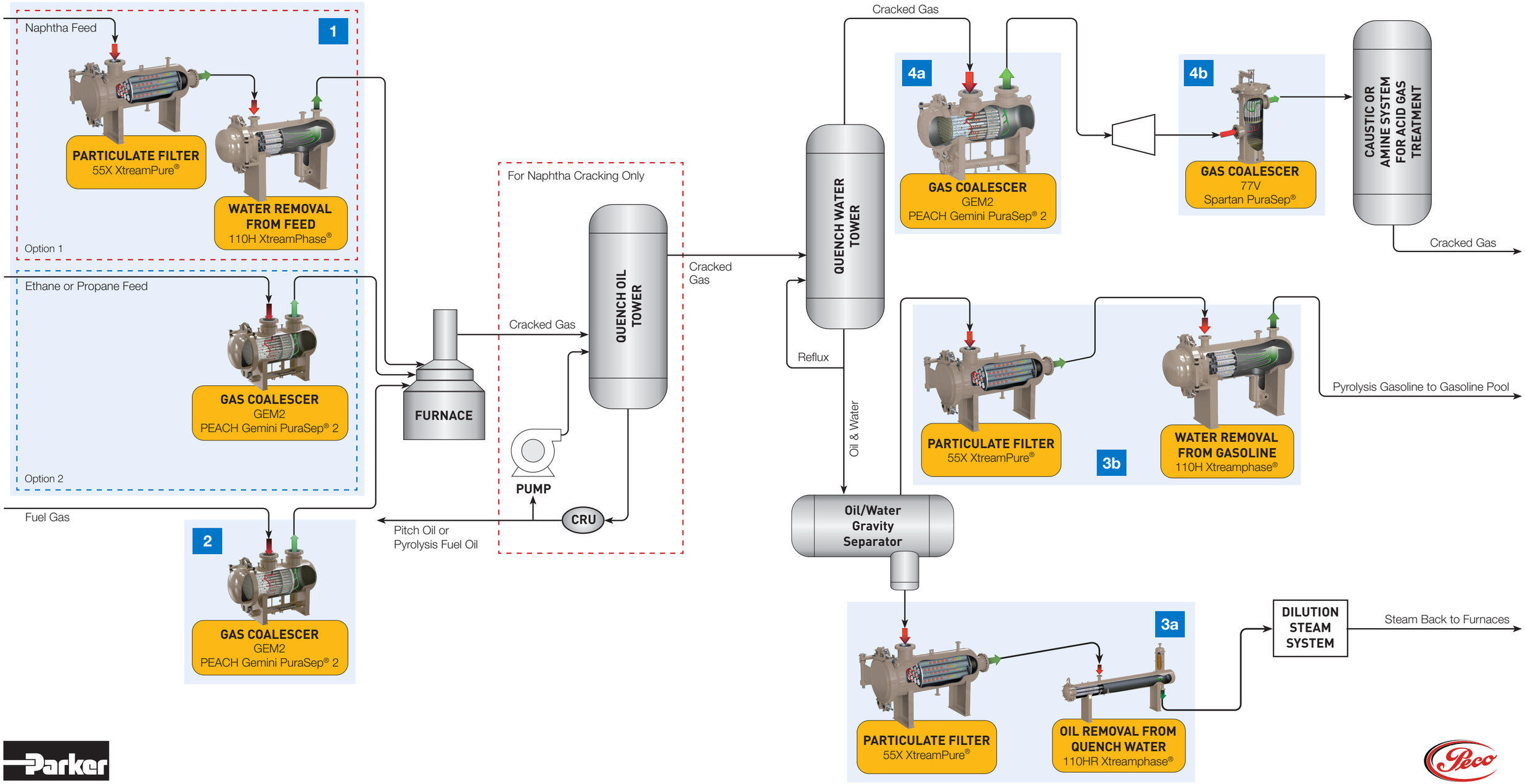
ETHYLENE - CRACKING

FILTRATION & SEPARATION EQUIPMENT



