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Startup Cracks Propane Fracture Puzzle, Provides 'Green' Solution ***By: Maurice Smith***

Sometimes, the best technological solutions seem, when accomplished, to be the simplest -- the ones where the users wonder why nobody else had thought of it.

One of the most impressive new fracturing technologies to enter the market recently, developed by Dwight Loree, founder of Calgary based GASFRAC Energy Services Inc., is one such invention. The proprietary new fracturing system uses liquefied petroleum gas (LPG), consisting mostly of propane, rather than water-or oil-based fracing fluids. Using propane as the fracturing fluid and pumping it into a reservoir does not result in the types of formation damage other fluids often cause.

The real advantage is derived from propane's two-phase nature -- it is pumped as a gelled liquid, effectively delivering proppant into the formation, and then drawn back out as a gas. That means virtually 100% recovery of the propane frac fluid, compared to the roughly 50% achieved with conventional fluids, establishing an effective frac length into the formation two to three times longer. It also means flow back can be shortened to as little as 24 hours versus an industry average of about five days with conventional fracing.

"Propane is a beautiful fluid because it can either be a liquid or a gas. It's inert, so it doesn't react with the formation or formation fluids at all. When fracturing with propane it stays liquid, but after completing the frac, the propane goes into solution with the reservoir gas," says Loree, GASFRAC president and CEO. "Even when fracturing very tight zones, all of the propane is recovered and, in over 70 fracs now, has been recovered in less than 48 hours."

This means, where the infrastructure is in place, the propane can be recovered during flow back directly to pipeline along with the produced natural gas. This eliminates the need to flare sales gas for a week or longer, as is often done in conventional fracing to remove contaminants such as carbon dioxide and nitrogen. Flaring of these contaminants is necessary until the produced gas stream meets pipeline specification. Using propane also eliminates the need to supply water, recover water back to surface and then finally dispose of it.

The timing for such an environmentally-friendly technique could hardly have been better as jurisdictions, such as British Columbia, move to put a cost on carbon dioxide emissions (carbon tax). The propane used in fracturing can be separated at the gas plant and recycled, Loree explains. Not only will the reduction in flaring convert what could be hundreds of thousands of dollars worth of natural gas from a single well to sales gas, but it will eliminate hundreds of tonnes of greenhouse gas emissions per well that flaring releases to the atmosphere.

"In conventional fracing, the well is flared until sufficient fluid is recovered so a test can be completed [before they can flow it to pipeline]. A tank is used to catch the fluids and a flare stack is used to burn off the gas. When a well is flowed back, it may be necessary to flare it for as much as two weeks, not only burning half a million dollars worth of gas, but also introducing 400 or 500 tonnes of carbon dioxide into the atmosphere. With GASFRAC the well can be fractured and flowed back right into facilities where the propane is recycled and reused. That's going green!"

Loree estimates propane gas fracs can increase production up to 35% over conventional fracs in some tight reservoirs, in part because it provides such a long effective frac. "Water and oil create a lot of problems in the reservoir," he explains. "When a well is fractured the process puts thousands and thousands of pounds pressure on the face of the reservoir rock. That extremely high pressure forces the frac fluid into the micro pores, while the reservoir only has a fraction of that pressure to push it back out. Where the created frac length may be 300 metres and only half of the frac fluid is recovered, the effective frac length is often 100 metres and that effective frac length is only near the wellbore where there is good pressure drawdown. Farther along the frac, the drawdown decreases to the point where that fluid is left trapped in the reservoir."

"Fluid remaining in the formation blocks production," says Grant Nevison, GASFRAC vice-president and COO. "The tighter the reservoir, the tougher it is to get that fluid out and the more benefit you will see with GASFRAC. We are seeing

effective frac lengths two to three times longer than conventional fracs."

Where re-completions have been done, GASFRAC has found its system can also remove fluid left behind from previous fracs. "One of the first wells we did was barely producing following a conventional oil frac; it was uneconomic. We fractured the well with propane and got 90 cubic metres of frac oil back along with all the propane within 20 hours. It turned out to be the best well in the field," Loree says.

Overcoming hurdles

The LPG concept had been bantered about in recent years as a potential holy grail to fracing but, while the idea sounds straightforward enough, no one had figured out a means to gel propane or to address potential safety issues surrounding pumping and adding proppant to the highly flammable fluid. It took a couple of years for Loree at GASFRAC to get over those hurdles.

Loree was a co-founder of Canadian Fracmaster Ltd. in the 1970s and left in 1985 to found Trysol Inc., a specialty solvent and frac-fluid production and marketing company. Loree sold that company in 2000 and came out of retirement three years ago to spearhead the GASFRAC effort.

"The trouble with fracturing using propane was that the process had to be safe before you could introduce it to the industry. We also had to be able to gel it. That took two years [to solve]. When you gel water, it ends up looking like Jell-O; we needed to create the same properties with propane. We developed and designed our own equipment to do the gel testing because nobody had done this with propane before. We had to find the right molecules," says Loree, declining to describe the proprietary gelling process any further than that.

