Ethylene Middle East Technology Conference

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IMPROVEMENT IN ASSET UTILIZATION AND PRODUCTIVITY IN THE FILTRATION/SEPARATION OF QUENCH WATER

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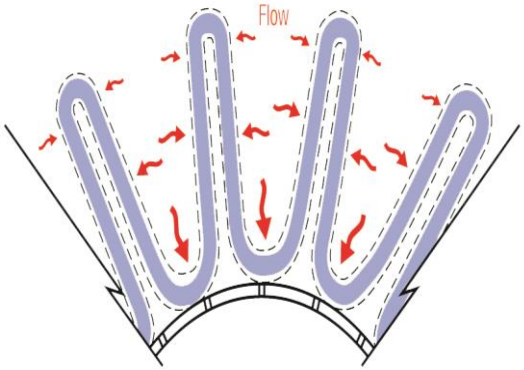
The major issues with process water in crackers

- **This is the process water that is utilized to make dilution steam for the furnaces, not the circulating water in water quench tower.**
- The problem is acute in gas crackers. The process water has high levels of coke and sticky tar.
- Oil contaminated water results in:
  - Heat exchangers and reboilers being cleaned frequently.
  - Premature shutdown of steam stripper and reboiler of the dilution steam generator.
  - Excessive use of steam in the stripper.
  - Use of fresh demineralized water to make extra dilution steam
  - Production of dirty waste water impacting waste treatment plant

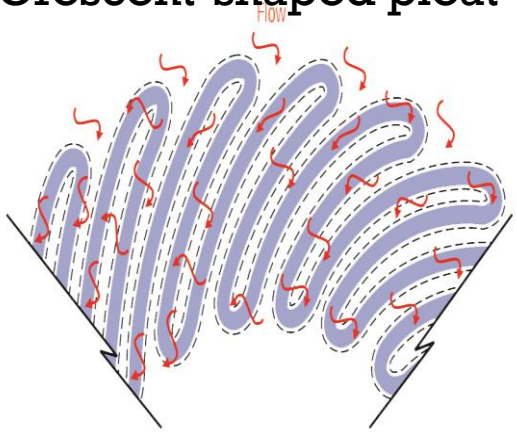
Pleated Filter Element

Pleated high surface area filter media captures fine contaminant particles

Fan pleat



Crescent-shaped pleat



Coalescence Principles

Coalescence = Removal of a fine dispersed liquid phase or gas phase from bulk phase

Liquid/Liquid coalescers = Removal of liquid **DROPLETS** from a liquid---break emulsion, remove pygas from water

Coalescence principle: MECHANICAL separation based on the ability of the coalescer media to combine droplets and separate them

