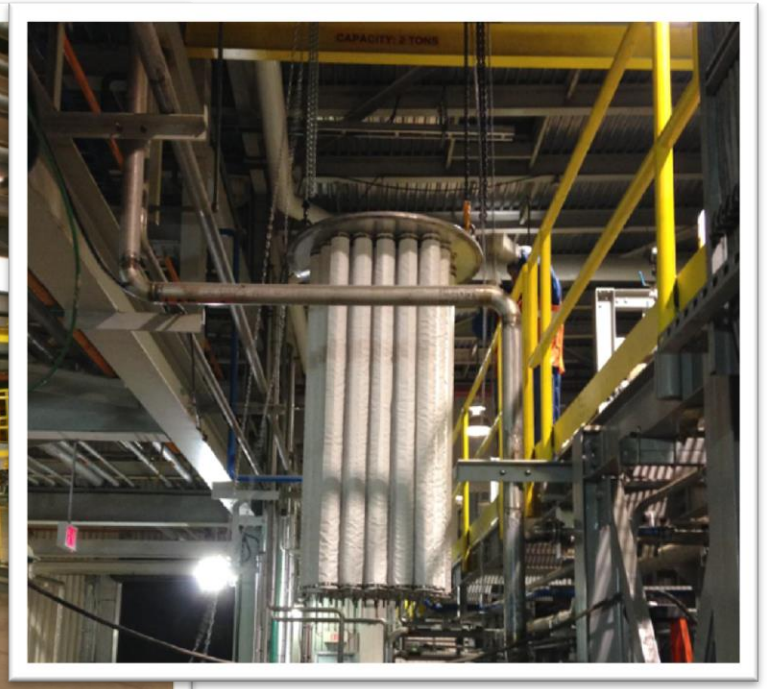
- **Amine Filtration for SO_2 Scrubbing**
- **Amine Filtration for CO_2 Scrubbing**
- **Water Scrubbing-Downstream of Clarifiers**
- **Grey Water Filtration**
- **Gasification**
- **Bioenergy / Biochemical**
- **MEG Filtration**

BHS Concentrating Candle Filters & Pressure Plate Filter: Amine Filtration



BHS Candle Filters with Activated Carbon for Amine Filtration

BHS Candle Filters for Amine Sweetening

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Downstream of Clarifiers for Water Scrubbing

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Downstream of Clarifiers for Water Scrubbing

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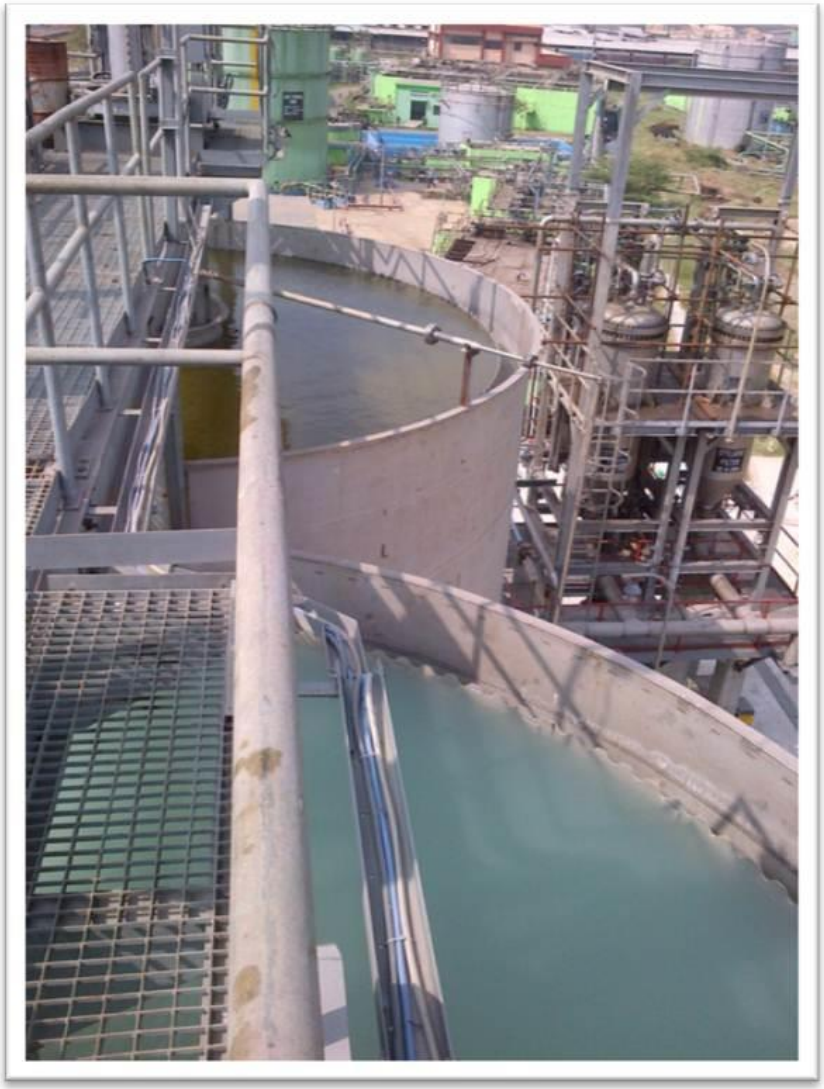


