Processing of Refinery Wastes for Quench and Feed-Cycle Injection in Delayed Cokers

A VWA HPI Service

Alan Okun
Sr. Business Development Manager
3-7 August, 2009 Rio de Janeiro, Brazil

Coking.com®

VEOLIA WATER
Solutions & Technologies

Who we are…

- Leader in On-site Refinery Waste Processing with
  50 Long-term DBOOM Projects
- Veolia Environment
  has >250,000 Employees
  Worldwide
- With >28,000 Employees in
  North America
- Revenues Exceeding
  $40 billion
- Publicly-traded on the NYSE and
  French Bourse Exchange

VEOLIA WATER
Solutions & Technologies

2

Clients in Portfolio

Why Process and Recycle Refinery Wastes Back to the Coker?

- Environmental - Recycling of hazardous wastes via introduction into the coking process presents the refinery with the least amount of environmental liability. In this scenario, the material is not classified as a waste because it is being recycled as part of legitimate production, so a number of the regulatory liabilities are removed.
- Cost Savings - Provides a means to manage wastes “within-the-fence” without incurring outside disposal or transportation costs.
- Oil Recovery - During Feed-Cycle Injection the oil will go through the entire coking process. The oil will go into the coke bed or go overhead with the lighter products. During the Coker Quench process any residual amounts of entrained oil will pass through the coke bed and either go into the coke product or go overhead with the lighter products.

VEOLIA WATER
Solutions & Technologies

Case Study: Texas Refinery – Quench-Side Coker Injection

- Contract for oil bearing secondary materials separation and quench-side Coker injection
  - Processing of 3,000 bbl/day, injection of 400 bbl/cycle into Coker drums
  - On Site since 1999
  - Comprehensive DBOOM approach on a service fee basis
  - Includes processing of third party oil bearing materials into coker at incremental fee
  - Eliminates hazardous waste leaving the refinery gates
  - **Savings and revenue to the refinery in excess of USD $1,500,000/year**

VEOLIA WATER
Solutions & Technologies

Case Study: California Refinery Feed–Side Coker Injection

- Contract for oil bearing materials separation and feed-side coker injection
  - Processing of 600 bbl/day, injection of 100 bbl/cycle into Coker drum
  - On Site since 2004
  - Comprehensive DBOOM approach on a service fee basis
  - Eliminates hazardous waste leaving the refinery gates
  - Recycles oil to the Coker
  - **Savings to the refinery are in excess of USD $1,000,000/year**

VEOLIA WATER
Solutions & Technologies

Case Study: Delaware Refinery Fluid-Bed Coker Injection Same Formulation as Feed-Side Slurry

- Fluid coking is a continuous process in which heated coker feeds are sprayed into a fluidized bed of hot coke particles which are maintained at 20-40 psi and 500°C. The feed vapors are cracked while forming a liquid film on the coke particles. The particles grow by layers until they are removed and new seed coke particles are added.
- Contract for oil bearing materials separation and feed-side injection
  - Processing of 500 bbl/day, injection of 100 bbl/day into Coker drum
  - On Site since 1993
  - Comprehensive DBOOM approach on a service fee basis
  - Remove 97% of water w/centrifuge and dryer eliminates hazardous waste leaving the refinery gates
  - For every bbl of water injected, you need to back out 4 bbls of feed into the Coker

