

Water Treatment Challenge



Cows are grazing in a field adjacent to the Ecopetrol Acacias facility, highlighting the importance of proper treatment of water in the oil production. Siemens is installing equipment maintaining highest ecological standards.

In the Castilla oil field in the Acacias township in Colombia, Siemens is partnering with Ecopetrol to set up a system that will purify about 40 million gallons of water daily, equal to the average water consumption of a city of 100,000 people.

Text: Chris Kraul

Within less than a decade, Colombia has joined the elite of global oil producers, doubling its average daily output to more than 1 million barrels per day, a level attained by only 19 other countries. Better known perhaps for its foreign shipments of coffee, cut flowers and bananas, Colombia is now a player in the global oil market, ranking behind only Saudi Arabia, Canada, Mexico, and Venezuela among top oil exporters to the USA.

But pumping all that oil is a highly complicated process. More than half of Colombia's output qualifies as so-called "heavy oil", with a viscosity so thick that it has the consistency of asphalt. And owing to heavy oil's peculiar geological characteristics, companies often must pump nine barrels of ground water for each barrel of crude they extract.

The "production water" is quickly separated from the oil at the well-head. But before it can be reintroduced into the ecosystem, it must go through a process called STAP, which is the Spanish acronym for "systemic treatment of production water", to eliminate oil, suspended solids, chemicals, and other contaminants.

This poses a significant water management challenge due to the high volumes of water that have to be treated and the sensitive rural areas known as the Llanos that surround the booming oil production in eastern Colombia. Farmers and cattle ranchers there are understandably concerned about what impact the spike in oil production may have on water quality.

At the Castilla Oil Field

Among those feeling the pressure is Ecopetrol, the state-controlled company that accounts for two of every

three barrels of oil that Colombia produces. The water treatment issue is especially urgent at its oil field in the Castilla La Nueva Municipality in eastern Meta province, which is now the company's single most productive oil field. While output there has doubled in recent years to 127,000 barrels per day and could jump by another 40 percent by 2016, the amount of production water pumped as a byproduct is climbing at an even faster pace. In two years, the ratio of water to oil produced is expected to rise to 20 barrels of ground water for each barrel of oil pumped.

"For technical, social, and logistical reasons, water treatment in the Llanos is a huge challenge," says Nelson Gonzalez, Ecopetrol's Project Manager for Castilla developments. "The company is depending on Castilla to produce 20 to 25 percent of its cash flow and to help it meet its future production goals. That Ecopetrol is investing US\$4.5 billion through 2016 in Castilla is an indication of its importance. But the discovery of oil is outpacing our ability to treat the water. And if you can't treat the water, obviously, you can't pump the oil." Equally delicate as the technical problem of treating so much water is the social challenge of explaining to surrounding communities that oil extraction is "not a problem, but a benefit," Gonzalez believes. It's a challenge all oil companies operating in the Llanos are confronting. Community protests over the last couple of years over hiring practices, truck traffic, and environmental uncertainties have resulted in blockades that at times have forced companies to shut down oil fields and cease operations. Enter Siemens. Since 2010, the com-



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Nelson Gonzalez, Ecopetrol Project Manager for Castilla Developments

Photos: Chris Kraul, Andres Gomez



A chemist examines a sample of heavy oil to analyze how effective the water dehydration process has been.

Ecopetrol Facts and Figures

778,000 barrels per day: Current production of oil and equivalents at Ecopetrol. Doubled since 2006.

Top 10: Ecopetrol's global ranking in terms of efficiency in the number of barrels produced per employee.

Top 40: Ecopetrol ranks among the top 40 oil companies in the world in production and reserves.

6.47 Billion USD: Investment in the Reficar refinery under construction near Cartagena, one of the world's most modern.

97 Percent: percentage of crude converted to value-added products, up from the previous facility's 74 percent.

pany has taken on a growing role in helping Ecopetrol purify production water at the Castilla field's central fluid processing centers, known by their Spanish initials CPF. It's at those facilities that water is purified and heavy oil is diluted with naphtha, allowing it to be transported to Caribbean depots via pipeline or truck.