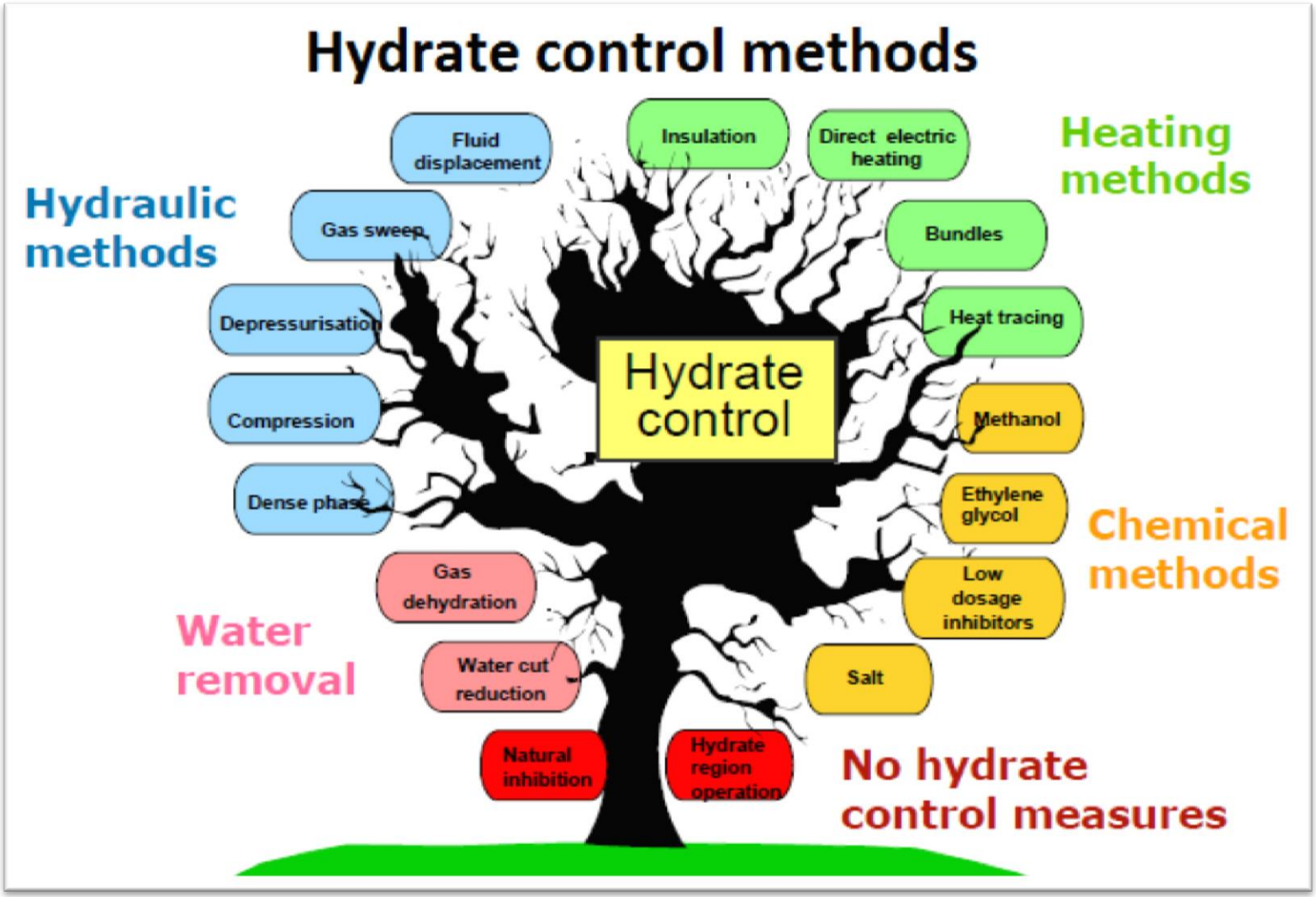
BHS Candle Filters-Amine Sweetening from Coker & Cracker Streams