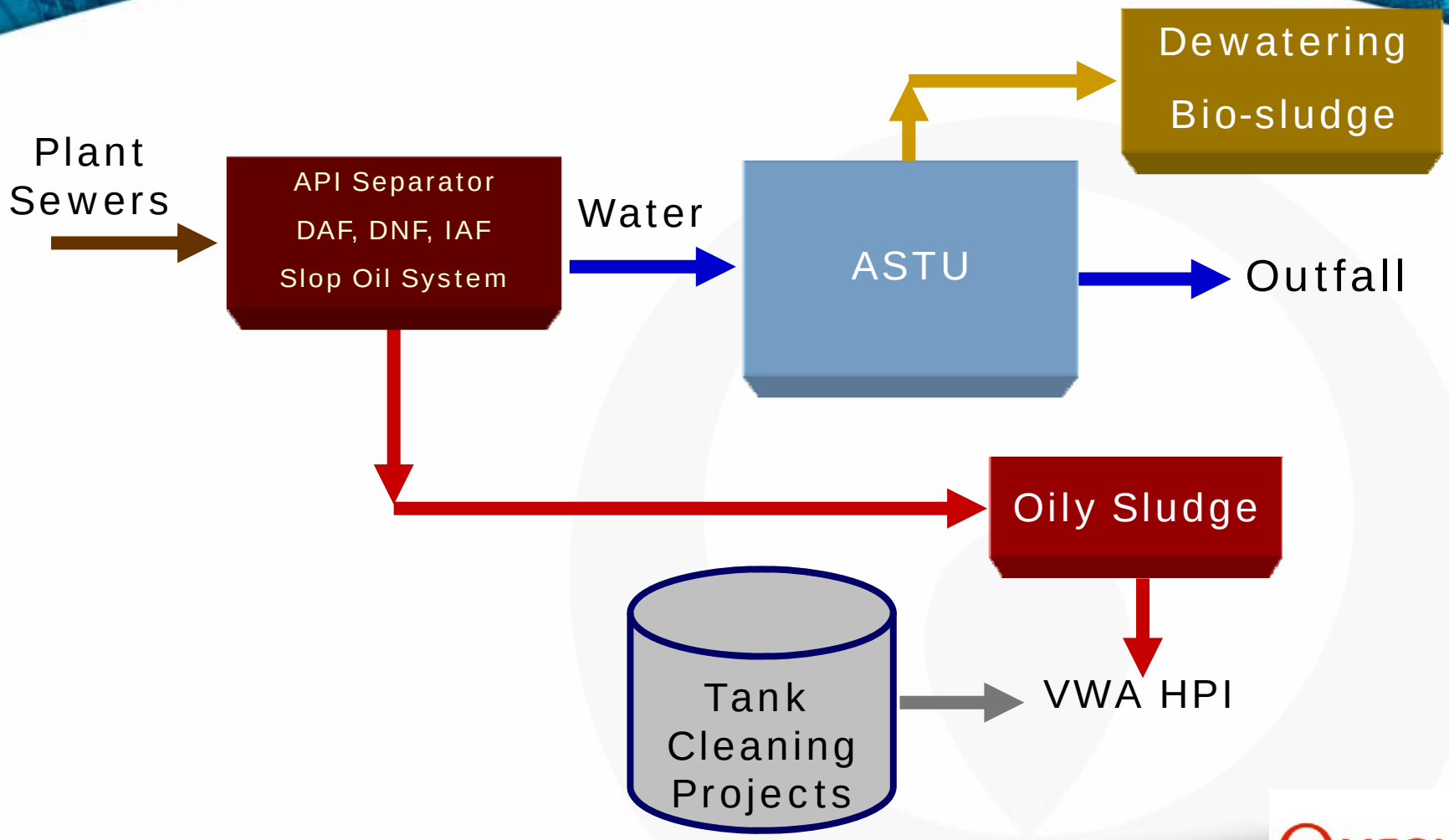
VEOLIA WATER
Solutions & Technologies

Optimized Annual Benefit to Delaware Refinery With Water Removal- 2008

- Average Sludge Processed: 14,000 bbl/month
- Water Content in Feed: 70%
- Remove 97% of water (centrifuge and dryer): 9,506 bbls (water removed)/month
- For every bbl of water injected, you would need to back out 4 bbls of resid into the Coker
- 4 (bbl of resid) x 9,506 (bbl of water) = 38,024 (additional bbls. of resid available to the Coker)
- 38,024 x $18/bbl Coker margin = $684,432/month
- Monthly Cost of Feed-side slurry Program: $200,000 (includes chemicals, utilities, and material transfer)
- $684,432 (Benefit) - $200,000(Processing Cost) = $484,432 per month (Benefit)
- x 12 months = **$5,813,184 (annual benefit)**

