

## Refineries: Application Focus

### Hydroprocessing

*Ensure your hydroprocessing reliably supports your daily production quotas and environmental protection needs.*

#### Process Description

Hydroprocessing covers a range of catalytic processes including hydrotreating and hydrocracking for removal of sulfur, oxygen, nitrogen and metals. The process is critical in the production of low sulfur fuels to reduce emissions, as removing the S reduces SO<sub>x</sub> emissions when fuels are combusted. Sulfur also poisons downstream noble metal reformer catalysts and must be removed (<0.5 ppm S is a typical naphtha feed spec). This “clean-up” also saturates olefins to yield easier-to-process intermediates.

The reaction is carried out in a hydrogen rich environment over a fixed catalyst bed. The process replaces sulfur or nitrogen contaminants in the hydrocarbon chains with hydrogen, making the process a consumer of hydrogen. Protection of the catalyst beds from fouling is critical to maintaining long term hydrotreating efficiency.

Treated products are then stabilized with heat to remove H<sub>2</sub>S and light ends. Use of direct steam injection is common, especially on diesel.

#### Refinery Needs

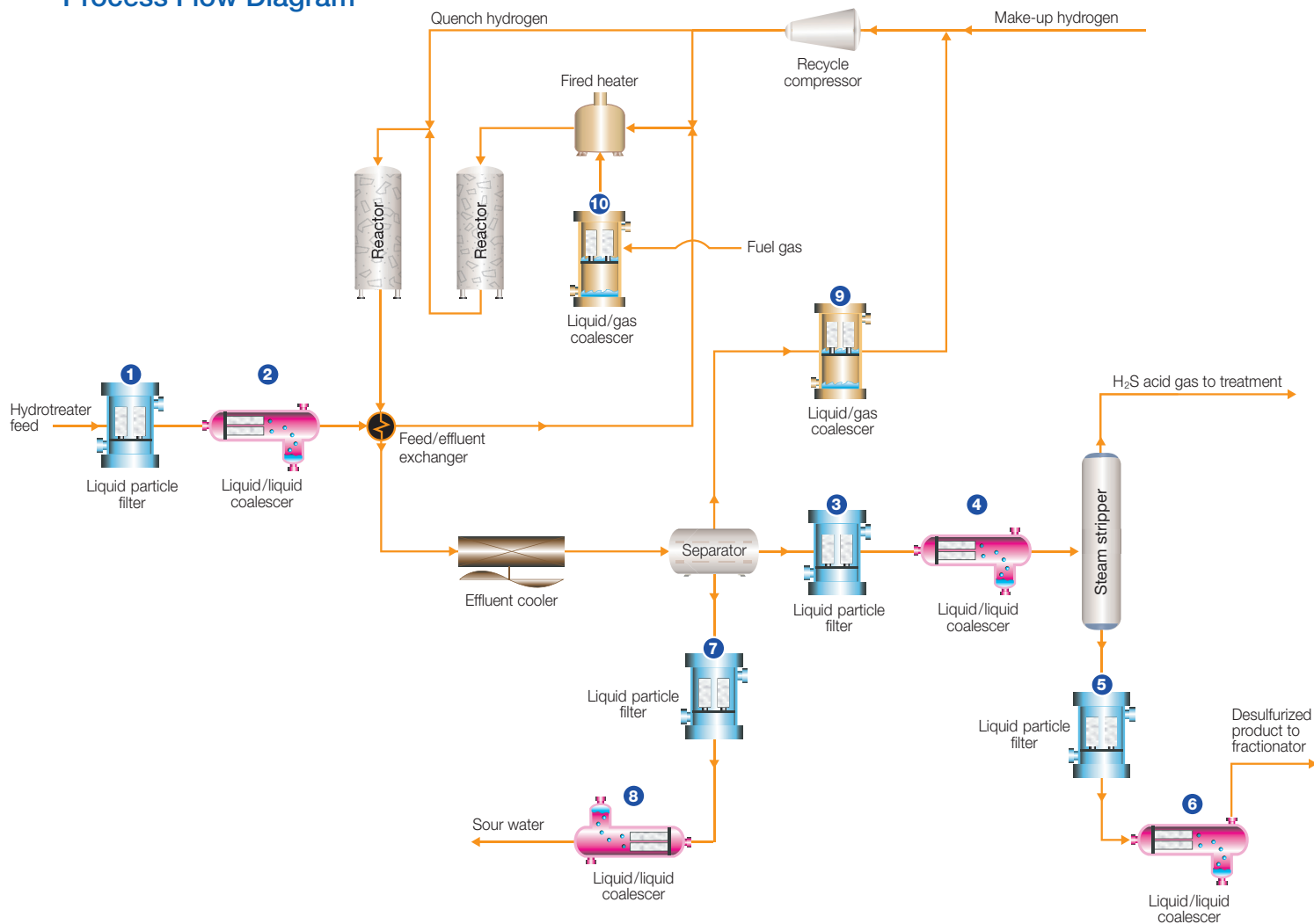
- Achieve production quotas of low sulfur gasolines and diesels via reliable hydrotreatment of straight run and cracked products that otherwise become a bottleneck
- Provide consistent “clear and bright” transportation fuel quality
- Protect against downtime from fouling of the feed/effluent heat exchanger
- Protect against downtime from catalyst bed  $\Delta P$  rise
- Protect against downtime from premature loss of catalyst activity
- Meet steadily increasing clean fuels specifications
- Reduce hazy product issues and high salt costs from overloaded downstream salt beds
- Achieve dryness specifications downstream of vacuum dryers and avoid dryer bottlenecking due to excessive water