BHS Concentrating Candle Filters for Grey Water from Coal Gasification

Presentation Overview

- **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



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**

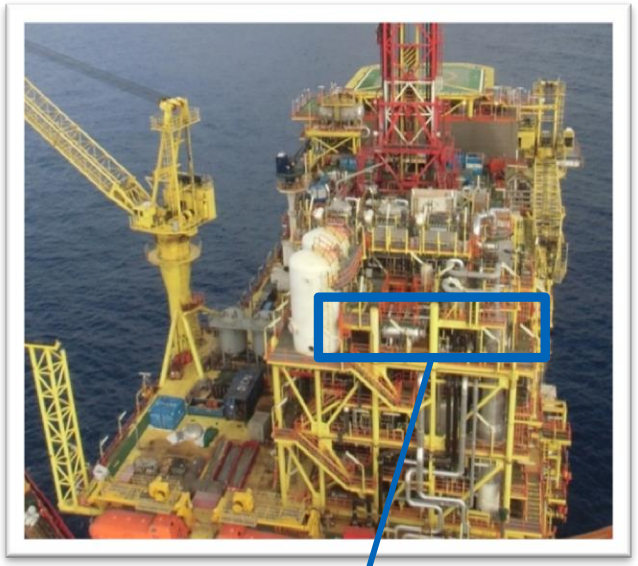
SELECTION OF FILTRATION TECHNOLOGY FOR MEG PROCESS

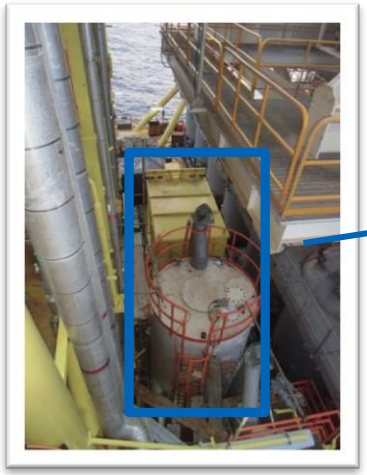
- **Filtration of the Rich MEG for Regeneration**
- **Filtration of the Salt Brine**

- **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

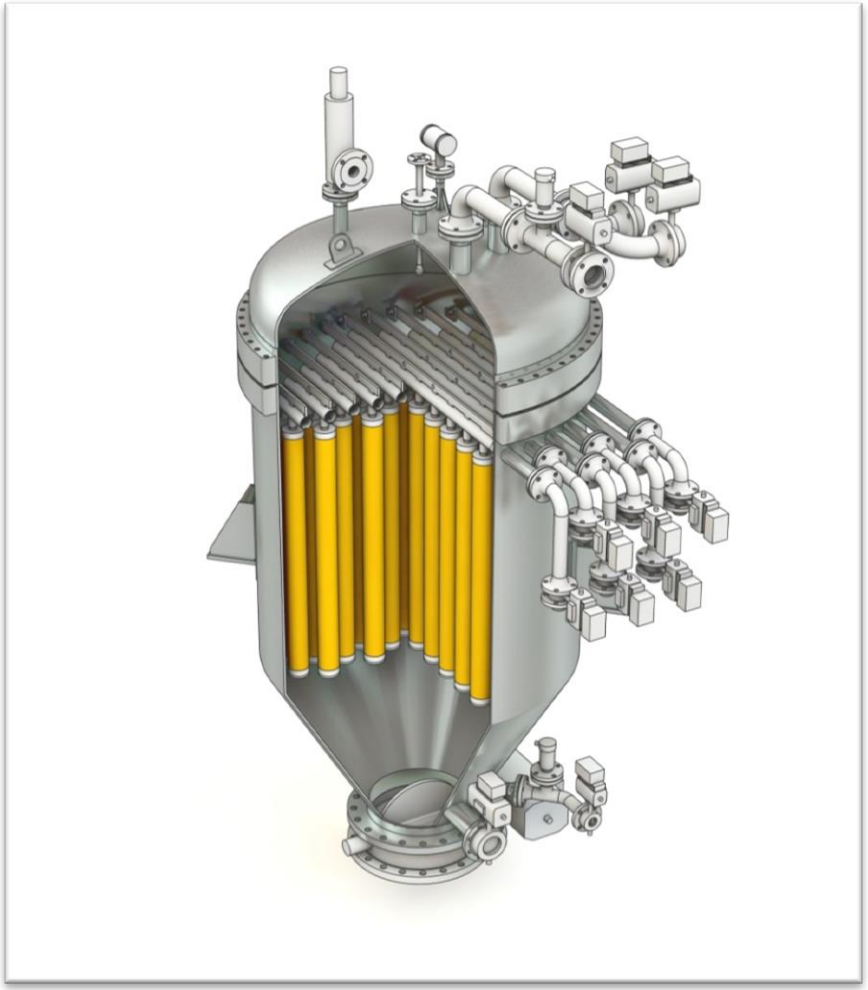
- Three Candle Filters
- Mono Ethylene Glycol
- Filtration for Regeneration