VEOLIA WATER
Solutions & Technologies

VWA

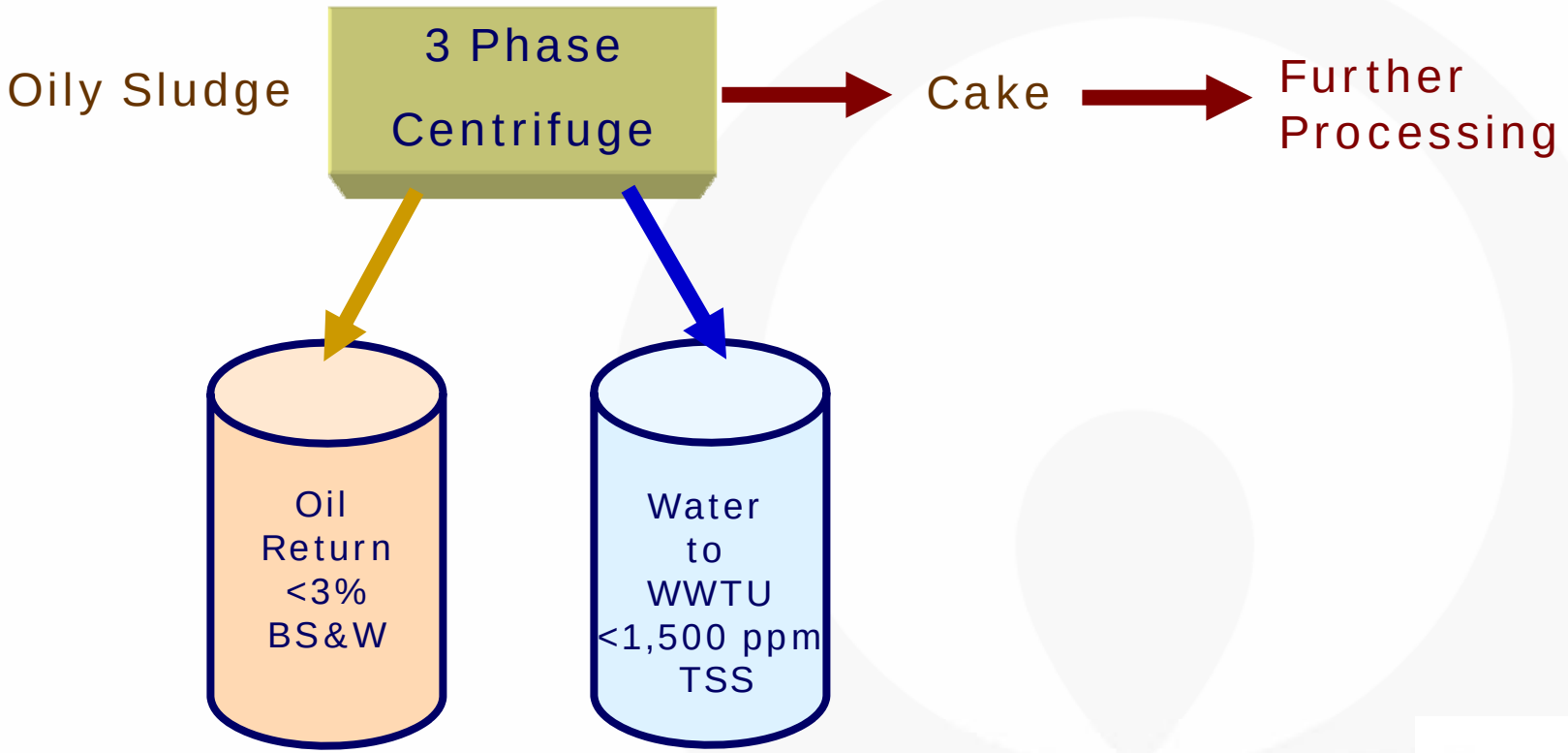

Plant
Sewers
API Separator
DAF, DNF, IAF
Slop Oil System
Water
ASTU
Dewatering
Bio-sludge
Outfall
Oily Sludge
Tank
Cleaning
Projects
VWA HPI