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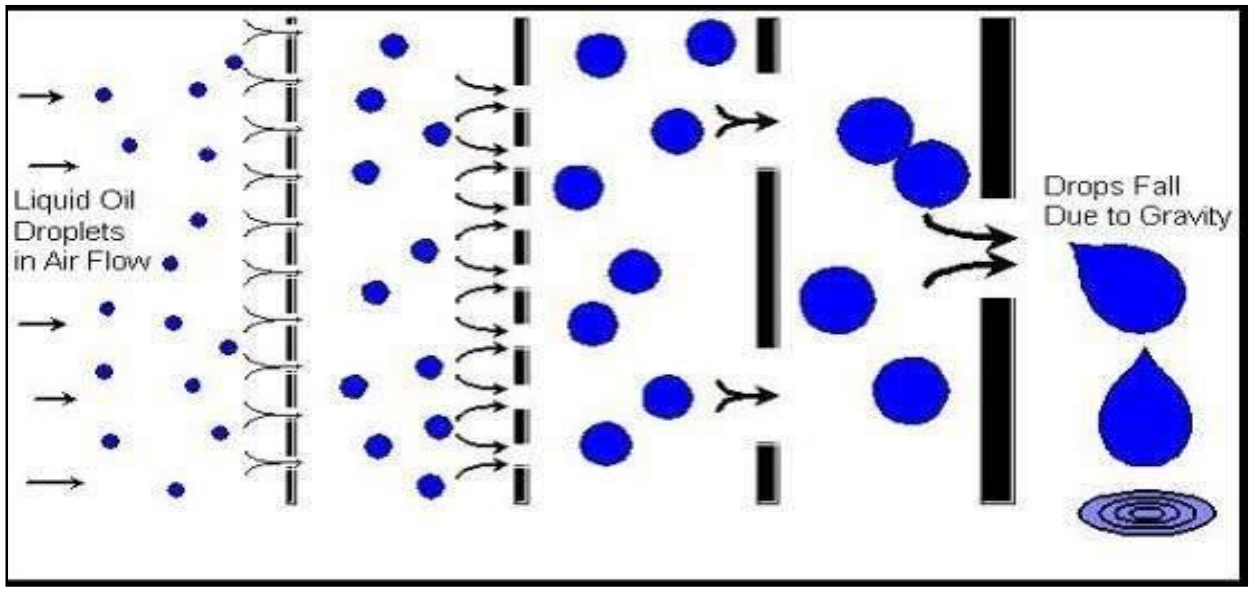
