

# AquaSep<sup>®</sup> EL Coalescers -Product and Applications



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# AquaSep EL Coalescers – Clear Customer Benefits

## The AquaSep EL Liquid / Liquid Coalescer will provide Oil & Gas, Refinery & Chemical segment customers with:

- Significantly lower capex, footprint, and weight
- Lower maintenance costs and off spec product
- Enhanced levels of productivity and quality
- Reduced prefiltration costs, even on higher solids applications

## AquaSep EL Coalescer key features:

- Up to 60% higher flow per element versus others
- Outlet water content as low as 15 ppmv
- Polymeric materials of construction
- The ability to directly upgrade existing Pall installations, with potential to:
  - Increase flow through the existing housing
  - Reduce your total cost of ownership via fewer elements per changeout
  - Achieve lower free water downstream content
- A coarser coalescing medium than other coalescers, enhancing the product's economic viability on higher solids applications



# AquaSep EL Coalescers - Clear Customer Benefits

## Higher Product Effluent Quality

Effluent Quality - AquaSep EL vs. Competitive Polymeric Coalescers, 0.1% Water Ingression, 30 dynes/cm Horizontal Configuration

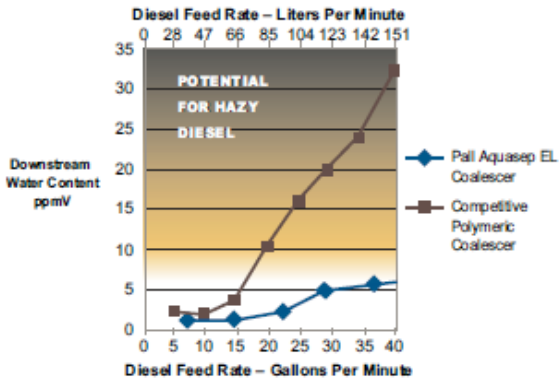


Figure 1

Effluent Quality - AquaSep EL vs. Competitive Glass Fiber Coalescers, 0.1% Water Ingression, 30 dynes/cm Horizontal Configuration

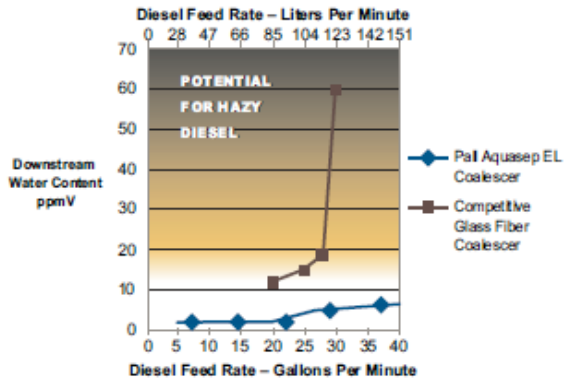
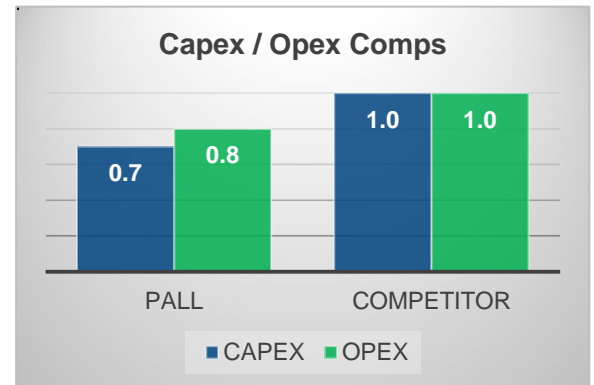
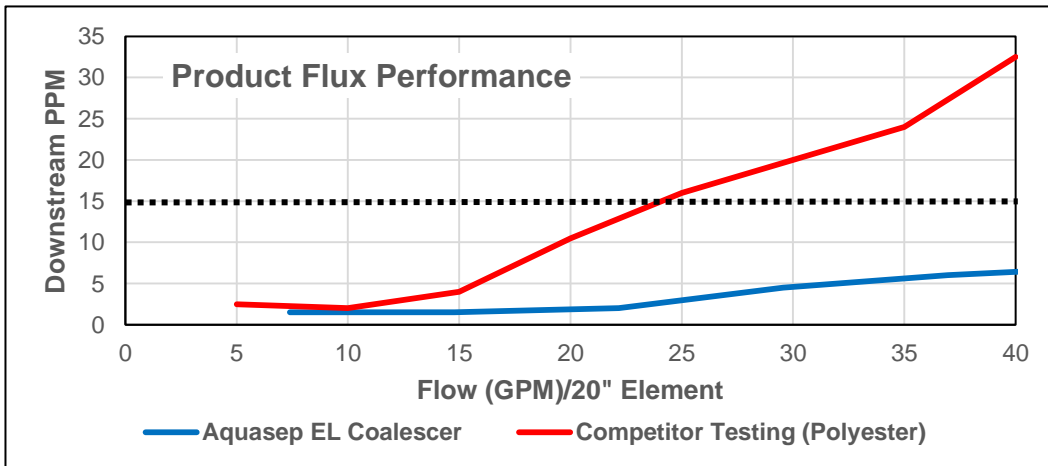