Waste Types:

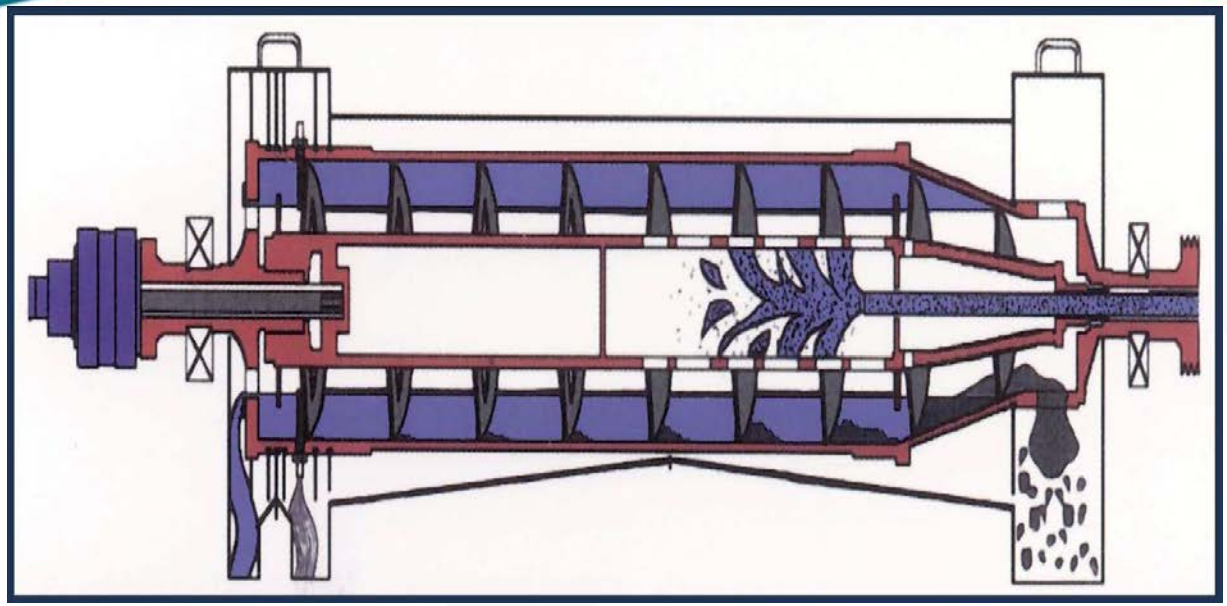
- Refinery Oil Sludge
- DAF Float
- Slop Oil Emulsions
- Heat Exchanger Bundle Cleaning Sludge
- Tank Bottoms
- Petroleum Oil Water Solids Separation Sludge
- Secondary Emulsified Oil Water Separation Sludge
- Crude Oil Storage Tank Sediment
- Clarified Slurry Oil
- Desalter Emulsions
- Tank Cleanouts
- WAS (Bio-Sludge)

VEOLIA WATER
Solutions & Technologies

First Stage Waste Reduction - Centrifugation



3-Phase Centrifugation



- Process Solutions 3000/3 Centrifuge
  - Up to 3,000 x “g”
    (Variable Frequency Drive Bowl Speed Control)
  - Hydraulic Scroll Drive (Controls Differential)
  - Adjustable Oil Nozzles

VEOLIA WATER
Solutions & Technologies

Centrifuge Cake - Typical Mass Balance

Basis: 1000 bbl Feed (approximately 160 m^3)