Conventional Single-Stage Process: Precoat Filtration with Candle Filters

- **Candle filters: Displace MEG from the solids by drying with compressed gas (typically N_2).**
- **Due to the low solid content a precoat layer (Perlite) is applied before filtration.**
- **The separated salts and <u>precoat</u> 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

SELECTION OF FILTRATION TECHNOLOGY FOR MEG PROCESS

BHS Process Development: Combination Process Based Upon Amine Filtration Experience

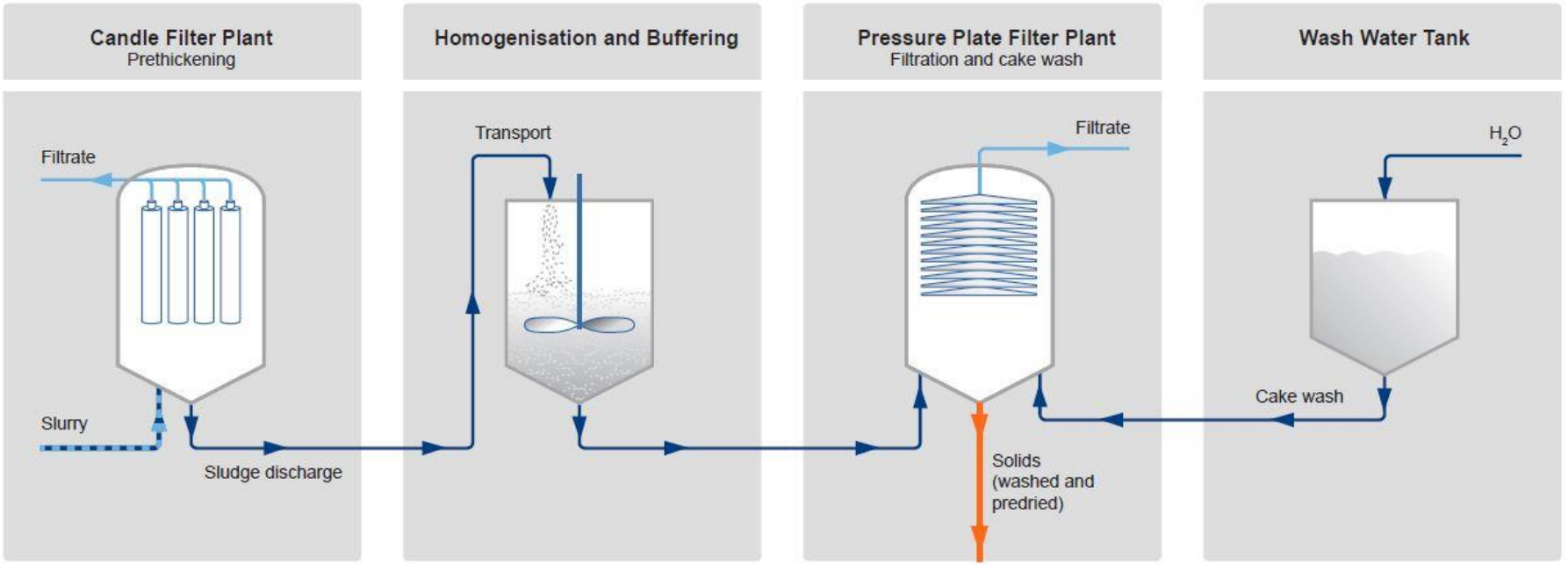
- **Concentrating Candle Filtration**