Figure 2

## Lower Project Implementation and Operational Costs



# AquaSep EL Coalescers – Target Applications



## The AquaSep EL Liquid/Liquid Coalescer:

### Refinery:

- Sour Water Stripping
- Delayed Coking
- Refinery intermediates



### Oil & Gas:

- Condensate
- Pipeline
- Dewatering

And for many other water from oil or oil from water separation challenges you may have



# AquaSep EL Coalescers - Product Description

Feature	Advantage	Benefit
Optimized multi layer pleated media pack reduces media velocity	Enhanced element flow capability, up to 60% higher	<b>-Up to 30% lower assembly capex -Reduced vessel volume and weight. Especially beneficial for offshore installations.</b>
Polymeric media pack	No element disarming (loss of efficiency) vs. glass fiber coalescers	<b>Consistent downstream quality and productivity, low maintenance costs due to extended coalescer life</b>
Stainless steel media pack support provides maximum $\Delta P$ rating of 3.4 bard (50 psid)	Robust design that keeps the fiber matrix stable as $\Delta P$ increases	<b>-Assured protection of downstream water content with increasing <math>\Delta P</math> -Reduced risk of catastrophic element failure</b>
Open media structure requires coarser prefiltration protection than AquaSep XS coalescers	Prefiltration requirements are 40 micron Beta rated, $\beta=5000^1$ vs. 10 um $\beta=5000$ with the AquaSep XS coalescer	<b>Attractive, lower, controlled filter operating costs in higher solids environments</b>



1. The test procedure is an adaptation of ISO 4572, modified to determine the micron size above which the particles are quantitatively removed.

# AquaSep EL Coalescers - Product Description

## Compatibility and Product Specifications

- Compatibility: hydrocarbon fuels, ethylene glycol, trace amounts of isopropyl alcohol (IPA), methanol and water. Check with Pall Corporation for compatibility with other fluids
- pH range: 4 – 8.5
- Maximum operating temperature: 60°C / 140°F
- Maximum differential pressure: 3.4 bard / 50 psid at 21°C / 70°F
- Recommended changeout: 1.0 bard / 15 psid at 21°C / 70°F

## Ordering Information

Part Number	Description	Outer Diameter (cm/in) nominal	Length (cm/in) nominal
LCS06ELBH	AquaSep EL Coalescer	7/2.75	15.2/6
LCS2ELBH	AquaSep EL Coalescer	10.7/4.2 (flange) 9.53/3.75 (main element)	50.8/20
LCS4ELBH	AquaSep EL Coalescer	10.7/4.2 (flange)	101.6/40
LSS2F2H	Separator	9.53/3.75	50.8/20

# AquaSep EL Coalescers – Typical Installation

A prefilter followed by a liquid / liquid coalescer is the typical Installation

- Prefilter
  - Provides particulate control for long coalescer life
  - Horizontal and vertical designs available
  - Ultipleat<sup>®</sup> High Flow, Marksman<sup>®</sup>, or Profile<sup>®</sup> Coreless filter styles are commonly recommended to optimize operating costs
- Liquid / Liquid Coalescer
  - Provides free water removal as low as 15 ppmv
  - Horizontal and vertical orientations available to suit budgetary, size, weight and footprint needs