Solids Capture =	90%
Feed Specific Gravity =	1.0
Oil Specific Gravity =	0.904

Feed Composition:				
	5%	Solids	8000	kg
	15%	Oil	24000	kg
	80%	Water	128000	kg

Solids Captured = 7200 kg

Centrifuge to Produce Cake

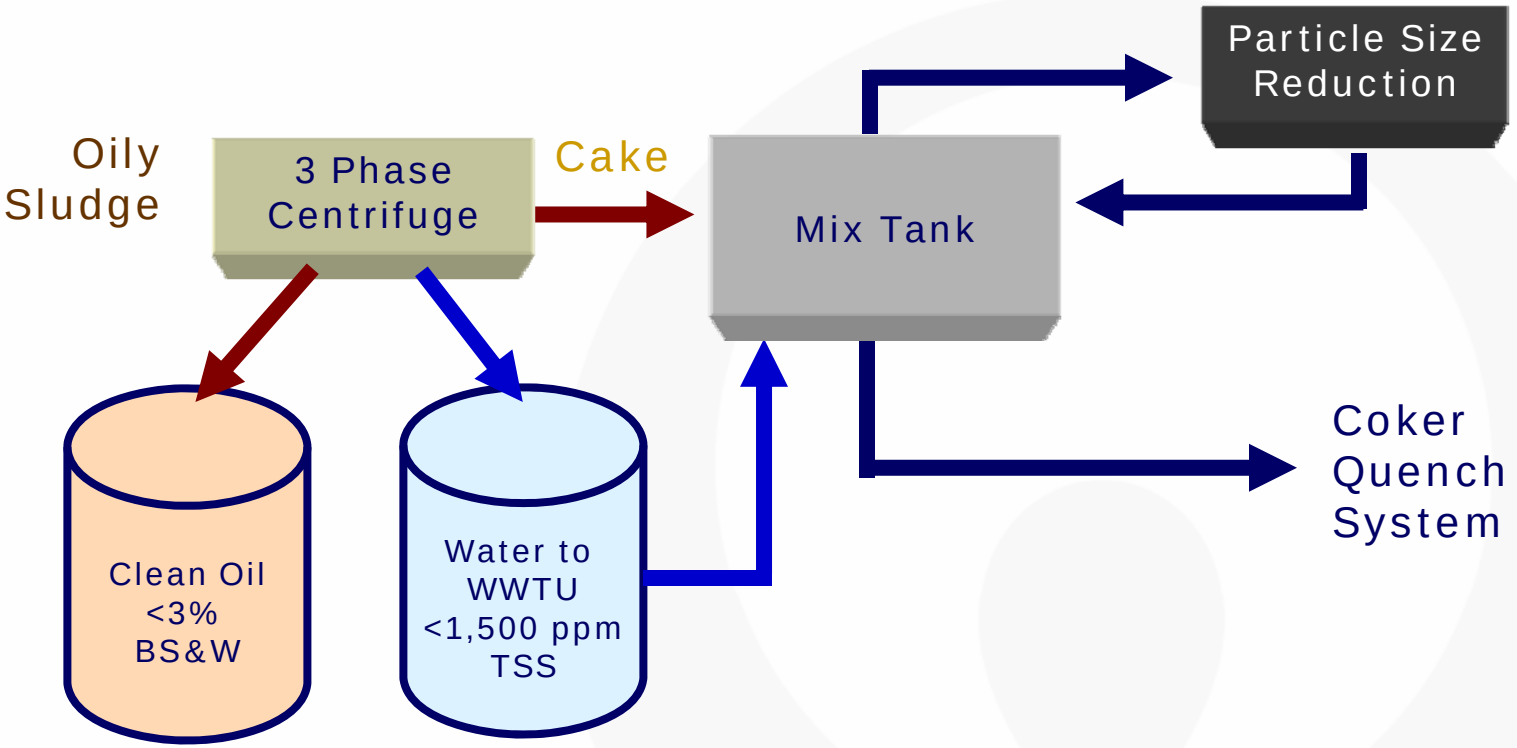
Cake produced = 18000 kg

Cake Composition:				
	40%	Solids	7200	kg
	10%	Oil	1800	kg
	50%	Water	9000	kg

Oil returned = 22200 kg or 154 bbl

VEOLIA WATER
Solutions & Technologies

Coker Quench - Second Stage Processing



Coker Quench - Typical Mass Balance

Basis: 1,000 bbl Feed (approximately 160 m^3)