40 Million Gallons Purified

Siemens is supplying water treatment systems at Acacias, one of three CPFs in the Castilla oil field. There, up to 960,000 barrels of water a day pumped up with oil are treated by four STAP systems, two already operating, two more being installed. Last July, Siemens won a contract to supply Acacias with a fifth STAP that will equal the treatment capacity of the previous four, a system that will manage and purify about 40 million gallons (over 150 million liters) of water daily, equal to the average water consumption of Boulder, Colorado (population: 100,000). The installation of the system will allow Ecopetrol to add about 40,000 barrels daily to its Castilla production, according to Félix Suárez, a Colombia-based Siemens chemical engineer who is assisting with the STAP installation. At the Acacias CPF, Siemens has installed systems that consist of three basic components to make production water clean enough to be piped back into the local Guayuriba River. The first is the corrugated plate separator, which removes the thickest concentration of oils and suspended solids. Then the water passes through flotation cells, where injected gas or oxygen adheres oil drops and suspended solids particles, enabling them to be skimmed off. Lastly, the water is pushed through filtering chambers filled with walnut shells that have the affinity for absorbing oil and other remaining impurities. "Other filtering agents, like rice and palm seeds, do the job; but walnut shells resist pressure and temperature best," says Suárez. He has worked at water treatment facilities around the world, but seldom has he been confronted with challenges like at the Castilla field. The sheer volume of water that must be processed in real time is more



Siemens Engineer Félix Suárez in front of a flotation cell for the new water purification complex that the company is helping to build at Acacias (left). Work is proceeding on the enormous underground tank for the Ecopetrol facility (right).

than any other oil field he knows of. There are also the unique challenges of Colombia's Andean geography, of trucking huge system components over two-lane roads that wind through mountains and canyons. But Siemens has been equal to the challenge, according to Jorge Bustamante, Ecopetrol's project mechanical installation manager for the expansion of the Acacias CPF. He has been impressed with how the company has helped solve "post-sale problems," such as incrustations in the flotation cells. With input from Siemens engineers in Colombia, the USA, and Germany, the issue has been fixed.

A Big Role in the Energy Boom

"We contracted with Siemens because our market intelligence indicated they had the seriousness, discipline,

and commitment that we needed," Bustamante states. "We knew that if there was a problem with engineering or project management, they would be there to help us fix it. It's important, because we can't do it all ourselves." As oil grows in importance to Colombia's economy, Siemens is playing a bigger role in the energy boom, which has been due to a convergence of several factors: The rise in oil prices to US\$100 a barrel and higher mean that the added cost of processing and transporting heavy oil, which is now 55 percent of all the petroleum that Colombia produces, is feasible. More pipelines are being added to the national grid, providing oil companies with more efficient means to getting their crude to market.

Venezuelan Expertise

The political upheaval in Venezuela's state-owned PDVSA oil company a de-

cade ago caused an exodus to Colombia of hundreds of former employees with deep knowledge of pumping and processing heavy oil in places such as the eastern Orinoco Belt in Venezuela, one of the world's richest oil reserves. Many of those Venezuelans are now applying that expertise in the service of several oil companies active in the heavy oil fields of Meta province. Suárez, who is a native Venezuelan and who has represented Siemens in oil fields there as well as in Peru and Ecuador, says Siemens guarantees the engineering of its systems, and offers project management advice as well. "That is an enormous comfort and help to us," says Leonardo Rojas, an Ecopetrol engineer at Acacias. Ecopetrol's Bustamante acknowledges that there is pressure on his crew and on Siemens to build an expanded water treatment facility that is environmentally sound while helping the company maintain its rising oil production trajectory. "There is the time pressure, and of course the communities are expecting more and more from us. Also, the company and the country have made an enormous bet on Castilla that, despite the difficulties, has given good results," Bustamante said. "Pressure? I like pressure. It gives you lessons learned that you can apply later on." ■

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