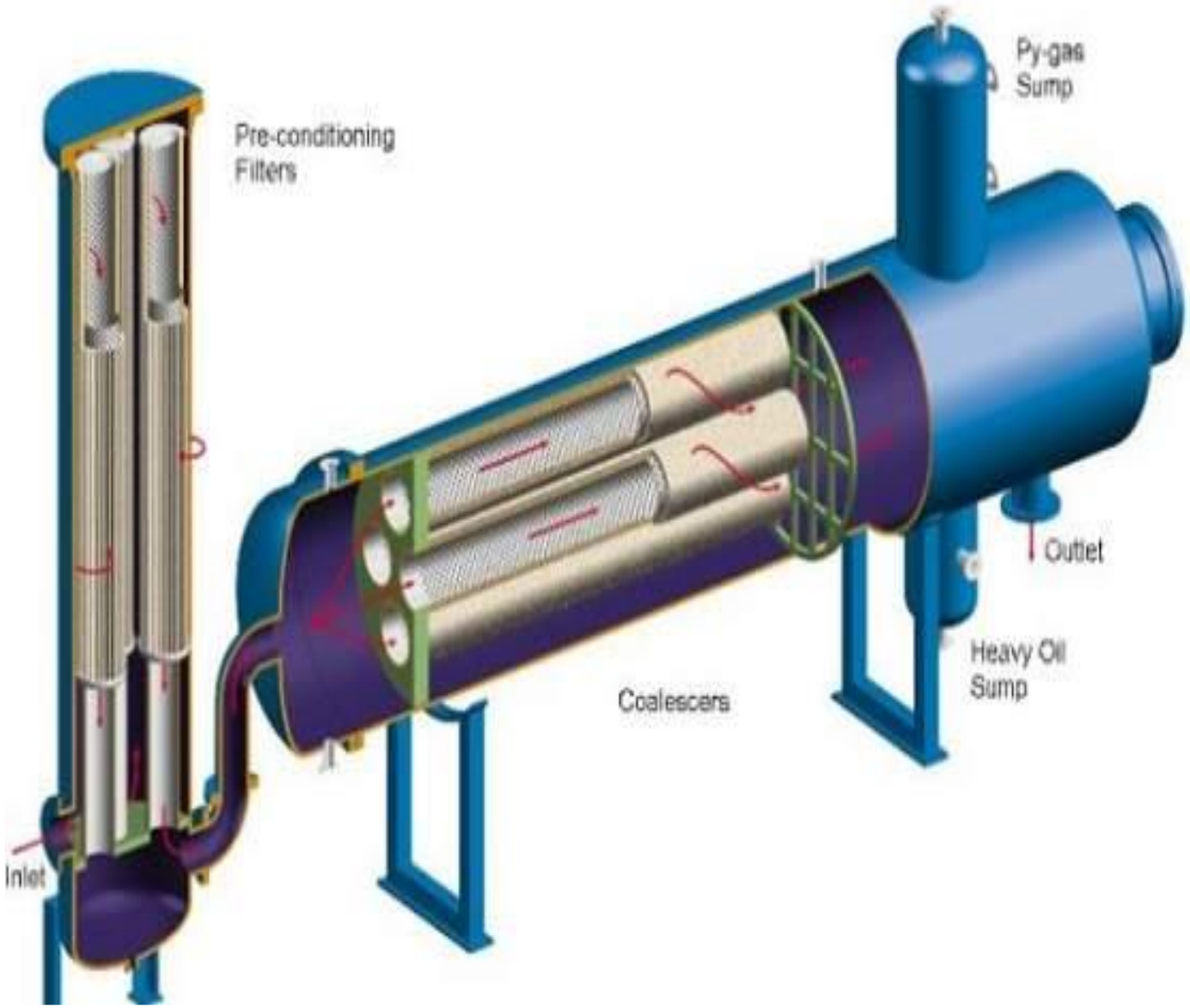
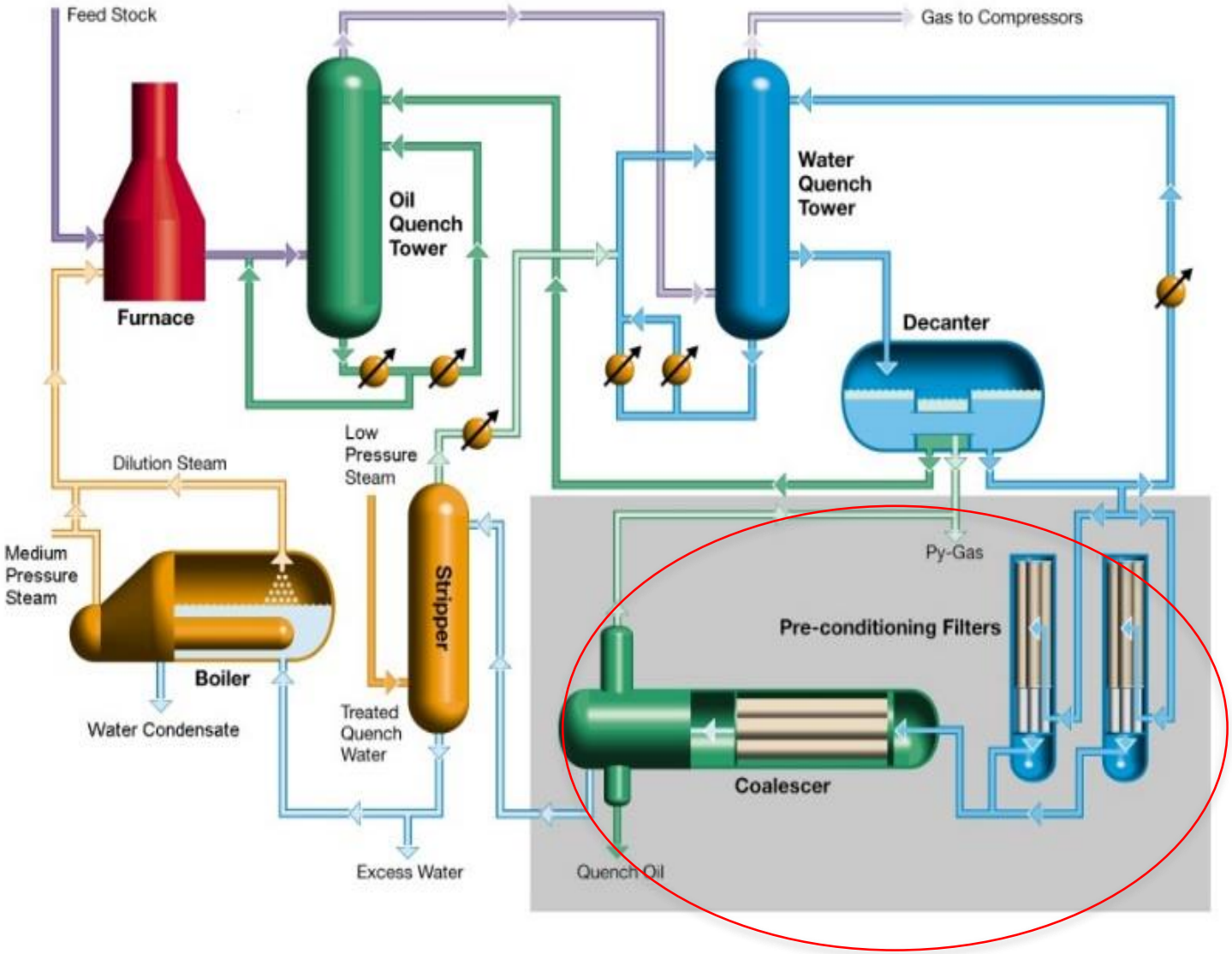