# AquaSep EL Coalescer Applications:

## Application

## Link to Application

1. All – Upgrade of Existing PhaseSep Installations → [1.](#)
2. Refinery – Sour Water Stripping → [2.](#)
3. Refinery – Delayed Coking → [3.](#)
4. Refinery – Refinery Intermediates → [4.](#)
5. Oil & Gas – Condensate Stabilization → [5.](#)
6. Oil & Gas – Condensate Pipeline Dewatering → [6.](#)



# 1. Upgrading of Existing PhaseSep Coalescer Installations to AquaSep EL Coalescing Elements

## Recommendations:

- **Note:** this applies to existing PhaseSep coalescer installations where the product was selected for its 10 um prefiltration requirement, **not its chemical or temperature capability**, and where prefilter life an issue
- Upgrade to AquaSep EL coalescers to enjoy the following benefits:
  - Reduced prefiltration costs. Longer filter service life is expected due to the 40 micron prefiltration requirement of the AquaSep EL coalescer vs. the 10 micron requirement for the PhaseSep coalescer
  - The increased flux capability may allow for a given housing to run at higher throughputs and maintain outlet water quality
  - The increased flux capability and long coalescer life may permit a reduction of up to 40% fewer coalescer elements at time of changeout, reducing element and disposal costs. Empty holes will be fitted with semi-permanent plugs
  - The larger coalesced droplet size and more rapid droplet settling may offer less free water downstream
  - Work with your representative to determine the upgrade capabilities of your housing with AquaSep EL coalescers!

Return to Applications List: [Return](#)