Rather than attempt to modify existing systems, safety issues were handled by developing new equipment and procedures from the ground up, something the company says was long overdue in a sector of the industry that hasn't changed much in decades. GASFRAC designed a new generation of equipment that is fully enclosed and entirely remotely operated, says Nevison. Propane volumes are managed throughout the system, electronic monitors watch for leaks and equipment is "configured to shut down smart" in the case of any leakage, he says. Personnel never enter the hot zone, or potential vapour zone. "We are able to provide a good comfort level to our clients -- they are risk averse, as are we."

GASFRAC enlisted experts in liquid gases to assist in design, and to undertake a detailed risk assessment of the system. "These specialists perform hazard analysis on nuclear plants and offshore production and drilling platforms, and are well known in the industry," Loree notes. "That had to be done, and it ended up being part of our patent work. The system is all patented and a good part of these patents are the strategies that we incorporated to make it safe."

So safe, he says, that insurance companies give them the same rate as conventional fracing. "Many of our clients are saying conventional fracing should include GASFRAC's safety procedures," he says.

Technology converts

With those hurdles cleared, GASFRAC can point to numerous advantages inherent in what seems an intuitively simple solution. "The fracing business started about 1950 and shortly thereafter began using water as a main fracturing proppant carrier. Today, nearly 60 years later, the industry is still using water. However, the type of reservoirs we are completing today have changed dramatically since then -- we are into very tight reservoirs, shale gas, unconventional gas and, in reality, water is no longer a suitable fluid for developing these reserves," says Loree.

Shaun James, vice-president, Engineering and Operations, for Caltex Energy Inc., says he has used GASFRAC's services on six wells since becoming one of the company's first customers in February of this year. The system was tried in low pressure, tight gas reservoirs that are fluid sensitive, he says. "The previous stimulations wouldn't flow back very easily. After exposure to frac oil, it was only at 20% of its initial permeability. We found GASFRAC did two things -- it flows back very quickly with minimal damage and it reduces costs on testing."

Caltex will also be able to reduce flaring, says James. "Normally we would flare for about three days. That's probably three million cubic feet of gas, possibly more, going up the flare stack. When we have infrastructure close, we won't flow back to flare; we will just pump our frac and do a quick forced closure where the well is flowed back for a couple hours until the frac closes. Then you run pipe and tie it in."

Steve Burnside, senior production technologist with Delphi Energy Corp., has become a convert after initially doubting the technology. "At the beginning I was very pessimistic. I didn't think you could place sand with propane let alone do what they were claiming they could do. They spent a lot of time and effort making me feel confident enough to give them a shot. And lucky for them our first well worked; it was fine and we got a great flow back. Now I find using gas fracs is an easy business decision -- you can anticipate what it provides, performance and value, and you want to use it every time."

Delphi performed gas fracs in tight reservoirs in its Big Stone area in central Alberta, where flow back was challenging. Burnside says he was impressed with the lack of damage to the reservoir in the wells that were gas fraced. "There is a lot of speculation out there about damaging reservoirs while fracing and how water affects flow backs; with this there is none of that. You are putting in the reservoir what is already there, hydrocarbon, so you really can't damage it -- in fact, in some cases, you probably make it quite a bit better." He says he also likes the environmental benefits that come with eliminating flaring, swabbing, flowing back and disposing of water for clean up.

The only negatives for Burnside and James were the lack of availability of GASFRAC crews and the cost, which initially can appear high. "It's a different cost structure," says James, noting that while equipment costs may be higher, they are made up for in reduced clean-up and test time. He also says propane costs are very favourable. "Propane is half the cost of frac oil, so not only do you get the flow back savings on quick turnaround into your pipeline, but your base fluid is half the cost. That's $50,000 [savings] right there -- that could be 25% of your total completion cost."

"If you don't understand the cost structure of GASFRAC versus the frac system you are currently using, it could look fairly expensive," agrees Burnside. "But if you look at it full-scale on the jobs that you are planning, it's a relative thing. We are seeing results that are better, because you are able to clean up the zone and see exactly what you've got, whereas with conventional fracing sometimes it's very misleading -- it doesn't flow back at you, you have to swab it in, and every day [with equipment in the field] you are spending money. Whereas with GASFRAC you discover within the next 48 hours exactly what you've got -- it cleans up quite a bit quicker and you get to the bottom of the story right away."

"Within the constraints of their equipment availability, we use GASFRAC as much as we can, let's put it that way," James concludes. "We are comfortable with the technology and we would use it more often than not in numerous applications. I think this is something that will eventually be utilized on a big scale."

Acknowledging its services are more costly, GASFRAC notes the reduced clean up time and increased production more than make up for the expense. One study, based on single zone fracs in an area, found the costs to be about $100,000 less expensive than a comparable conventional frac, all expenses included, the company says. "By evaluating the work we have done so far, we have found our frac completion costs over- all to be about 30 to 35% less than those with a conventional frac," says Loree.

Having just raised $60 million, GASFRAC is now concentrating on expansion to meet the ample demand. Just six months into commercial operations, the company has some 30 clients in Canada, both big and small, and has been contacted by a couple of major producers in the U. S. seeking the company's services. "Our biggest challenge will be managing demand," says Nevison. "Our second frac set just went operational; we will have two more by the end of '08 and two more by June of '09."

"It's already taken off," Loree enthuses. "It's really catching on, I mean, it has surpassed my expectations."

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