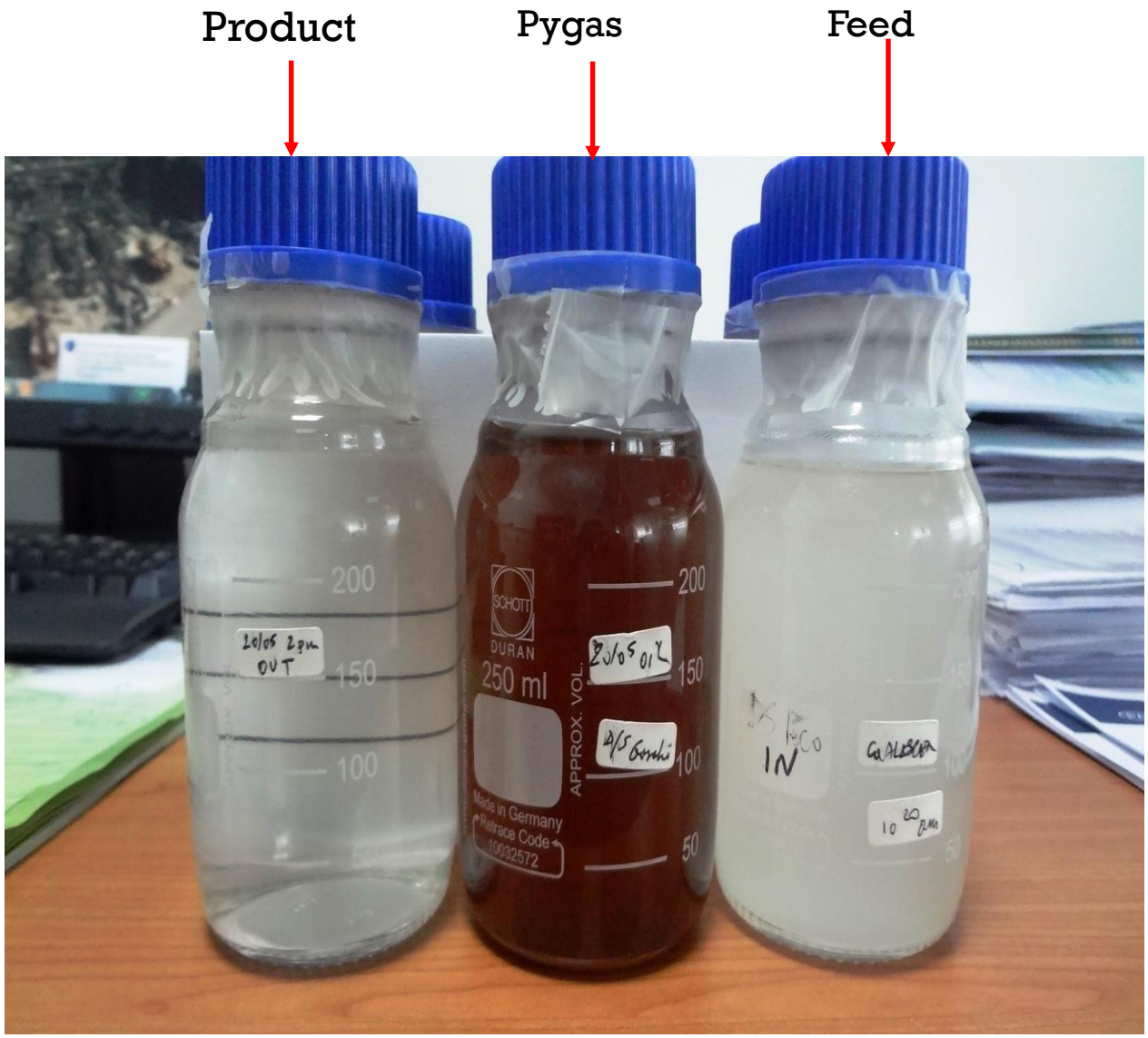
Liquid/Liquid Coalescers—Separate Pygas from Water



