REAL WORLD EXAMPLES OF INFLUENCES OF PARTICLES AND CAKE FORMATION ON SOLID-LIQUID SEPARATION TECHNOLOGY OPERATION

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Particle Influences on Filtration

- BHS Introduction & BHS Testing
- Continuous Rotary Pressure Filter
  - Particle Size Distribution Changes
- Batch Candle Filter
  - Chemical Changes
- Batch Pressure Plate Filter
  - Cake Structure Changes
- Summary
BHS-Sonthofen GmbH
Filtration, Mixing & Recycling
BHS-Sonthofen Inc.
Filtration, Mixing & Recycling
BHS Technology

Rotary Pressure Filter  Indexing Belt Filter  Rubber Belt Filter

Candle Filter  Pressure Plate Filter  Autopress
BHS-Sonthofen Inc.
Filtration Laboratory
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Pressure Filtration

• Filtration Pressure
• Filter Media
• Flow Measurements
• Cake Washing
• Cake Drying
• Cake Discharge
• Cake Thickness
• Cycle Times
• Observations
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Pressure Filtration
BHS Rotary Pressure Filter

Specialty chemical application: particles changed from lab scale to production scale
Continuous Pressure Filtration: Particles changed from lab to production

The existing process is as follows:

- Batch crystallizer operating at 0 – 5 degrees C with 13- 20% solids.
- Filtration is currently a vacuum batch operation. The vacuum filtration for 6-inch cake is fast.
- There is a heptane wash.
- There is a drying / blowing step to remove the heptane down to 1.0 – 0.5%.
- Then the product is fully dissolved in methanol for pumping to another downstream reactor.
Continuous Pressure Filtration: Particles changed from lab to production

- With filtration area and driving force held constant, filtration rate varies inversely with mother liquor viscosity, cake resistance.

- A 16% decrease in filtration rate will occur when cooling the slurry from 15 degrees C to 5 degrees C.

- Additional slowing of the filtration rate in the 18 inch filter cakes is due to a non linear relationship between cake resistance and cake thickness.

- Cake resistance is linear with cake thicknesses up to 5 inches which is the design cake height.

- Filtration rate data for current slurry for a 5 inch cake is consistent with the data used to design the commercial filter. *No change in the commercial filter is needed.*
BHS Rotary Pressure Filter

New Process: Continuous Reaction to Continuous Pressure Filtration
Rotary Pressure Filter Components
Continuous Pressure Filtration: PSD Changed from Lab to Production

- With Continuous Reaction:
  - PSD became a dual distribution

- Result:
  - Change filter media
  - Reduce cake thickness to 2.5 inches from 5 inches
  - Change cloth wash pressure and solvent
Grey Water Treatment Units Without Filter Aid-Concentrating

- In this application, the wet scrubber water purge is pumped to a clarifier for primary removal of large catalyst solids. The clarifier overflow discharges to an oxidation tower and the effluent from the tower is pumped through the effluent filter and heat exchanger prior to discharge.

- The flow rate is 46 m³/hour with a solids concentration of 200 ppm. The particle size is below 1.0 micron. Initially, backwashable metal cartridges were planned but the low dirt holding capacity and the frequent backwash was estimated to be uneconomical.

- The benefits of the candle filter included clear filtrates to less than 1 ppm & less backwash to the clarifier as the candles are “cleaned” with compressed gas and not liquid.
BHS Candle Filter Technology
BHS Candle Filter Technology

- Vertical cake surface
- Materials: 316L SS, PP, Hastelloy/Alloys
- Dip tube open at bottom
- Outer perforated structure
- Vertical tie rods
- Cloth media
BHS Candle Filter Technology

Cake discharge by sock expansion
Grey Water Treatment Units Without Filter Aid - Concentrating
Filtration System Troubleshooting

Three main areas that must be examined:
• The filter itself for mechanical reasons
• The equipment around the filter is not working
• The filter operational procedures are not correct

Troubleshooting The Purge Water Treatment Unit (PWTU)
• In a clarification application previously discussed, the system was installed and started-up and successfully ran for over one-year.
• Inexplicently, the performance changed and the filter media began plugging very quickly during the cycles.
Process Examination:
- Clarifier overflow with no coagulant / no flocculants
- Clarifier overflow with only coagulant / no flocculants
- Clarifier overflow with both coagulant and flocculants
- Clarifier overflow with only flocculants / no coagulant

Results:
- The chemical change caused the larger particles to settle out; only the smaller particles reached the filtration system which was blinding the filter media.
- The flocculants were eliminated - coagulant usage reduced (better for the client/not for the chemical supplier)
- Result is a consistent PSD and better filtration rates.
- Once again, we see the systems and holistic approach to process filtration.
Batch Pressure Filtration and Changes in Cake Structure

- Client uses a filter press to process a 1000 gallon batch of Sodium Molybdate
- This operation takes about 48 hours.
- Client Objective: Reduce batch time to 3 hours
- Lab Testing with BHS Pocket Leaf Filter
Batch Pressure Filtration and Changes in Cake Structure

Scale Up: Based on the benchtop testing of the Sodium Molybdate solution will be processed on the BHS Pressure Plate filter, the scale up was based on processing 3785 l in two batches in a 2-3 hour period.

- Slurry Volume = M : 300 ml
- Filter area: 20 cm²
- Cake height: 12-30 mm
- Filtration time: 20 minutes
- Wash time: 11 minutes
- Drying Time: 5 minutes
- Cycle time total: 68 min

The recommended filter for this application is PF 1017 with 13.2 m² of filter area
BHS Pressure Plate Filter
BHS Pressure Plate Filter

- Horizontal cake surface
- Materials: 316 SS or Alloys
- Conical Disk
- Support Screen
- Cloth media or metal mesh
BHS Pressure Plate Filter

Cake discharge by mechanical vibration and air assist
Batch Pressure Filtration and Changes in Cake Structure

Pilot Testing

• Initial Results Showed a Difference between Lab Testing and Pilot Testing
• First change: filter media
• Second change: temperature of the slurry
• The results still showed a difference in design

New Approach

• Develop a more even cake structure by slowly ramping up the filtration pressure from 15 – 30 psig and then to 60 - 90 psig
• Based on this approach, the process is 23 minutes
  This is faster than predicted by the Lab testing
Summary of BHS Process Filtration Solutions

Sherlock Homes and Dr. Watson

No jumping to conclusions

- Engineers must evaluate all outcomes to make an informed and successful decisions
- Close collaboration between the client and BHS provides for creative problem-solving for process filtration solutions