

Refinery Process Solutions > Crude Calcium Removal

Northshore™ CC827494

Strips 80–90% of Calcium from High-Calcium Crude and Cuts FCC Fresh-Catalyst Make-up by 70%

Key results

83%

average calcium removal across the desalter train (71–90% daily, peak 90.4%)

3.9 → 1.2 kg/t

FCC fresh-catalyst consumption; calcium on equilibrium catalyst down 80%

RMB 18 M/yr

FCC catalyst-cost saving reported by the refinery — about RMB 9 M/yr net of chemical cost

Benefits

- **High removal at low dose** — 90% calcium removal at a chemical-to-calcium ratio of just 2.4 (180 ppm on 76 ppm Ca)
- **Catalyst protected** — calcium on equilibrium catalyst 17,660 → 3,444 µg/g; micro-activity up from 68.6 to 71.4
- **Yield up** — FCC light-product yield +6.4 points, total liquid yield +5.6 points
- **Desalters run easier** — third-stage current down from 64–87 A to a stable 30–50 A; no trips
- **Corrosion-friendly chemistry** — full removal held at neutral effluent pH (7.1–7.5); no corrosion found; stays in the water phase
- **Cleaner effluent** — desalter water runs clear; COD cut 77% once

Challenge

A refinery in North China runs its 1.8 Mt/a crude unit on **100% high-calcium offshore crudes** — calcium from 30 to over 200 ppm depending on the blend. Calcium naphthenates are not removed by conventional desalting. In the desalters they drove current and power consumption up and caused trips; downstream, the calcium that slipped into atmospheric and vacuum residue and VGO poisoned the FCC catalyst, agglomerated particles and plugged the riser, interrupting fluidisation. Equilibrium catalyst was carrying **17,660 µg/g calcium**, fresh-catalyst make-up had climbed to **3.9 kg/t** and light-product yield was suffering. The refinery's target for a chemical program: calcium removal above 70% across the desalter train, with no change to metallurgy or mechanical equipment.

Analysis

Calcium in crude is bound mostly as oil-soluble naphthenates that stay with the oil, so wash water alone leaves them behind. **CC827494** is a water-soluble calcium-removal agent that reacts with calcium naphthenates at desalter conditions to form a water-soluble complex that leaves with the brine — and, unusually, keeps working at neutral to weakly alkaline effluent pH, which limits corrosion of wash-water lines and vessels. Cestoil's team designed a three-point program on the three-stage desalter train — injection ahead of each stage's wash-water static mixer, supported by a pre-treatment aid at the crude charge pump — with daily monitoring of calcium and iron in and out, desalter currents, effluent pH and COD.

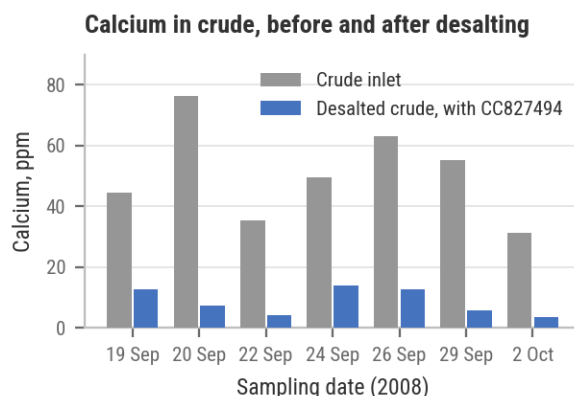


Figure 1: Calcium in crude entering and leaving the three-stage desalter train on the seven days analysed. Removal was 71.2%, 90.4%, 88.2%, 71.6%, 80.0%, 89.7% and 88.4% at total CC827494 doses of 343, 180, 180, 240, 282, 215 and 120 ppm. Refinery laboratory data.