Proven solution—filters/coalescers to remove solids, break emulsion



Results from Pilot Tests from Naphtha Cracker in China



Typical Savings from Calculator

Value Proposition: Example for a 640 KT/Year Ethylene plant

Pall Filter and Coalescer Technologies enable an improved plant reliability and operation, and provide substantial savings as described below :

Typical Savings/Year (US Dollars)

- Steam saving on stripper and furnace $1000 K
- Heat exchangers and boilers cleaning $150 – 400 K
- Chemicals--emulsion breakers, others $100 K
- Extra make up & waste water $200 K

- **Production limitations**
  - Rarely observed, but there could be major losses
  - Sporadic limitation on waste water treatment $200 K
  - Unscheduled shut down for heavy maintenance $800 K
  - Severe Unscheduled shutdown $4000 K

Case Study - Ethane Cracker, Rayong, Thailand

- Pall System operating since 2009
- Process Quench Water Feed Rate: 132 m^3/hr, Temperature: 83 ^{0}C
- Two sets of Pall elements used– **One Prefilter and L/L coalescer**
- Basket strainer used as first prefilter—not ideal

- **Prefilter :** Pleated Epocel@10 microns, 148 elements
- **Coalescer** : PhaseSep 40" design, 80 elements in horizontal style
- Both prefilter and coalescer sized conservatively

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Case Study - Ethane Cracker, Rayong, Thailand

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- Good performance from prefilter, which is a challenge in gas crackers. Life varies from 1-3 months, depending on contamination load
- Superb coalescer performance with outlet oil typically below 15 ppm. Coalescer replacement in generally 6-12 months.
- Significant cost savings downstream due to fouling mitigation.

Results at Braskem Idesa--Mexico

- 100% gas cracker—started in Mexico in 2016
- Process Water Feed Rate: 135 m^3/hr design
- 3 sets of Pall elements used– 2 Prefilters and Liquid/Liquid coalescer
- **Solvent injection with high aromatic solvent initiated**
- **Results:**
  - Coalescer inlet is hazy, outlet is bright and clear
  - First prefilter@ 70 microns, only 3 elements, 15 days life
  - Second prefilter@ 10 microns, 65 elements, 2 months life

