
# UPGRADER FOR HEAVY, EXTRA-HEAVY CRUDE/BITUMEN AND RESIDUAL FRACTIONS

## HYDROGEN ADDITION UPGRADER FOR HEAVY AND EXTRA-HEAVY CRUDE/BITUMEN

- GenOil has a hydroconversion process that is the most cost efficient in the market.
- Reduces new upgrader construction costs to approx. $10,000 per barrel
- Refineries can be retrofitted from for residual upgrading at a cost below $6000 per barrel
- IRR on first commercial refinery retrofit = 116%. This can substantially increase depending on refinery configuration

## HYDROGEN ADDITION UPGRADER FOR HEAVY AND EXTRA-HEAVY CRUDE/BITUMEN

- GenOil has proven on a ten barrel a day upgrader test with ConocoPhillips their hydrocracking process that raised the crude API from 6.8 to 28 full bodied oil using their pilot refinery unit

- Third party engineering estimates GenOil upgraders economical from only 10,000 barrels per day

- When compared to delayed coking, the Genoil Hydroconversion Upgrader results in 25-30% higher liquid yields without the coke bi-product

- If you utilize the GenOil upgrading process to retrofit an existing carbon rejection refinery processing 100,000 barrels a day, if the hydrogen is available at the site, then the nominal cost of about $15 million is required. This can generate savings of up to $150 million per year.

## HYDROGEN ADDITION UPGRADER FOR HEAVY AND EXTRA-HEAVY CRUDE/BITUMEN

- 10,000 barrel a day GenOil upgraders can be stationed at heavy oil fields to raise the API to pipeline specifications for transportation of crude.
- Commercial retrofit at greater than 1000 barrels a day has been negotiated with financing pending.
- Proves scale up capacity

## HYDROGEN ADDITION UPGRADER FOR HEAVY AND EXTRA-HEAVY CRUDE/BITUMEN

- A refinery designed to process 23 API oil that cannot purchase the specified crude oil due to changes in the market such as price and supply would run below capacity raising capital costs per barrel.

- GenOil's process can take lower API oil and make it higher to meet refinery specifications thus maintaining full utilization of the refinery.

## HYDROGEN ADDITION UPGRADER FOR HEAVY AND EXTRA-HEAVY CRUDE/BITUMEN AND RESIDUAL FRACTIONS

- Hydrocracking and Hydrotreating (Hydroconversion) in One Process
- Unique Reactor Produces Superior Mass/Heat Transfer of Hydrogen to Crude and Between Hydrogen, Crude and the Catalyst
- Increases Yield by 20%-30% Over Carbon Rejection Processes (Output is 100%-107% of Input Volume)

## HYDROGEN ADDITION UPGRADER FOR HEAVY AND EXTRA-HEAVY CRUDE/BITUMEN and RESIDUAL FRACTIONS

- Can Raise API from 8º-10º API to 32º API or Higher
- Reduces Sulphur and Nitrogen to Negligible Proportions (below environmental agency requirements in the U.S. and E.U.)
- No Coke Production

## HYDROGEN ADDITION UPGRADER FOR HEAVY AND EXTRA-HEAVY CRUDE/BITUMEN

- Recovers Hydrocarbons from Residual Fractions (Bottoms) with High Efficiency Producing a Greater Quantity of High End Products
- Reduces Capital and Operating Costs by 30%-40%
- Smaller, Lighter and More Compact Units Than Conventional Upgraders
- Lower Operating Temperatures Required---Minimum 740º F/393º C
- Lower Operating Pressures Required---Minimum 1200 psig for Hydrocracking and Minimum 700 psig for Hydrotreating
- Flow Rate (LHSV) Variable for Desired Product at Constant Temperature and Pressure

