



Pacific E&P CPE-6 crude oil facility

eliminates chemicals and heat
during separation

at a glance

Unit Type—Two 4-in. Separation Enhancers

Application—Crude oil production facility

End User—Pacific Exploration & Production (E&P) Corporation is a Canadian-based, oil and gas exploration and production company with assets in 7 countries, mostly in South America.

Reason for Installation—The CPE-6 facility in Columbia had expensive production costs because of the need for a variety of chemicals and heat treatment to help separate and move heavy oil. A test was conducted to determine how effective Separation Enhancers could be at reducing those production costs.

Results—The Separation Enhancers allowed operators to eliminate the chemicals and heat previously used in the separation process while still meeting oil quality expectations. Total estimated savings 36 days after installation was \$57,000 (U.S. dollars).

contact distributor

Site Description

One of the largest oil producers in Columbia (about 275,000 bbl/d or 43,722 m³/d), Pacific E&P operates a crude oil production facility located about 109 miles (176 km) southeast of Gaitán Port, Columbia. According to Hugo Bernal, the Pacific E&P Artificial Intelligence Leader, the fluids being processed at this facility are produced from CPE-6 Block, which is in the Llanos Basin.

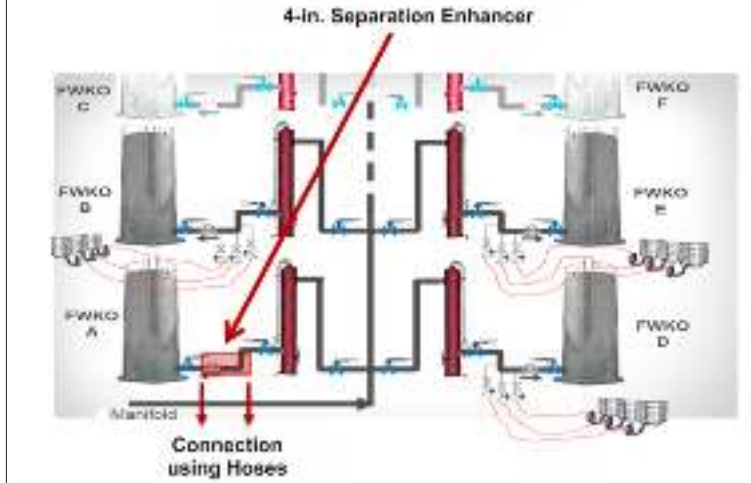
While actual flow rates vary, Bernal indicates that the production facility processes an average of 1,200 bbl/d (191 m³/d) of oil and 20,800 bbl/d (3,307 m³/d) of water for a total fluid production of about 22,000 bbl/d (3,498 m³/d). The incoming fluid has an average basic sediment and water (BS&W) content of 94% and a temperature of 150°F (65.6°C). After passing through a manifold, the flow can be split into different pathways to accommodate various operational needs. The configuration typically used has two pathways, each with 3 free water knock out (FWKO) tanks available (i.e., FWKOs A→B→C and FWKOs D→E→F). Initial separation at FWKOs A and D results in a crude stream with a BS&W of about 14%. Given that the desired BS&W is less than 1%, more processing is needed before the crude can leave the facility. All of the separated water is disposed through re-injection back into the ground.



Map of CPE-6 Block

CPE-6 Block occupies about 2,349 mi² (6,083 km²) along the regional heavy oil trend in the Llanos Basin. In an independent evaluation, reserves for CPE-6 Block were estimated at 38,000,000 bbl as of December 31, 2014.

Phase 1 Configuration



Planned and Actual Unit Installation

For Phase 1, 50 % of flow passes through Separation Enhancer at FWKO A. For Phase 2, 100% of flow is handled collectively by units at FWKOs A and D.



“Effective treatment is complicated by the fact that the oil is a heavy crude,” explains Bernal. “The gravity is about 10.5°API, which translates to a density of 995 kg/m³. In our treatment process, we were routinely using several different types of chemical additives such as viscosity reducers, direct emulsion breakers, reverse emulsion breakers, universal emulsion breakers, and biocides. We were also applying heat at various points in the process to improve separation and to make it easier to move the heavy crude to the load station. To help the chemicals with separation, the fluid temperature at FWKOs A and D was raised from 150°F (65.6°C) to 170°F (76.7°C), an increase of 20°F (11°C).”

The direct costs in labor and materials associated with using chemicals and heat are substantial, prompting the company to search for ways to lower those production costs. “One of my responsibilities,” offers Bernal, “is to identify and evaluate new technologies that may offer strategic solutions to operational challenges and in doing so improve the economic bottom line. On paper, the Separation Enhancer technology looked like it could help the CPE-6 facility operate more efficiently, but what we really needed was to test it out for ourselves in actual operating conditions.”