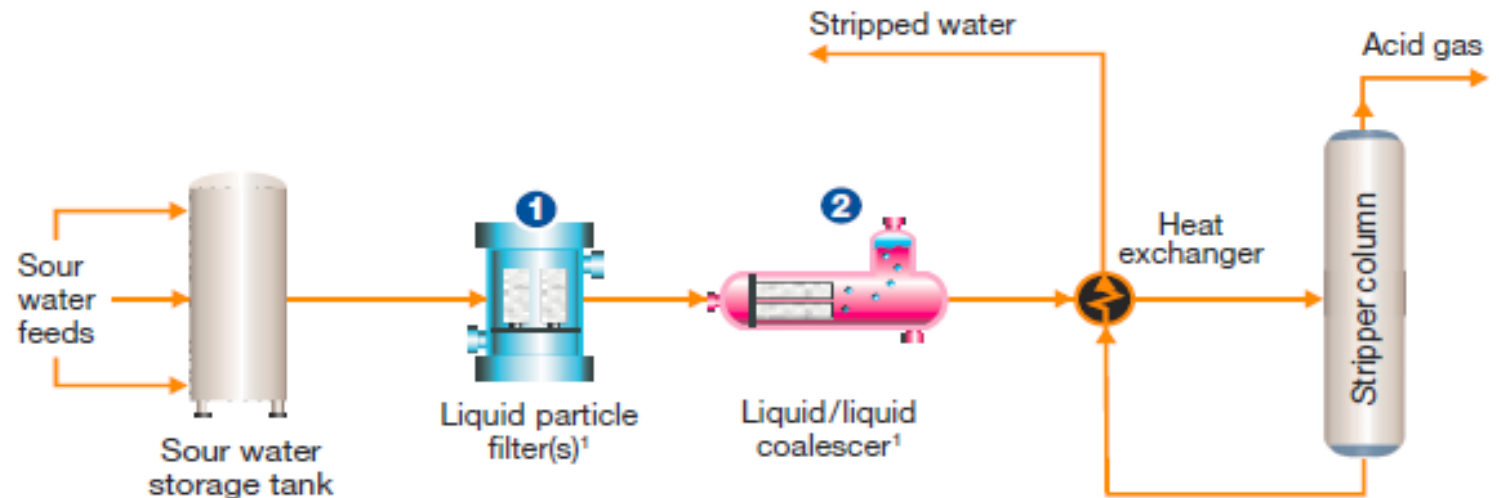


## 2. Refinery – Sour Water Stripping

- Sour water stripping (SWS) is found in all refineries – a waste from many units – distillation, fluid catalytic cracking (FCC), reforming, coker, acid gas removal
- SWS removes ammonia and hydrogen sulfide to condition toe water for reuse or discharge by heating the water via exchanger and single or twinned columns
- Presence of solids and hydrocarbons ('oils') causes heat exchange, stripper column and reboiler fouling, causing a loss of SWS capacity
- Issues:
  - Bottlenecking of refinery production rates
  - Unscheduled SWS shutdowns and cleanouts
  - High maintenance costs
  - Worker safety issues from exposure to hydrogen sulfide
  - Potential sulfur plant fires from oil carryover
  - Overload of water treatment plant reducing refinery capacity
- Cyclonic separators are challenged to effectively remove oils due to the stable oil emulsions, and variation of flow causing loss of inertial separation efficiency. Recycle loops are complex and reduce reliability

## 2. Refinery – Sour Water Stripping

### Process Flow Diagram



<sup>1</sup> Consider placement of the particle filter and coalescer upstream of the storage tank if oil fouling of the tank is a labor and maintenance issue, or if one incoming stream is identified as problematic.

## 2. Refinery – Sour Water Stripping

### Key Applications/Filter Recommendations

Application	Pall Product	Advantages	Customer Benefits
<b>1</b> Prefiltration prior to liquid/liquid coalescer	Ultipleat® High Flow filters, coreless filters, and/or a range of FSI bag filters	Efficient removal of solids from the coalescer and SWS	Improves the efficiency and life of the liquid/liquid coalescer Improves SWS production, reliability, safety and opex by controlling particulate fouling of the heat exchanger and stripper reboiler and trays
<b>2</b> Hydrocarbon removal	AquaSep® EL <sup>2</sup> liquid/liquid coalescer in horizontal configuration	Removes hydrocarbon carryover into the heat exchanger and stripper column	Improves SWS reliability, safety and opex challenges by controlling oil fouling of the heat exchanger and stripper reboiler and trays Improves sulfur plant reliability and safety by removing oil carryover into the reactor beds Freedom from oil overload to the water treatment plant that can create an environmental hazard and/or a refinery capacity limitation.

<sup>2</sup> Based on sour water pH between 4 and 8.5 at point of filtration. Consult Pall for pH outside of this range.