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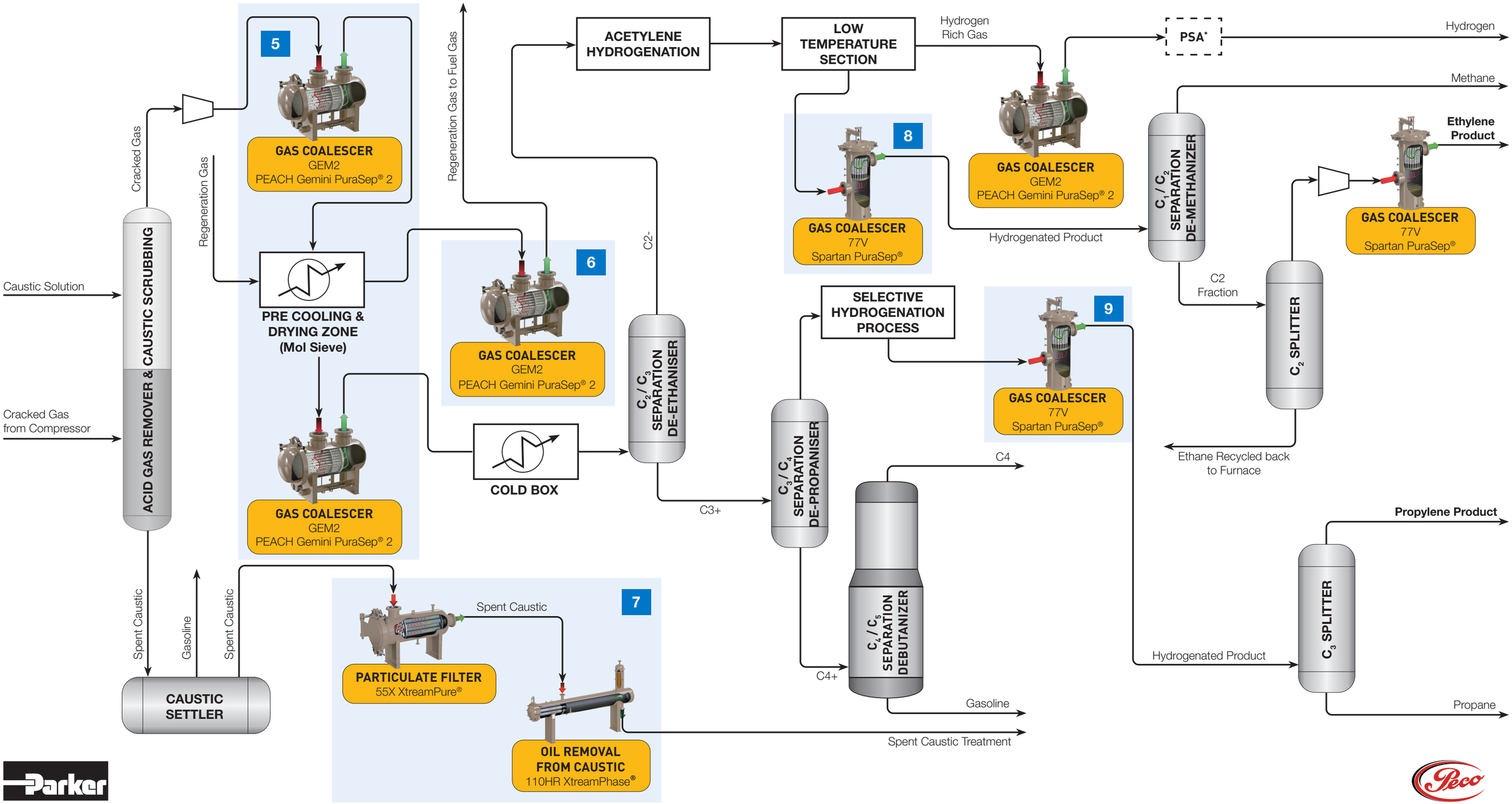
ETHYLENE - SEPARATION SECTION FRONT END HYDROGENATION