Coalescer has 80 elements in horizontal style

- Operating efficiently for ~ 6 months

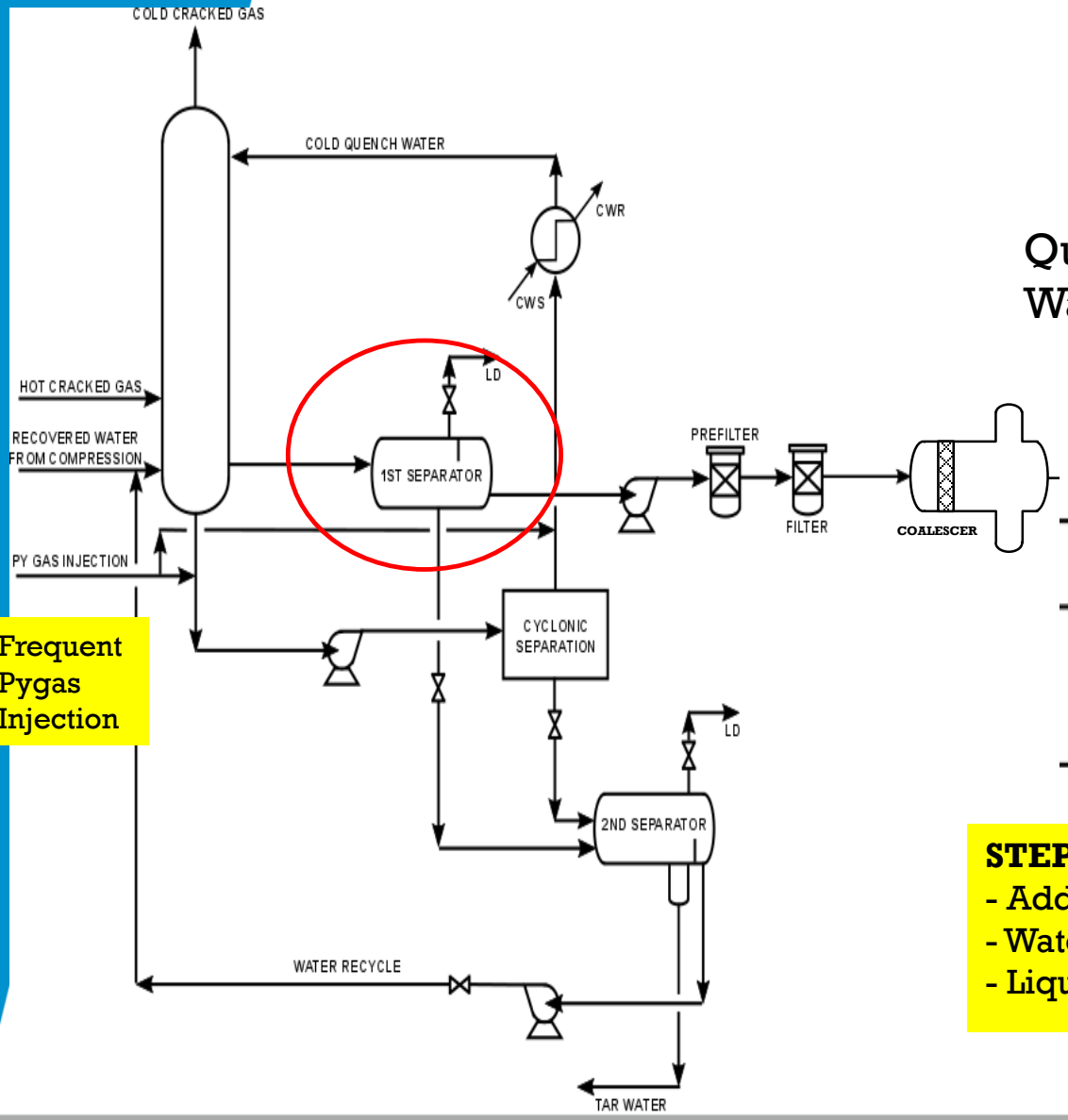
Impact of Solvent Injection at Braskem Idesa

Quench Water (feed)