Cake Produced = 18000 kg

Cake Composition:	40%	Solids	7200	kg
	10%	Oil	1800	kg
	50%	Water	9000	kg

Coke Produced = 1000 tonne per day

Allowable ash (solids) addition = 1% of coke made = 10000 kg of solids per day

Quench Slurry Composition	15%	Solids	7200	kg
	4%	Oil	1800	kg
	81%	Water	39000	kg

Quench Slurry Specific Gravity = 1.036

Total Quench Slurry = 48000 kg = 46 m^3 = 290 bbl

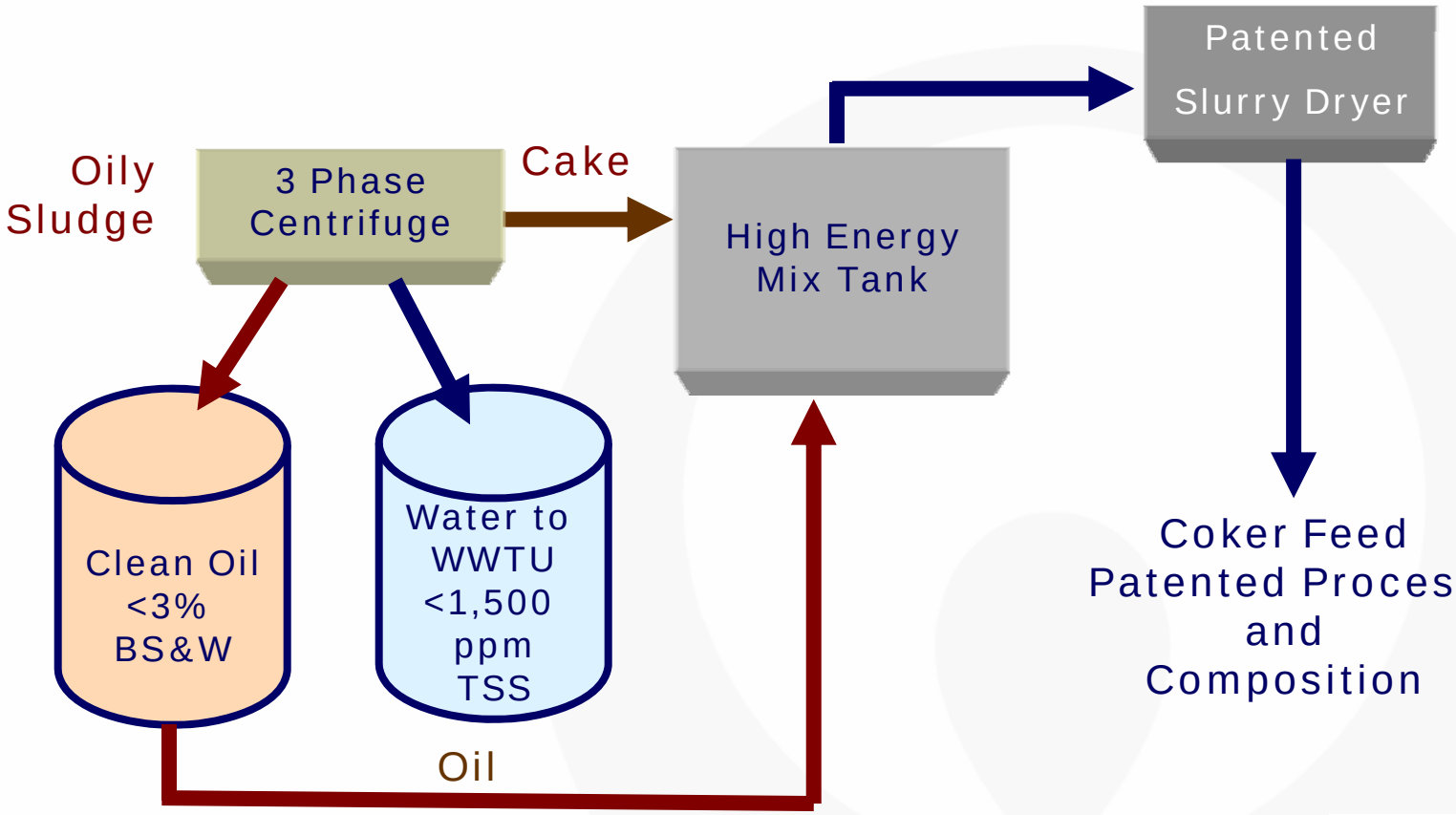
VEOLIA WATER
Solutions & Technologies

Coker Quench-Side Slurry Injection Process Summary

- Free oil is removed from the cake which is then blended with water to produce a slurry that is approximately 15% by weight solids. This aqueous slurry is injected into the coker during the water quench phase of the coking cycle.
- Because this material is introduced to the coker after the coke bed has formed, the solid particles must be reduced in size to increase their permeability through the bed (>70% must be <100 microns for even distribution through the coke bed).
- Coker quench injection is economically attractive because it does not require additional equipment or energy to remove water from the waste prior to injection.
- Quench-side coker injections do not have the same impact on coker feed rates that are seen with feed-side injections because the aqueous slurry simply replaces quench water that would otherwise be used after coking is completed.
- May only be added at the start of the quench cycle. Must stop when overhead temperature reaches 550 F. Maximum slurry weight 15% solids. Must be less than 5% oil by volume.

VEOLIA WATER
Solutions & Technologies

Coker Feed-Side Slurry – Second Stage Processing



Coker Feed-Side Slurry- Typical Mass Balance

Basis: 1000 bbl Feed (approximately 160 m^3)

Cake Produced = 18000 kg

Cake Composition:				
	40%	Solids	7200	kg
	10%	Oil	1800	kg
	50%	Water	9000	kg

Adjust oil to solids ratio to produce dry fuel

Feed-side slurry composition:				