FILTRATION & SEPARATION EQUIPMENT



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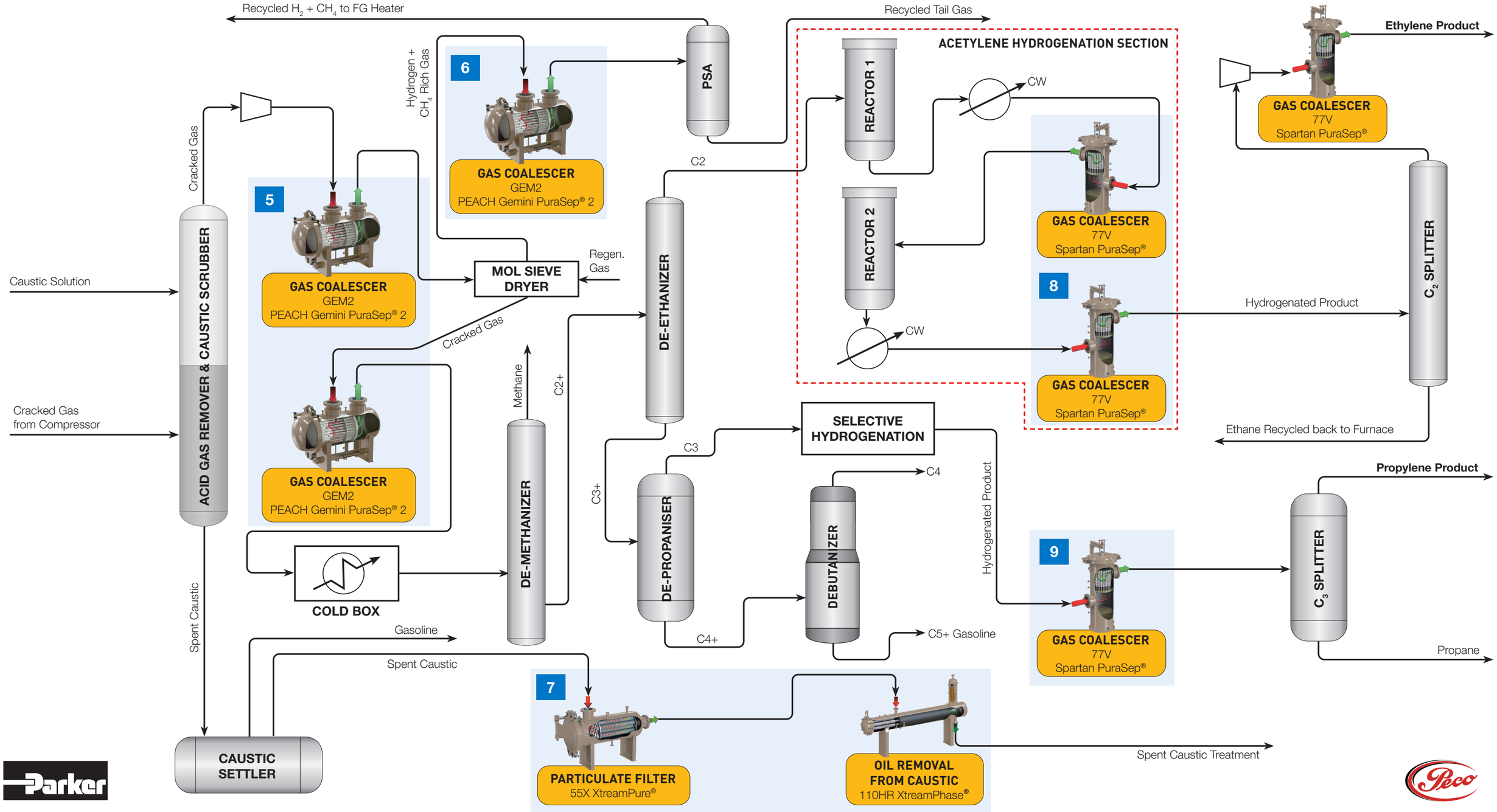
ETHYLENE - SEPARATION SECTION BACK END HYDROGENATION

FILTRATION & SEPARATION EQUIPMENT



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ETHYLENE - SEPARATION SECTION FRONT END HYDROGENATION

FILTRATION & SEPARATION EQUIPMENT

PROCESS UNIT

- Ethylene Manufacturing Process

FEED TO THE UNIT

- Ethane
- Ethane and Propane
- Naphtha
- Gas Oil

ETHYLENE PROCESS CONTAMINANTS

- Corrosion products, water, salts, pipeline scales, coke particles
- Green Oil
- Red Oil
- Yellow Oil
- Mol Sieve Fines
- Lube Oil, aerosols and mist

PROCESS DESCRIPTION

Ethylene by Steam Cracking Process
The steam-cracking process for ethylene production from an ethane-propane mixture, can be divided into three main parts: (1) cracking and quenching, (2) compression and drying, (3) separation.