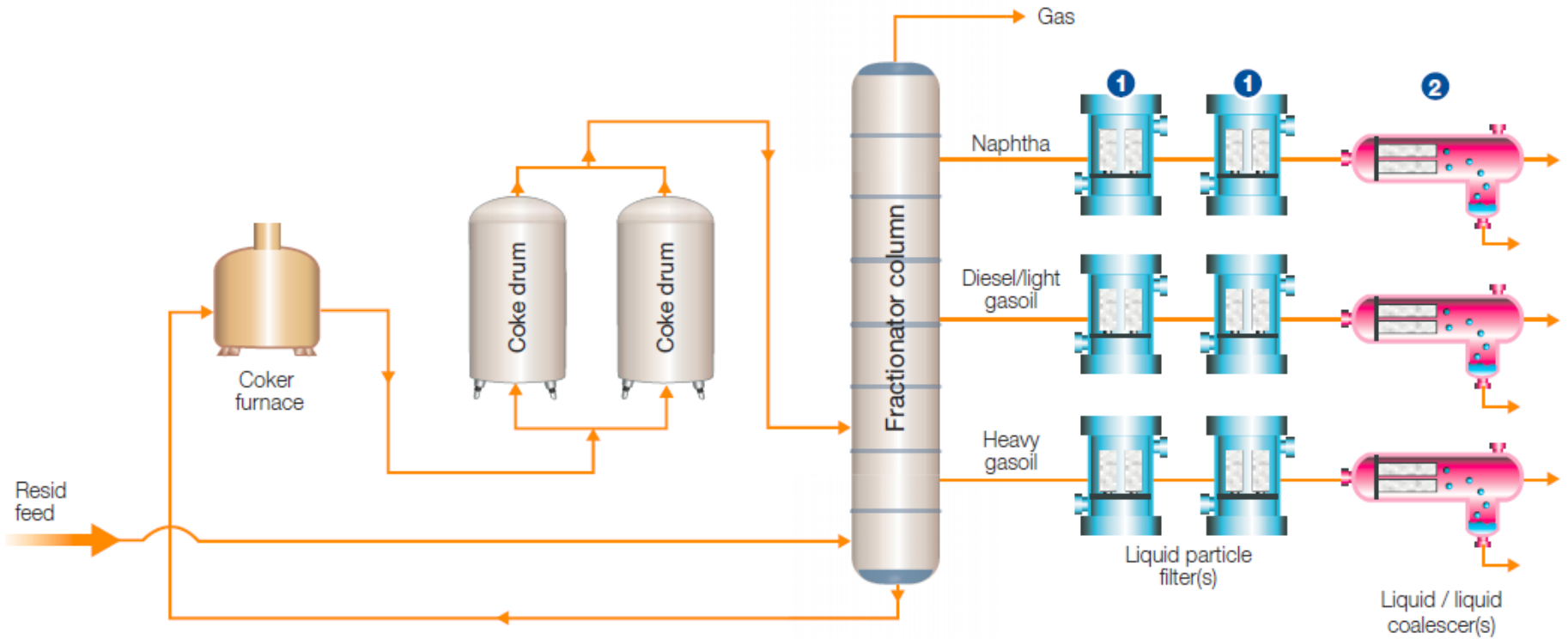
### 3. Refinery – Delayed Coking

- Coking is found in complex refineries to convert residual or ‘resid’ streams from vacuum and atmospheric distillation into value-added products such as LPG, naphtha, diesel, light and heavy gasoils
- Delayed coking is style of coker utilizing a furnace and two coking drums, one on-line and one in regeneration
- The coking process generates large volumes of coke in the on-line drum, which is removed during the regeneration cycle
- Large volumes of steam are injected into the feed to control the reaction. The end result is free water in the products
- Depending on the product removal of water is required to achieve final product quality or to meet feedstock requirements for other unit operations, e.g. hydrotreater feeds



# 3. Refinery – Delayed Coking

Process Flow Diagram



### 3. Refinery – Delayed Coking

#### Key Applications/Filter Recommendations

Application	Pall Product	Advantages	Customer Benefits
1 Prefiltration prior to liquid/liquid coalescer	Ultipleat® High Flow filters, Coreless filters, and/or a range of FSI bag filters	Efficient removal of solids from the coalescer and the coker fractionates	Improves the efficiency and life of the liquid/liquid coalescer Ensures product quality and downstream unit reliability needs are met through effective removal of problematic solids
2 Water removal	AquaSep EL liquid/liquid coalescer	Consistently removes water from the coker fractionates	Ensures product quality and downstream unit reliability needs are met through effective removal of problematic free water

Return to Applications List: [Return](#)



## 4. Refinery – Refinery Intermediates

- Many refinery intermediate streams flowing from one unit operation to another require continuous efficient liquid/liquid separation to ensure reliable operation of the downstream process
- Commonly seen separation legacy equipment solutions include mesh pack coalescers, electrostatic precipitators, sand bed coalescers and API separators
- Separation efficiency tends to vary widely depending on flow conditions and the interfacial tension of the fluid requiring liquid/liquid separation, causing unit productivity, efficiency or reliability gaps downstream
- Cartridge style glass fiber media coalescers have rarely been used reliably on these applications due to regular occurrence of disarming, gradually rendering the filter unable to remove water