## Production Challenge/Pall Solution

Challenge	Solution
<p><b>Shortened campaigns and unscheduled downtime</b> due to bed fouling and reduced catalyst bed activity</p>	<p><b>Improve refinery productivity and extend hydrotreater/hydrocracker bed life</b> by removing solids from the feed to protect the feed/effluent heat exchanger and/or catalyst bed.</p> <ul style="list-style-type: none"> <li>A range of absolute and nominal rated filter elements is available to <b>reduce suspended solids levels in the feed, to protect the exchanger and/or catalyst bed from fouling.</b></li> </ul>
<p><b>Products failing to meet specifications</b> due to stripper fouling, or from solids and water carryover after direct injection steam stripping</p>	<p><b>Improve product quality</b> by removal of water and solids both upstream and downstream of the steam stripper.</p> <ul style="list-style-type: none"> <li>A range of absolute and nominal rated filter elements is available to <b>reduce suspended solids to &lt;5 ppmw, and extend the coalescer life.</b></li> <li>High efficiency PhaseSep®, AquaSep® Plus or XS liquid/liquid coalescers reliably meet ‘<b>clear and bright</b>’ product specification and/or <b>reduce the cost for downstream dehydration.</b></li> </ul>
<p><b>Hydrogen recycle and make-up gas compressors requiring rebuilds and downtime</b> due to liquid and solid carryover from separator causing severe fouling and erosion of compressor internals</p>	<p><b>Reduced maintenance of the recycle and make-up gas compressors</b> by removal of liquids and solids in the hydrogen recycle stream from separator.</p> <ul style="list-style-type: none"> <li>KO pots, mesh pads, cyclonic devices and conventional filter-separators may not effectively remove aerosol-sized liquid hydrocarbon droplets or fine solids.</li> <li>High efficiency SepraSol™ Plus and Medallion™ HP liquid/gas coalescers provide 99.999% removal at 0.3 microns per the DOP test and 1 ppb downstream per the modified ANSI/CAGI-400-1999 test procedure. <b>Both provide excellent compressor protection.</b></li> </ul>