	45%	Solids	7200	kg
	52%	Oil	8320	kg
	3%	Water	480	kg

Feed-side slurry Produced = 16000 kg = 83 bbl (recycled in coker)

Oil to add:		
8320	kg oil required	
-1800	kg oil in cake	
6520	kg oil to add	
45	bbl oil to add	

Oil returned = 15680 kg or 109 bbl

VEOLIA WATER
Solutions & Technologies

Coker Feed - Summary Points

- Feed-side injection can be performed in the period where the resid is being fed to the drums which translates into a wide timing window to introduce feed-side slurry. It may be added at any time after 1 hour of starting the coking cycle to 1 hour prior to ending the coking cycle.
- Feed-side slurry is Introduced at a Low Feed Rate (30-70 gpm) and Low Water (3%)
- Because modifications to coke drums are costly and can only be completed during unit turnarounds, the use of existing nozzles and piping is generally desired. Possible injection points exist in the residual feed line, the antifoam injection line, and virtually any existing nozzle large enough to accommodate the necessary flow.
- Ash Increases of 0.2% to 0.7% are to be expected.
- Cat slurry oil from the bottom of the ash tanks, stock can be fed into Waste Streams and some crude tank bottoms if cut with the feed tank without centrifugation.
- There is no chance of odors or hotspots when the drum is deheaded.
- Feed-side slurry Allows for 35%-45% Solids Loading
- Greater solids loading allows for approx. 2/3 less waste volume going to the coker than quench side injection.

Typical Mass Balances Comparisons

Process	Oil Used (bbls)	Oil Returned (bbls)	Solids to Coker (kg)	Total Volume Sent to Coker (bbls)
Coker Quench	12 (mostly entrained)	154	7200	290
Feed-side slurry	58	109	7200	83

Although there are equal amounts of solids going to the coker, you need to inject 3.5 times more volume with Quench side injection.

VEOLIA WATER
Solutions & Technologies

Muito Obrigado!

alan.okun@veoliawaterna.com

VEOLIA WATER

Solutions & Technolc