## HYDROGEN REQUIREMENTS/BBL (HYDROGEN PLANT CAN BE INCLUDED WITH MODULE)

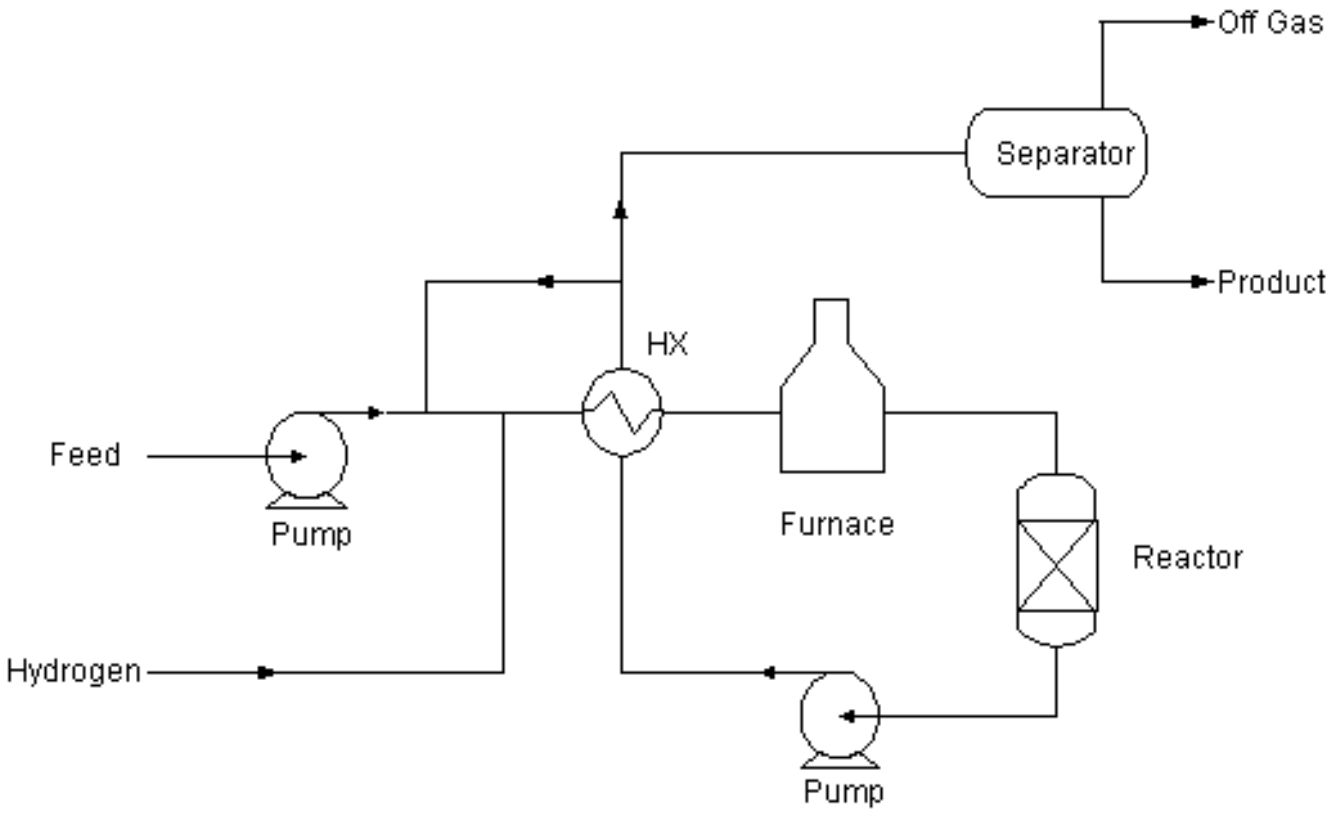
- 50 $ft^3$/1.42 $m^3$ for Each Degree API of Upgrading
- 70 $ft^3$/1.98 $m^3$ for Each % Point of Sulphur Reduction
- 320 $ft^3$/9.06 $m^3$ for Each % Point of Nitrogen Reduction
- Example: API 9º with 6.5% Sulphur and 0.125% Nitrogen Upgraded to API 32º with 0.2% Sulphur and 0.085% Nitrogen:

| | |
|---|---|
| API 9º to 32º: | 23X50 = 1150 $ft^3$/32 $m^3$ |
| Sulphur: | 6.5X70 = 450 $ft^3$/12.74 $m^3$ |
| Nitrogen: | 0.125X320 = 40 $ft^3$/1.13 $m^3$ |
| Total Hydrogen/bbl | 1640 $ft^3$/45.9 $m^3$ |