## 4. Refinery – Refinery Intermediates

### Filter Recommendations:

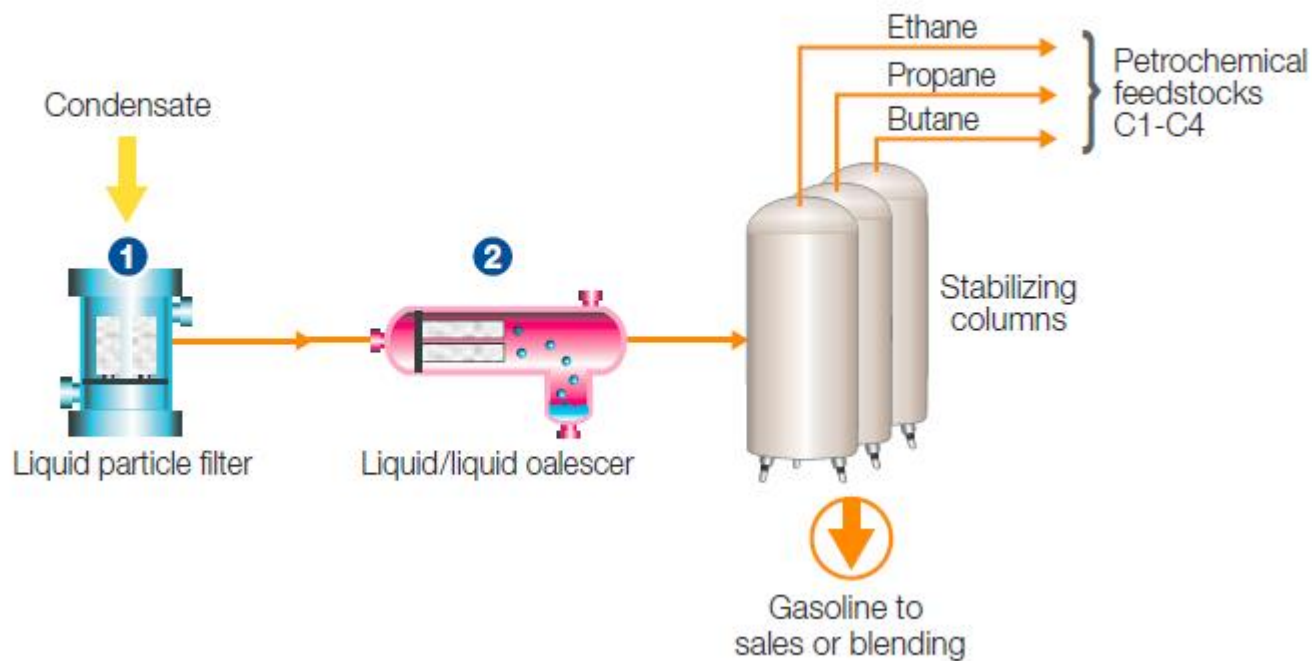
- The AquaSep EL coalescer will operate on many refinery intermediate streams with outlet quality of the discontinuous phase as low as 15 ppm
- The coalescer will not disarm in service
- Typical coalescer service life will be a minimum of one year when protected with the recommended Pall prefilter
- Pall prefiltration costs are anticipated to provide excellent value on the application due to the long service life provided by the coarseness of the rating requirement for adequate protection of the AquaSep EL coalescer, and the high dirt holding capacity of the Pall elements



Return to Applications List: [Return](#)

# 5. O&G – Condensate Stabilization

## Process Flow Diagram





## 5. O&G – Condensate Stabilization

### Key Applications / Filter Recommendations *(other applications not shown)*

Application	Pall Product	Advantages	Customer Benefits
1 Prefiltration prior to liquid/liquid coalescer	Ultipleat® High Flow filters, Profile® Coreless filters, Marksman™ filters	High filtration efficiency, reproducible performance, easy changeout, and long filter life	Ensure long life of the coalescers, eliminate particulate fouling of the stabilizer columns
2 Stabilizer column protection	AquaSep® XS or AquaSep EL liquid/liquid coalescer	High efficiency specially formulated coalescer media for the separation of stable liquid mixtures	Safe and reliable production of hydrocarbon liquids by protecting stabilizer columns from brine-initiated corrosion and fouling

Return to Applications List: [Return](#)

