

Aqua-Pure's recycling system NOMAD 2000 uses Alfa Laval's AlfaVap technology to clean wastewater from gas wells in northern Texas.




# Clean water visionary

**New use of old technology** keeps clean water flowing to gas wells in the Barnett Shale in Texas and recycles up to 80 percent of “flowback” wastewater for future use – protecting a valuable natural resource while maximizing gas production.

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TEXT: **JIM DALE** PHOTO: **ED LALLO**



More than 80 percent of Devon's early flowback water is recycled by Aqua-Pure's system.


**THE GOOD NEWS?** A 13,000-square-kilometre region of North Central Texas lies atop the Barnett Shale – the largest single shale gas play currently under development in North America. Estimates say the area contains 700 to 1,000 billion cubic metres of natural gas, enough to feed US domestic natural gas needs for the next dozen years or more.

Since the first exploratory well was drilled in the Barnett more than 25 years ago, a number of exploration and production companies have developed technologies, including horizontal drilling, to economically extract gas from the highly dense shale formation. Producers are currently drawing in the range of 71 million cubic metres per day through 8,000 producing wells.

**THE NOT-SO-GOOD NEWS?** The key to making the Barnett Shale economically viable is hydraulic “fracturing” (or “fracking”), a process that involves forcing high volumes of freshwater into gas wells under enormous pressure to create fissures in the shale. These fissures allow the trapped gas to flow into the well bore and to the surface, some 2.5 kilometres upward to the Texas prairie, an area with limited water and periodic droughts.

Each well drilled in the Barnett Shale requires between 4 and 19 million litres of water for fracking. The water supply comes largely from regional reservoirs, municipal water supplies and wells drilled into the Trinity River and Woodbine aquifers that lie between the Barnett and the surface.

After fracking, the residual wastewater – usually containing high levels of salt, polymers, friction reducers and



Devon's Jay Ewing and Aqua-Pure's Brent Halldorson review the results from cleaning water using the NOMAD 2000.

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**BRENT HALLDORSON**, chief operating officer, Fountain Quail/Aqua-Pure

surfactants – has traditionally been pumped down disposal wells drilled far beneath the Barnett layer, never to be seen (or used) again. This scenario involved thousands of individual truck trips over the region’s dusty rural roads to haul water from gas wells to disposal sites.

**THE REALLY GREAT NEWS?** Devon Energy, which accounts for roughly 30 percent of all Barnett wells, has teamed up with Canada-based Aqua-Pure Ventures to develop a purpose-built recycling system that reclaims 80 percent or more of the initial “flowback” water used in the overall fracking process. Aqua-Pure Ventures, through its Texas-based operating company, Fountain Quail Water Management, has decades of experience in industrial and municipal wastewater treatment innovation.

This “flowback” water – which is ejected from the well due to the initial pressure – typically makes up about 20 to 30 percent of the total water used in the process. The remaining water is extracted along with the natural gas over the lifetime of the well. The ability to recycle four-fifths of the



Julia Holden of Fountain Quail works the control panel of the NOMAD 2000.



flowback water means that Devon is able to reduce its total water needs by 16 to 24 percent – a significant savings, both in water costs and environmental impact.

“Technology for cleaning water through MVR [mechanical vapour recompression] evaporation goes back a hundred years or more,” says Aqua-Pure’s Brent Halldorson, chief operating officer and driver of the Fountain Quail team in Texas. “You boil the wastewater and get pure distilled water as an output, leaving a small concentrated salt solution behind. In this case, that means all the subsurface contaminants and residual materials used in the fracking process.”

Aqua-Pure found a way to develop the old idea of MVR evaporation into something that could efficiently and economically handle the large volumes of water used in the gasfields.

**THE INITIAL PROTOTYPE** was designed for cleaning the water associated with landfill leachate. “It seemed a logical next step to take our technology a bit further to process wastewater associated with oil and gas production,” says Halldorson. “By making our systems mobile we could take MVR evaporator technology into a new arena – highly variable oilfield wastewater.”

The solution was the NOMAD 2000 Mobile Evaporator – a three-stage portable platform that could move from field to field and use Aqua-Pure’s improved MVR technology to

process a well’s wastewater on the spot. Basic MVR technology, which recovers the heat lost in the evaporation/condensation process and reuses it to fuel additional evaporation, could provide considerable efficiencies. But a compact, two-phase heat exchanger was needed that could keep up with the messy, high-volume process of converting nearly 2.3 million litres of wastewater per day into highly pure distillate.