Cracking and Quenching: Initially an ethane-propane mixture or liquid feed like Naphtha or gas oil is fed to furnaces in which, under high severity conditions is cracked, forming ethylene, propylene and other by-products. The furnace outlet stream is subsequently fed to a water-based quench, to prevent further reactions and formation of undesirable by-products. Cracked gas from the quench is then directed to compression and separation.

Compression and Drying: The compression of the cracked gas is performed across five stages. After the third stage of compression, carbon dioxide and sulfur are removed from the cracked gas by caustic soda and water washes in a caustic scrubber. The compressed cracked gas is cooled and subsequently dried by molecular sieves that remove most of the water.

Separation: The dried cracked gas is then fed to a cold box for the removal of hydrogen and light hydrocarbons, while minimizing ethylene losses. At this point, condensates from the chilling train are fed to a series of separation columns. After being processed through the series of separators, Ethylene is obtained as a final product.

KEY ISSUES

FEED

Feed: Hydrocarbon feedstock often contains significant levels of corrosion products, water, and salts. Sodium and iron oxides are known to be coke promoters and their presence can reduce the run time of the ethylene furnaces before decoking is required and, in some instances, reduce the life of the furnace tubes by as much as one-third. Unscheduled or frequent decoking cycles lead to a loss in ethylene production, shortened furnace tube life, and create higher maintenance costs.

Fuel Gas: Burner tip plugging is one of the primary performance and maintenance concerns requiring fuel gas filtration. A Fuel Gas Filter / Coalescer is recommended to remove particulate, scale and condensed liquids in the fuels.

QUENCH SYSTEM: QUENCH "PROCESS" WATER AND PYROLYSIS GASOLINE

Quench "Process" Water: The water out of the Quench Water Tower is known as Quench "Process" Water. It contains some C5/C6 oil and coke particles. In an Ethylene Plant, fouling of the Dilution Steam System Heat Exchanger can be a source of high maintenance and operating cost. Common problems Include:
- Increased energy consumption as steam usage increase
- High downtime and maintenance cost
- Reduced efficiency due to fouling of heat recovery system

Pyrolysis Gasoline/PyGas is a by-product of the cracking process, used as a blending agent in the gasoline pool, thus the need to be clean and free of any solids/coke particles and water, to ensure quality of the final product.

COMPRESSOR INLET AND OUTLET CRACKED GAS FILTRATION

Compressor Inlet: Cracked Gas from the quench tower may contain solid particles and liquid aerosol contamination, causing mechanical failures in reciprocating and centrifugal compressors.

Compressor Outlet: Lubrication oil from compressors is the source of liquid contamination, which fouls and plugs downstream equipment nozzles, valves, instruments, process streams, heat exchangers, etc.

Protection of Mol Sieve Bed: Hydrocarbon condensates, and/or wash oils from the compressor, can greatly reduce the performance and life of a Molecular Sieve adsorbent bed. Common problems include:
- Frequent regeneration cycles
- Adsorption performance loss
- Premature replacement of the Molecular Sieve material due to attrition

Spent Regeneration Gas Treatment for Burner Protection: The spent regeneration gas, if not treated, will lead to plugging of Low NOx Burners.

Caustic Wash and Spent Caustic Treatment: The presence of contaminants like Oil/Gasoline affect the performance of the Wet Air Oxidation Reactor. Polymer formation is the most common cause of fouling in caustic towers. Entrained oils, formed from polymerization, can also upset the WAO operation.