Solution

Dosing began on **18 September 2008**, immediately after the unit restarted from turnaround, at 3,500–4,000 t/d of crude with the desalters at 110–130 °C, 0.7–0.8 MPa and 5–8% wash water. In the first week the refinery's oversized metering pumps could not control the dose precisely, so on 29 September Cestoil installed dedicated metering pumps (110 L/h for stages 1–2, 170 L/h for stage 3), all three stages were dosed and the total dose was trimmed from **343 to 120–215 ppm** while calcium, iron, desalter currents, effluent pH and COD were tracked at each step into early October.

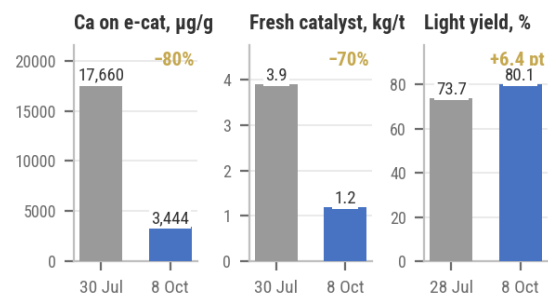


Figure 2: FCC equilibrium-catalyst calcium, fresh-catalyst consumption and light-product yield before decalcification (late July 2008) and after three weeks of treatment (8 October 2008).

Result*

- **80–90% calcium removal, 83% average.** On the seven analysed days calcium in desalted crude fell from 31–76 ppm to 3.6–14 ppm – removal of 71–90%, average 83%, every day above the 70% target. At 76 ppm inlet calcium, 180 ppm of CC827494 removed 90.4%: a chemical-to-calcium ratio of just 2.4 (Figure 1).
- **Catalyst protected, make-up cut 70%.** Calcium on equilibrium catalyst fell from 17,660 to 3,444 µg/g (–80%), micro-activity rose from 68.6 to 71.4 and fresh-catalyst consumption dropped from 3.9 to 1.2 kg/t (Figure 2).
- **Yield up.** FCC light-product yield rose from 73.7% to 80.1% and total liquid yield from 78.2% to 83.8% at higher throughput (940 → 1,292 t/d). The refinery attributes the gain chiefly to calcium removal, with some contribution from unit upgrades.
- **Desalter relief, no side-effects.** Third-stage currents fell from 64–87 A to a stable 30–50 A within a day of dosing; the refinery reports lower power consumption, no trips and clear effluent water. As the dose was optimised, effluent pH moved from 4.5 to 7.1–7.5 and COD fell 77% (13,697 → 3,199 mg/L) while calcium removal held at 88–90%; no corrosion was found and crude TAN rose by less than 0.2 per 100 ppm of calcium removed.

Value delivered

Calcium removal	71–90% daily, 83% average (target > 70%)
FCC fresh-catalyst consumption	3.9 → 1.2 kg/t (–2.7 kg/t; RMB 51.86 per tonne of FCC feed)
FCC catalyst-cost saving (refinery, 350 kt/a unit)	RMB 18.2 million / yr
Decalcifier cost (refinery, RMB 5/t on 1.8 Mt/a crude)	RMB 9.0 million / yr
Net benefit before yield upside (derived)	≈ RMB 9 million / yr (≈ USD 1.3 M at 2008 rates)



About Northshore™ CC827494

Northshore™ CC827494 is a water-soluble crude-oil calcium-removal agent injected into desalter wash water. It converts oil-soluble calcium naphthenates into a water-soluble complex that leaves with the desalter brine, protecting downstream FCC and hydroprocessing catalysts from calcium poisoning without changing desalter metallurgy or hardware.

It maintains high removal at neutral to weakly alkaline effluent pH, adds less than 0.2 TAN per 100 ppm of calcium removed and does not partition into the oil. Cestoil designs the injection program, supplies metering equipment where needed and monitors the trial.



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Discuss a similar application

Send us your crude calcium range, desalter configuration and equilibrium-catalyst metals – we will propose an injection program and a monitored trial.

About Cestoil Chemical

Cestoil Chemical is a global provider of specialty chemicals – fuel additives, process additives and advanced materials – headquartered in Ontario, Canada, with operations in North America and Asia. For over 20 years we have combined disruptive technology with hands-on technical service to deliver bottom-line results for refiners, petrochemical producers and pipeline operators.