### Process Flow Diagram



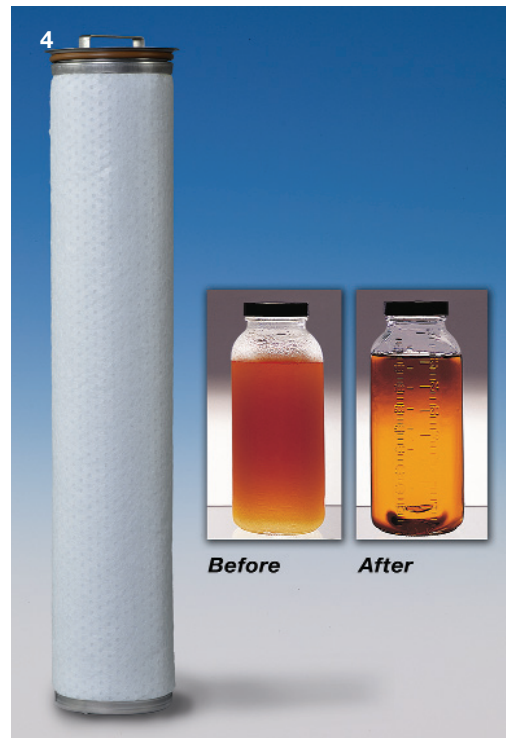
## Key Applications/Filter Recommendations *(other applications not shown)*

Application	Pall Product	Advantages	Customer Benefits
1 Hydrotreater feed filtration	Ultipleat® High Flow filters Ultipleat High Flow HT filters Ultipor® HT filters	Removes scale, rust, and solid particles	Assured HDT profitability by <b>protection from unscheduled reactor downtime or off-spec product</b> due to exchanger fouling, catalyst bed activity loss or high delta P due to bed fouling
2 Hydrotreater feed water removal	AquaSep® XS or AquaSep EL liquid/liquid coalescers PhaseSep® liquid/liquid coalescers	Consistent water removal without disarming	
3 Liquid/liquid coalescer protection	Ultipleat High Flow filters	Removes scale, rust, and solid particles	Low operating costs by ensuring long coalescer life while meeting particulate specifications for final products
4 Sour water removal from hydrotreated product	PhaseSep® liquid/liquid coalescers	Removes sour water carryover from separator	<b>Reduced steam stripper corrosion and capacity loss</b>
5 Liquid/liquid coalescer protection	Ultipleat High Flow filters	Removes scale, rust, and solid particles	Low operating costs by ensuring long coalescer life while meeting particulate specifications for final products
6 Water removal from stabilized product	AquaSep XS or Plus liquid/liquid coalescers	Removes emulsions of direct steam injection stripping	<b>Reliably meet 'clear and bright' final product specification</b> <b>Reduce costs for downstream salt dryers or desiccant dehydration units</b> <b>Improve water removal via downstream vacuum dryers</b> by removing the free water load, enabling full vacuum attainment and maximum drying efficiency
7 Liquid/liquid coalescer protection	Ultipleat High Flow filters	Removes scale, rust, and solid particles	Low operating costs by ensuring long coalescer life while meeting particulate specifications for final products
8 Hydrocarbon removal from sour water	AquaSep EL or PhaseSep liquid/liquid coalescers	Reliable hydrocarbon removal from sour water flow to sour water stripper	Reduced contamination load to sour water stripper reduces stripper maintenance costs, capacity loss and extra loading on water treatment plant
9 Hydrogen recycle and make-up gas compressors protection	SepraSol™ Plus and Medallion™ HP liquid/gas coalescers	Removes liquids and solids from recycle hydrogen	<b>Eliminate cost and revenue losses due to compressor rebuilds and unscheduled downtime due to fouling</b>
10 Low NOx burner protection	SepraSol Plus and Medallion HP liquid/gas coalescers	Removes liquids and solids from refinery fuel gas	<b>Elimination of burner tip fouling</b> leading to burner maintenance costs, potential unit downtime or productivity loss due to poor burner performance

### For fast track upgrades, NO CAPEX:

**Pall-Fit filter and coalescer retrofits** enable a move to Pall quality without change to your existing filter housing

**Pall filter and coalescer housing rentals** enable a technology upgrade for rapid problem resolution



1) SepraSol™ Plus Coalescer: compressor protection; 2) AquaSep® XS Coalescer: steam stripped diesel; 3) Filter Rental Fleet: quick problem resolution; 4) AquaSep XS Element: reliable diesel deahazing; 5) Ultipleat® High Flow Filter: catalyst guard



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