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CASE STUDY

The Case of the Missing HAGO

The refinery had recently completed a revamp that included installation of a prefractionation column, heat train modifications, and changes to pumps and vacuum systems. Approximately 18 months after startup, a significant degradation in diesel blending performance was observed.

CHALLENGE

The refinery experienced a sudden and unexplained loss of Heavy Atmospheric Gas Oil (HAGO) yield, accompanied by an increase in Light Vacuum Gas Oil (LVGO) production. Maintaining the diesel product specification—specifically the D86 95% point of 360°C—became impossible under normal operation.

Operational workarounds negatively impacted both the atmospheric and vacuum columns, leading to instability, reduced Heavy Vacuum Gas Oil (HVGO) production, downstream FCC yield impacts, and significant economic penalties. The root cause of the missing HAGO was unknown.

Oil Refining*

- **Company Type:** Refinery with atmospheric and vacuum distillation units
- **Project Type:** Troubleshooting and performance recovery of a crude unit main column

SOLUTION

Engineering consultants used a calibrated CHEMCAD process simulation model to replicate current plant performance. By systematically adjusting operating variables and tray efficiencies, they identified abnormally low tray efficiency (as low as 35%) in trays located below the HAGO draw section of the main column.

Simulation results strongly suggested mechanical damage or obstruction of trays rather than purely operational issues. To verify the hypothesis, a gamma scan of the column was performed, which confirmed dislodged and damaged trays in the suspected zone. A temporary operational workaround was implemented until a short turnaround allowed for tray replacement.

**Adapted from Hydrocarbon Engineering, January 2013, pp. 34–37.*

RESULTS

- Gamma scan data confirmed severe tray malfunction below the HAGO draw tray.
- Damaged and dislodged trays were physically observed and replaced during turnaround.
- After repair, the distillation column returned to its design performance.
- HAGO yield and diesel blending specifications were fully restored.
- Vacuum column stability and downstream unit performance improved.

TANGIBLE BENEFITS

- Recovery of HAGO production from ~10 m^3/hr back toward design rates (~49 m^3/hr).
- Elimination of off-spec diesel production and blending constraints.
- Reduced fuel consumption and improved heat recovery in pumparounds.
- Avoidance of prolonged trial-and-error operations and unnecessary shutdowns.
- Demonstrated value of calibrated simulation as a low-cost diagnostic tool.

TABLE 1 - Calculated HAGO outputs at different tray efficiencies

ASSUMED TRAY EFFICIENCY	100%	50%	35%
Fuel Flow (lb/hr)	1591	124.9	31.1
Temperature (°F)	283.3	280.3	260.5
Pressure (barg)	0.676	0.767	0.676
Vapor Mole Fraction	0	0	0
Tc(°C)	512.6	511.2	511.7
Pc (barg)	15	15.1	15.34
API	31.87	32	31.94
Density (kg/m^3)	679.1	680.5	697.2
D86 90% (°C)	355.1	353.3	349