## HYDROGEN REQUIREMENTS/BBL (CONTINUED)

- Methane Requirements/bbl: 1640 $ft^3$/45.9 $m^3$ Hydrogen requires 720 ft/19 $m^3$ Methane X 50,000 bpd = 36M $ft^3$/950,000 $m^3$/day
- Note: As Purity of Hydrogen Declines from 99.999% Pure, Pressures Higher Than 1200 psig Are Needed. Example: 80% Pure Hydrogen Requires 1500 psig (1200÷0.8 )

# Simplified Upgrader Process Diagram



## UPGRADER PILOT PLANT AT TWO HILLS, ALBERTA

- Capacity 10 bpd/1.5 tons
- Test Results:

  ---6.5º API Increased to 28.5º API

  ---Sulphur Content Reduced from 5% to 0.2%

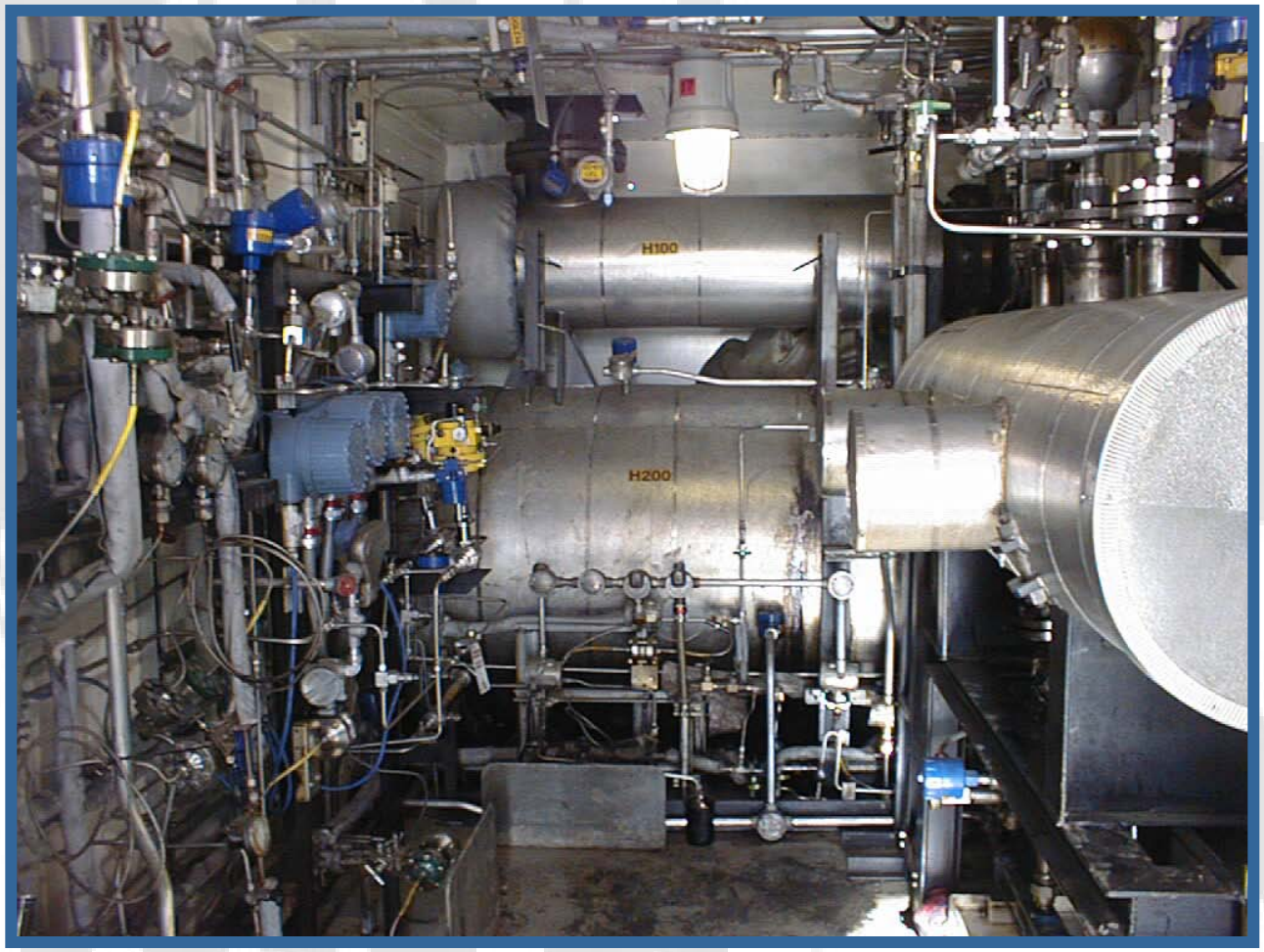
  ---Viscosity Reduced from 8,000 cp to 65 cp