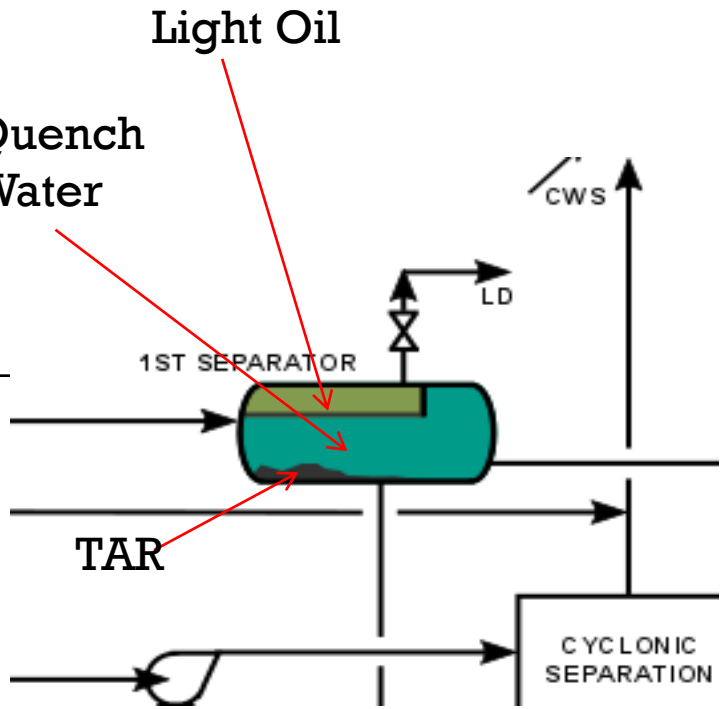
Quench Water With Solvent

Mixture After Agitation and settlement

Braskem Idesa Simplified Quench Water System



Frequent Pygas Injection



STEPS

- Add Pygas
- Watch 1st separator interface level
- Liquid drain oil and coke (~ after 15 mts)

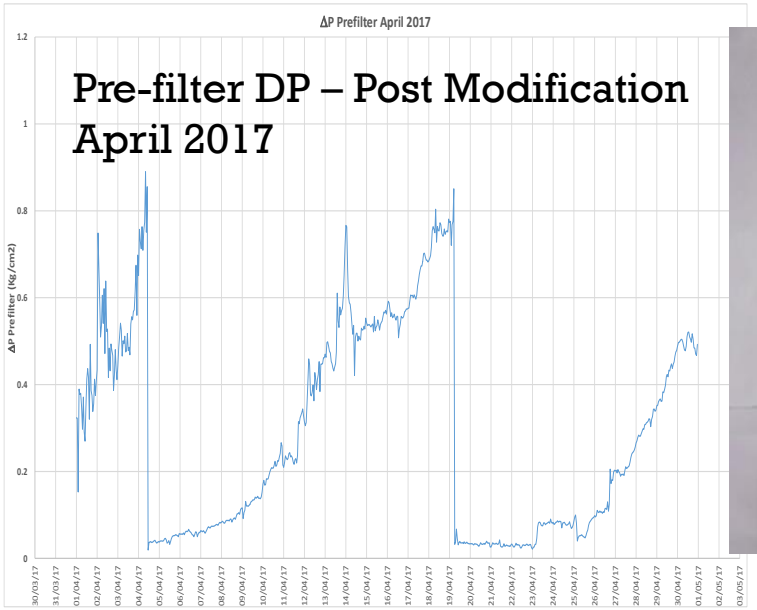
Filter Consumption After Solvent Injection

Pygas lab first results 2016)

Pygas injection program applied (2016)