Green Oil Removal: Green Oil carry-over, along with gas, can result in the following issues:
- Reactor bed fouling
- Fouling of heat exchangers, dehydrator beds, fractionators
- Regeneration gas fouling, leading to furnace burner tip plugging

FILTRATION SOLUTIONS

1 FEED FILTRATION

a. Gas (Ethane, Ethane – Propane mix) Feed:
Gas Filter-Coalescer
(PECO, PEACH Gemini PuraSep® 2, Series GEM2 horizontal coalescer with PGC cartridges)
- High efficiency 0.3 micron coalescer
- Removes solid and liquid contaminants
- Prevents fouling of furnace tubes.

b. Liquid (Naphtha, Gas Oil) Feed:
Liquid Filter Pre Filter
PECO, XtreamPure®, Series 55X filter with 6" diameter XP cartridges
- Removes corrosion products and particulates
- Prevents clogged furnace tubes
- Prevents particulate deposits steam cracker

Liquid-Liquid Phase Coalescer
PECO, XtreamPhase®, Series 110H coalescer
- Protects fouling of furnace by removing water down to 8-10 ppmv in the feed stream

2 FUEL GAS FILTRATION

Gas Filter-Coalescer
PECO, PEACH Gemini PuraSep® 2, Series GEM2 horizontal coalescer with PGC cartridges
- High efficiency 0.3 micron coalescer
- Removes solid and liquid contaminants
- Protects burner tips

3 A. QUENCH "PROCESS" WATER FILTRATION

Liquid Filter
PECO, XtreamPure®, Series 55X filter with 6" diameter XP cartridges
- Removes particulates from the Quench "Process" water stream

Liquid-Liquid Phase Coalescer
PECO, XtreamPhase®, Series 110HR coalescer
- Removes hydrocarbon (oil) carryover down to 8-10 ppmv in the Quench "Process" water stream.
- Prevents fouling in downstream equipment such as dilution steam generators
- Helps maintain good water quality and steam balance
- Reduces loss of water or requirement of fresh water make-up

3 B. PYROLYSIS GASOLINE/PYGAS FILTRATION

Liquid Filter
PECO, XtreamPure®, Series 55X filter with 6" diameter XP cartridges
- Removes particulates from the Pyrolysis Gasoline/PyGas stream

Liquid-Liquid Phase Coalescer
PECO, XtreamPhase®, Series 110H coalescer
- Removes water/mist from the PyGas stream down to 8 – 10 ppmv, which helps in improving its purity.

4 A. COMPRESSOR INLET CRACKED GAS FILTRATION

Gas Filter-Coalescer (PECO, PEACH Gemini PuraSep® 2, Series GEM2 horizontal coalescer with PGC cartridges)
- High efficiency 0.3 micron coalescer
- Removes solid and liquid contaminants
- Prevents mechanical damage of compressors.

4 B. COMPRESSOR OUTLET CRACKED GAS FILTRATION

Gas Coalescer
PECO, Spartan PuraSep®, Series 77V vertical coalescer with NGGC cartridges
- High efficiency 0.3 micron liquid coalescing
- Prevents lube oil carryover in the compressed Cracked Gas

5 PROTECTION OF MOL SIEVE BED

Gas Filter-Coalescer
PECO, PEACH Gemini PuraSep® 2, Series GEM2 horizontal coalescer with PGC cartridges
- High efficiency 0.3 micron coalescer
- Removes solid and liquid contaminants
- Prevents Molecular Sieve fouling
- Prevents Solid and Oil carryover to cold box

6 SPENT REGENERATION GAS TREATMENT FOR BURNER PROTECTION

PECO, PEACH Gemini PuraSep® 2, Series GEM2 horizontal coalescer with PGC cartridges
- High efficiency 0.3 micron coalescer
- Removes solid and liquid contaminants
- Protects burner tips

7 CAUSTIC WASH AND SPENT CAUSTIC TREATMENT

Liquid Filter
PECO, XtreamPure®, Series 55X filter with 6" diameter XP cartridges
- Removes particulates from the Caustic stream

Liquid-Liquid Phase Coalescer
PECO, XtreamPhase®, Series 110HR coalescer
- Removes hydrocarbon (oil) carryover down to 8-10 ppmv in the Caustic stream.
- Helps protect the Thermal Oxidizers (WAO) from failures by removing oil from the caustic stream

8 GREEN OIL REMOVAL

Gas Coalescer
PECO, Spartan PuraSep®, Series 77V vertical coalescer with NGGC cartridges
- High efficiency 0.3 micron liquid coalescing
- Prevents fouling of critical equipment's like acetylene reactor, furnace tubes.

9 OIL REMOVAL

Gas Coalescer
PECO, Spartan PuraSep®, Series 77V vertical coalescer with NGGC cartridges
- High efficiency 0.3 micron liquid coalescing
- Prevents oil carryover and fouling of critical equipment

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