  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



Combination Process: Concentrating and Filtration

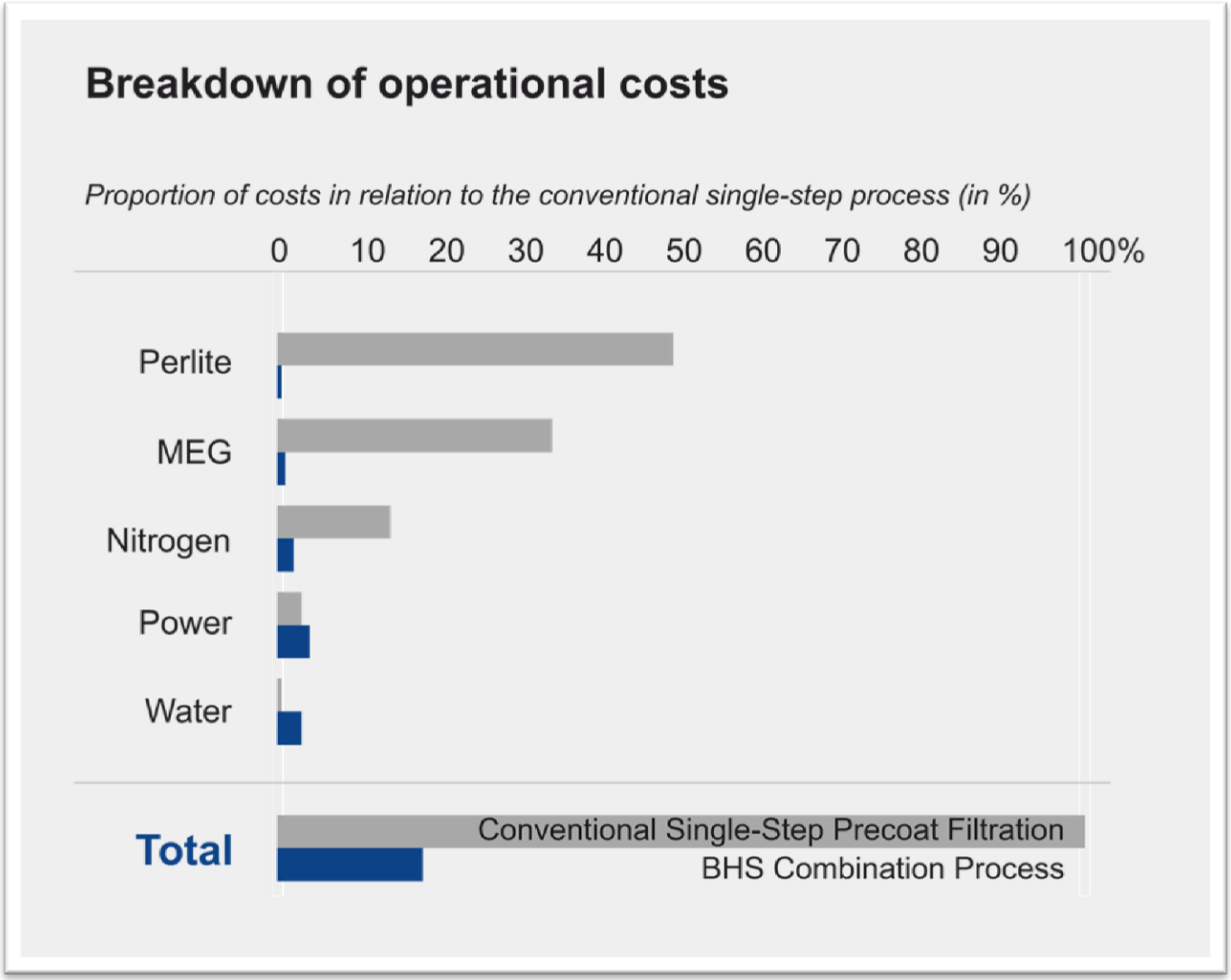
Concentrating Candle Filters (60 m^2)to Pressure Plate Filtration (8 m^2)-Typical Reduction

Combination Process: Concentrating and Filtration

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



SELECTION OF FILTRATION TECHNOLOGY

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- 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**
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THANK YOU!

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