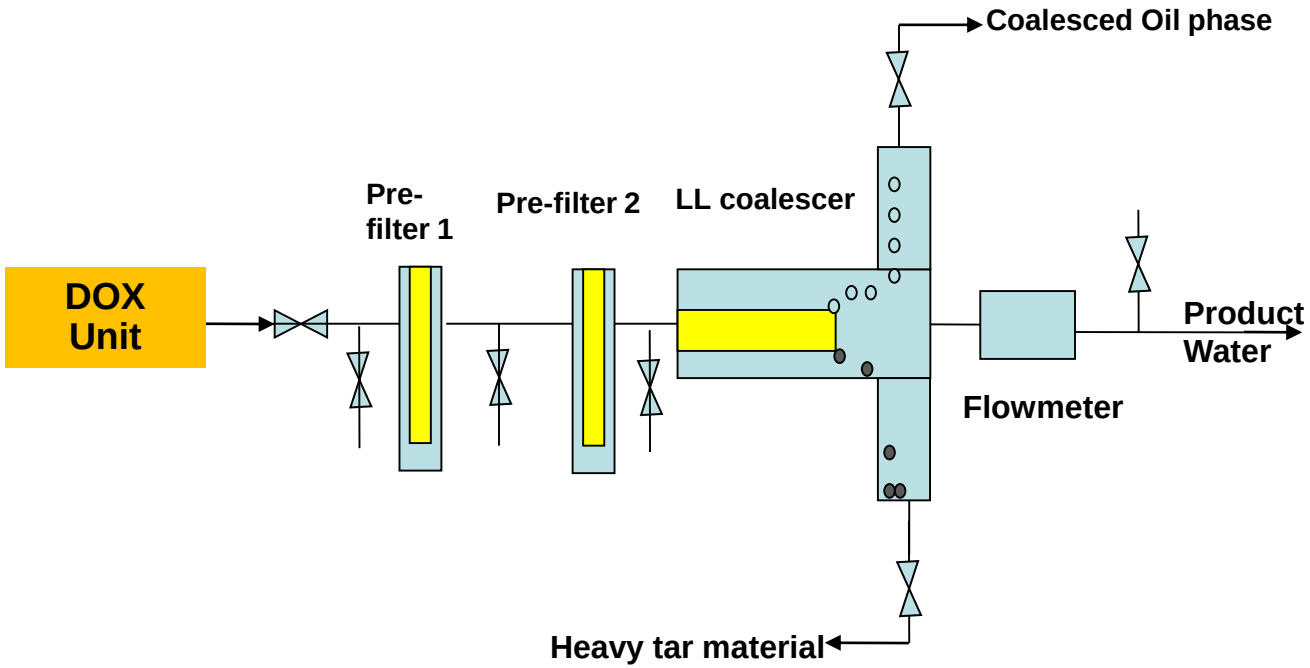
Control loop for perturbation minimization (2017)

Month	September	October	November	December	January	Feb	March	April
Prefilter	25	15	19	9	8	5	5	2
Filter	2	2	2	2	1	0	1	0



Saudi Arabia Gas Cracker– Pilot Case Study

- Hydrocarbon carryover from the existing DOX (Dispersed Oil Extractor) unit results in problems--
  - ➢DOX performance is inconsistent, creating high oil content/fouling downstream
  - ➢Dilution Steam generator is put on maintenance every 50-60 days
- Pilot Coalescer Tests conducted downstream of existing DOX unit.



Saudi Arabian Gas Cracker—Pilot Test Results

Parameter	Downstream 0f DOX Unit	Downstream of Pall Pilot Unit
Oil/Grease (ppm)	1100	<5, 5, 7
Turbidity (NTU)	165, 182	16, 39
Total Suspended Solids (ppm)	3	0.5

Conclusions

- The prefilters/coalescer combination is very effective in mitigating coke and tar in the process water loop.
- Excellent performance has been achieved in the challenging gas cracker process water.
- The lifetime of the coalescer is dependent on the effective separation of the contaminants achieved by prefiltration.
- The overall performance can be enhanced by the use of solvent injection upstream of the prefiltration step.

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