  ---Yield 103% of Input Volume

## PDU Results of Upgrading 9 Runs of Same Feed (12.5º API; Sulphur 3.26 wt%; and Nitrogen 0.37 wt%) at Constant 740º F/393º C and 1600 psig at Two Hills Pilot Plant with Increasing LHSV (flow)

| PDU RESULTS | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| Case | Yield | Gravity | Total Sulfur | Elemental Nitrogen | LHSV |
| # | % | API | wt % | wt % | hr-1 |
| 1 | 101.2 | 23.2 | 0.586 | 0.24 | 0.730 |
| 2 | 100.2 | 22.8 | 0.559 | 0.24 | 0.657 |
| 3 | 100.3 | 23.1 | 0.537 | 0.22 | 0.532 |
| 4 | 103.4 | 25.3 | 0.438 | 0.17 | 0.530 |
| 5 | 101.2 | 24.5 | 0.457 | 0.19 | 0.540 |
| 6 | 98.6 | 28.5 | 0.214 | 0.12 | 0.354 |
| 7 | 101.1 | 29.9 | 0.276 | 0.15 | 0.348 |
| 8 | 100.5 | 28.2 | 0.266 | 0.14 | 0.365 |
| 9 | 101.2 | 30.4 | 0.204 | 0.15 | 0.362 |
| | | | | | |
| Feed | ---- | 12.5 | 3.260 | 0.37 | |

**Designed to Upgrade Refinery Residuals and Heavy Oil. Refinery HVGO Pilot Test Summary for 1250 BPD Commercial Installation**


H100
H200


LI300
PI301


Back Next


Back Next

## PATENTS PROTECTION

- Canadian Patent Pending
- U.S. Patent Pending
- Worldwide PCT

## CRUDE TESTING AT TWO HILLS

- 75-100 bbl Required
- Observation by Client Engineers Recommended
- O/W Maxis Separation and Desalting Demonstration If Necessary
- Upgrading at Varying Pressures, Temperatures and Flows
- Testing with Two Dimensional Material Enhanced Catalyst Possible
- Complete Report on Termination of Testing


# THANK YOU FOR YOUR ATTENTION

**Contact:**
**Abdullah Al Khashrami**
**G.C.C. General Trading LLC.**
**P.O. Box 98445**
**Dubai U.A.E.**
**Tel: +971 50 919-5658**
**Fax: +971 4 261-8448**
**E-mail: Abdullah@gccgt.com**

**Contact:**
**David Lifschultz**
**Chairman & Chief Executive Officer**
**Genoil Inc.**
**Tel: (914) 393-5800**
**Fax: (914) 834-9045**
**E-mail: dklifschultz@genoil.net**