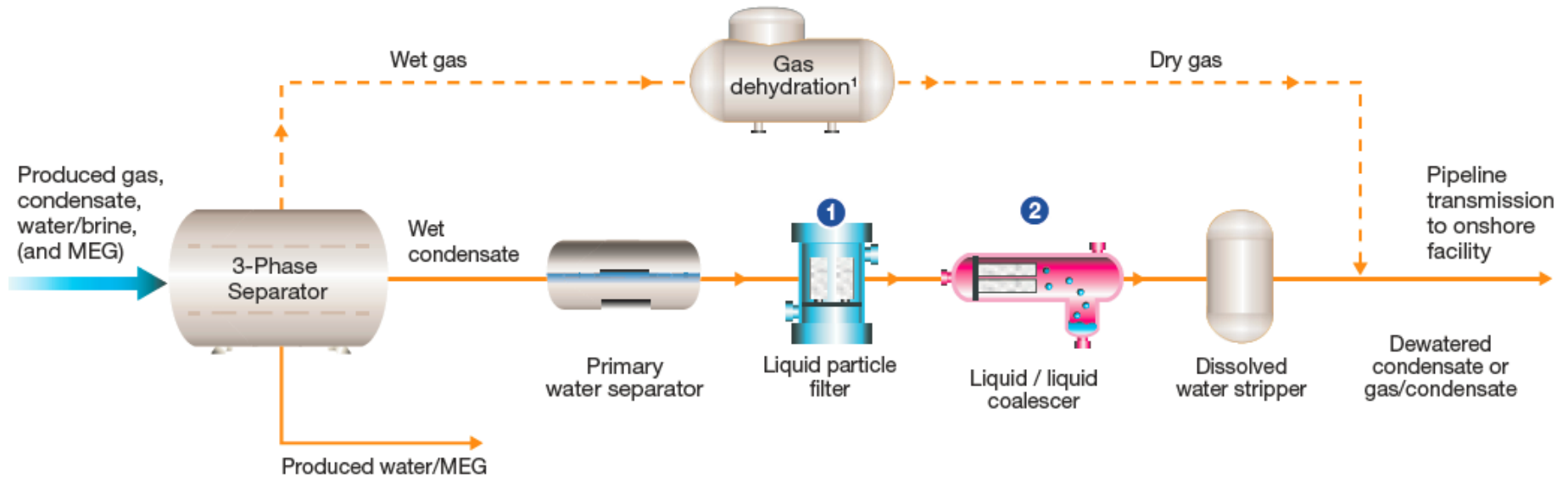


## 6. O&G – Condensate Pipeline Dewatering

- Natural gas production often produces large volumes of hydrocarbon condensate liquids that may be transported tens or hundreds of kilometers for delivery or treatment, e.g. from offshore platforms to processing onshore
- When carbon steel pipelines are used, water removal is recommended to reduce pipeline corrosion that will otherwise lead to shortened pipeline life and fouling of onshore facilities
- Monoethylene glycol (MEG) or methanol may be present as well if it has been used for hydrate suppression at the well
- Along with free water removal via separators and L/L coalescers, a dissolved water stripper column may be used for dissolved water removal
- The dried condensate may be combined with a dry gas flow for transport
- Effective liquid/liquid coalescing is an essential component in achieving the needed pipeline protection

# 6. O&G – Condensate Pipeline Dewatering

## Process Flow Diagram



## 6. O&G – Condensate Pipeline Dewatering

### Key Applications / Filter Recommendations

Application	Pall Product	Advantages	Customer Benefits
1 Prefilters for liquid/liquid coalescer protection	Ultipleat High Flow, Marksman or Profile® Coreless filters to remove incoming solids	Long life of coalescer elements Protection of the dissolved water stripper	<ul style="list-style-type: none"><li>• Low operating costs</li><li>• Freedom from fouling-related stripper shutdowns</li></ul>
2 Free water / MEG removal from condensate	AquaSep EL coalescers for water/ MEG removal on high solids condensates AquaSep XS coalescers for water/ MEG removal on low solids condensates	Consistent and continuous high efficiency removal of the fine water/brine/MEG emulsions without the risk of element disarming	<ul style="list-style-type: none"><li>• Low pipeline capex</li><li>• Improved pipeline opex due to better protection and service life</li><li>• Reduced stripper energy costs</li><li>• Optimized MEG recovery and reuse</li><li>• Controlled downstream plant opex and freedom from upsets due to slugs of pipeline corrosion products</li></ul>



# Questions?