The challenge that Aqua-Pure faced was that most conventional standard heat exchangers available were not designed for two-phase service and fouled too often, requiring countless hours of physical dismantling and cleaning. “They simply weren’t up to the rigours of the gas production world,” says Halldorson.

Enter Alfa Laval. “I saw the things we did with our AlfaVap evaporator and couldn’t stop thinking of all the other possible uses,” recalls Tomas Kovacs, marketing manager and technologist at Alfa-Laval. “And the AlfaVap is the very heart of what the NOMAD does.” When Kovacs introduced to Aqua-Pure the range of solutions that

► Facts

**AQUA-PURE VENTURES**

- Based in Calgary, Canada
- Operates in Texas under Fountain Quail Water Management
- About 80 employees in the Texas region
- Primary business is wastewater treatment
- Main product is the NOMAD 2000 Mobile Evaporator
- Key differentiator: Patented mechanical vapour recompression technology enables the NOMAD to boil highly variable oilfield wastewater, recover the steam and create distilled water. The system uses wide-gap two-phase plate technology instead of more traditional shell-and-tube evaporation, achieving extremely high efficiency in the production of recycled wastewater.

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JAY EWING, completion construction manager, Devon Energy



▶▶ [www.alfalaval.com/here/water/aquapure](http://www.alfalaval.com/here/water/aquapure)

>>> could be developed using new designs and materials for the NOMAD process, it was an ideal match from the very beginning.

**WORKING WITH ALFA LAVAL,** Aqua-Pure was able to incorporate the AlfaVap into the NOMAD design, using titanium that is immune to the highly caustic briny conditions of gasfield recycling.

“Not only is it highly efficient,” Halldorson says, “but it also needs very little other than routine maintenance and the occasional scale removal. Once you get it fired up, using local gas directly from the site to power a start-up boiler, it’s basically an exercise in balancing energy.”

For Devon, whose production plans included 600 wells

for 2008 and exploration of an additional 7,500 sites for 2009 and beyond, using the NOMAD is a great long-term investment. The NOMAD solution costs from 50 to 75 percent more than just pumping wastewater back down into the ground, says Jay Ewing, Devon’s point person on the project. “But,” he says, “we believe the economics will work out over the long run, because we’ll save money by reusing our own water and not having to truck water all over North Texas. Water is a finite resource here. More important, this is absolutely the right thing to do, both to provide ourselves with the water we need for fracking and also to minimize our impact on the environment.”

**THE FIRST NOMAD UNIT** went into full operation in 2005. Now there are nine complete NOMAD systems in operation, each consisting of three 40-foot modules. Aqua-Pure, Devon and Alfa Laval have worked closely to fine-tune these systems to deliver maximum performance. “We’ve learned a few things as we’ve gone along,” says Ewing.

While water recycling in the Barnett Shale gives Aqua-Pure plenty of room for future expansion, the company is also looking to apply its NOMAD technology as other fields open. One example is the Marcellus Shale, which runs from upstate New York hundreds of miles south through the Appalachians. The Marcellus, many geologists predict, could be the largest single shale field in North America, but it is also among the most environmentally sensitive.

“We’ll be ready to go with as many NOMADs as we need when the time comes to go there,” says Halldorson. “We’re looking at almost unlimited opportunity over the coming decades. Once we discovered Alfa Laval’s AlfaVap technology and saw what it could do for our patented process technology, we’ve never looked back.”

And that’s good news for everyone. ■

▶ Alfa Laval’s AlfaVap heat exchanger

## It’s all in the details

Alfa Laval’s AlfaVap technology has unique features that make it particularly well suited for use in gas and oil fields. The design of the plate pattern, for example, creates high turbulence and dramatically increases heat transfer while at the same time reducing fouling and scaling.

AlfaVap solutions are typically far more compact than conventional “falling film” systems, which work by pumping contaminated water to the top of a vertical shell-and-tube heat exchanger

and having the liquid boil in a thin film as gravity pulls it down through a series of internal tubes. Their compactness ensures a reduction in installation and operation costs. And designed-in expandability makes adding plates

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to extend capacity easy and cost-effective.

“We knew we had a process that would meet the economics of the gasfields and help create a sustainable water cycle to allow fracking in shale,” says Aqua-Pure’s Brent Halldorson. “Our success hinged on having a serviceable evaporator exchanger that could handle the rigours of oilfield wastewater. Alfa Laval’s AlfaVap gave us the robust, powerful, efficient and easy-to-service heat exchanger technology we needed,



Alfa Laval’s AlfaVap has the right features for the job.

and we’ve had a great working partnership ever since.” ■