Test Description

To evaluate the potential effectiveness of the Separation Enhancer technology, Pacific E&P conducted a pilot test at the CPE-6 facility. While there were multiple test objectives, Bernal states that the four primary objectives

were to determine if the Separation Enhancers could yield the following benefits:

- Reduction or elimination of chemicals and associated labor
- Reduction of the crude BS&W to less than 1%
- Reduction of oil in water to less than 5 ppm
- Reduction of fuel consumption from 10% to 15%

To help ensure that the Separation Enhancer technology was installed and operated appropriately, Pacific E&P worked with Juan Michaels, the Senior Project Manager for Eco1st South America. For reasons unrelated to the Separation Enhancers themselves, during the testing period the facility ran at a little over 70% (17,000 bbl/d or 2,703 m³/d) of its typical total flow rates.

“The test was conducted in two phases. The first phase began with the installation of a 4-inch Separation Enhancer at the entrance to FWKO A,” Michaels recalls. “Half the facility’s production – about 8,500 bbl/d or 1,351 m³/d – was run through FWKO A, and the remaining half was run through FWKOs B, C, and F. No changes were made to operations in terms of chemicals and heat. Running only a portion of the flow through the Separation Enhancer during this phase allowed Pacific E&P to gain experience with the unit before deciding whether to move to the next phase, which would place all of the fluid flow under the influence of the Separation Enhancers.”

Michaels indicates that Pacific E&P allowed the system to stabilize for a week before moving ahead with the next phase by installing a second 4-in. Separation Enhancer at the entrance to FWKO D. Then the flow paths were

adjusted so that 100% of the flow through the facility went through either FWKO A or FWKO D, meaning that all of the flow was subject to the influence of the Separation Enhancers. Over the next week, the amount of chemicals injected was gradually reduced and the resulting system response was observed and measured. Eventually, the use of chemicals was eliminated altogether. In addition, the use of heat at FWKOs A and D was eliminated in the last 10 days of the test.

Results

Pacific E&P's Bernal reports that, after 36 days of testing, the Separation Enhancers met or exceeded expectations both in terms of performance benefits and cost savings.

Performance Benefits – “One of the most significant test outcomes,” reflects Bernal, “is a direct demonstration showing that the CPE-6 facility can be operated with a simpler, more streamlined process that does not rely on chemical additives. The Separation Enhancers also made it possible to stop heating the crude at FWKOs A and D, thereby reducing fuel consumption.”

Bernal points out that the elimination of chemicals and associated labor and the reduction in fuel consumption was accomplished while still meeting the test objectives regarding the quality of the separated fluid streams. The BS&W of the crude fluid stream was less than 1%, and the oil-in-water value for the produced water stream was less than 5 ppm.

The performance benefits seen during the test stem from the fact that the ionization induced by the Separation Enhancers causes the fluid constituents to separate more completely according to their specific gravities. Bernal notes, “The test surprised us. We have never seen fluid separation occur as fast as it did with the Separation Enhancers. Besides that, the beneficial influence of the Separation Enhancers extended not only to the FWKOs downstream of the unit installations, but also to the pipelines and the 7 wellheads located up to 2.5 miles (4.0 km) upstream of the installations.”

Another performance benefit realized during the test was the clean-up effect that causes existing build up and scale to slough off of pipeline and tank walls. The same forces causing the internal clean up also prevent the formation of new build up and scale. Evidence of this clean-up effect was detected during maintenance operations.

Production Cost Savings – Over the 36 days of the test, Bernal estimates that the production cost savings was about \$57,000 (U.S. dollars). The largest contributor was the elimination of chemicals, which resulted in a savings of \$27,000 (U.S. dollars), followed by the reduction in labor (\$24,000 U.S. dollars). The reduction in fuel costs caused by eliminating heat for initial separation for the last 10 days of the test was \$6,000 (U.S. dollars). Per month, the projected fuel savings is \$18,000 (U.S. dollars).

Cost Savings Achieved after 36 Days of Testing with Separation Enhancers

Item Description	Savings (U.S. dollars)
Elimination of Chemicals	\$27,000
Elimination of Chemical-Related Labor	\$24,000
Reduced Fuel Consumption Due to Elimination of Heat for Initial Separation	\$6,000*
Total Savings	\$57,000

NOTE: *Amount calculated reflects elimination of heat for last 10 days of test. Projected savings for a month of operations is \$18,000 (U.S. dollars).

“The test surprised us. We have never seen fluid separation occur as fast as it did with the Separation Enhancers.”

—Hugo Bernard, Pacific E&P Artificial Intelligence Leader

Test Sample Shows Separation of Heavy Oil and Water with Separation Enhancers

