RESEARCH

NEWS FROM THE LAB

UNCONVENTIONAL OIL

Cold Case

LARICINA RELEASES RESULTS OF COLD SOLVENT TESTS ON BITUMEN CARBONATES BY PAT ROCHE

RESULTS OF A LAB TEST AND A field test suggest cold solvent — rather than steam — could achieve commercial production of Alberta's massive bitumen carbonate resource.

Billions of barrels of bitumen locked in carbonate rock in northern Alberta have yet to yield commercial production. Apart from a few pilots in the late 1970s and early 1980s, the resource remained largely off industry radar screens until recently.

Now several companies — including big players such as Royal Dutch Shell plc and Husky Energy Inc. and start-up Laricina Energy Ltd. — are looking at ways to commercialize the vast resource.

In the winter of 2007-08 Laricina did a single-well cold solvent injection test on 2-26-85-19 W4M at Saleski.

Two slugs of propane were injected during the three-week test, each followed by a production period. The second cycle was cut short by spring break-up after about five days of production.

Neil Edmunds, Laricina's vice-president of enhanced oil recovery, outlined the results in June at a joint conference of the Petroleum Society and Society of Petroleum Engineers. (Co-authors of the paper Edmunds presented are Kent Barrett, Sandeep Solanki, Mauro Cimolai, all of Laricina, and Angie Wong of Laricina and the University of Calgary.)

"My vision right now is cold

Opportunity	Action	Potential
Reduce steam	• Well placement and/or injection cycling (Germain pilot)	• 15-20% less energy
Solvent-assisted process	• Target optimal steam/propane/C_3 combination (Germain pilot)	• 30% less energy • 30% less capital
No steam	• Cold solvent (Saleski field test)	• 25-50% less operating and capital cost • "zero" emissions

TECHNOLOGY TOOLKIT
Laricina says a single application of technology is not optimal for all reservoirs. It says low-cost extraction can be achieved by using less steam, through solvent-assisted processes and by using no steam at all (cold solvents).

solvent," Edmunds told the conference when asked what technologies would work in the bitumen carbonates. "As far as we know we can get the same recovery that we can with steam."

Slashing operating costs would be the biggest advantage in replacing steam with cold solvent.

No source water would be required and Laricina expects the long-term producing water/oil ratio would probably be around 10%. Carbon emissions from the operation would be negligible on a "well-to-wheels" basis.

"Work so far suggests the ultimate recovery factor will be

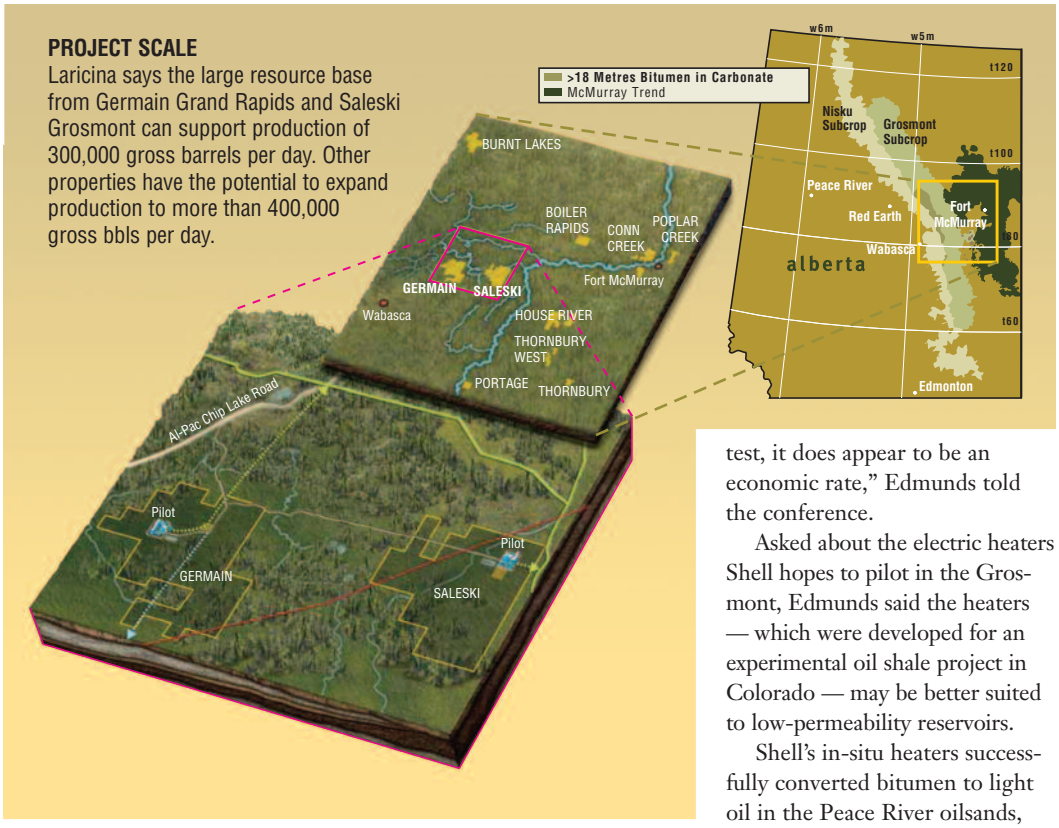

Illustration courtesy of ERCB and Laricina

described only as "modest," but limited by the small amount of solvent used, which resulted in higher-than-ideal bottomhole viscosity.

"[But] most importantly, although the oil rate from this test was very modest, if we extrapolate that to a horizontal test, it does appear to be an economic rate," Edmunds told the conference.

Asked about the electric heaters Shell hopes to pilot in the Grosmont, Edmunds said the heaters — which were developed for an experimental oil shale project in Colorado — may be better suited to low-permeability reservoirs.

Shell's in-situ heaters successfully converted bitumen to light oil in the Peace River oilsands, but the devices have yet to be tested in the Grosmont carbonate formation, which has extremely high permeabilities.

"I would question whether they can get enough pressure [in the Grosmont] to do the kind of upgrading that they are looking for," Edmunds said. (For more on Shell's electric heaters, which the supermajor plans to test on the bitumen carbonates, see the June 2008 edition of New Technology Magazine.)

In Laricina's modest solvent test, no problems with solids or asphaltenes were encountered. Some water was produced, but the cumulative amount was a small fraction of the fluid lost while drilling the well, the paper reported.

"Based on work to date, operating cost (primarily for the net solvent retained in the reservoir) is expected to be about half that for steam," the co-authors said in the 12-page paper.

The entire water/steam plant and its extensive supporting infrastructure would be replaced by a modest compression facility.

"Basically the whole steam plant disappears. And that's about three-quarters of the facility capital," Edmunds told the conference. "Productivity may be comparable to SAGD (steam-assisted gravity drainage)."

Cold solvent production would allow flow lines to be buried, eliminating the need for piles, expansion loops, insulation or freeze protection.

comparable with that for SAGD, i.e., exceeding 50%," the paper said. "Depending on the chosen configuration, individual well productivity may approach levels typical of SAGD or CSS (cyclic steam stimulation) wells."

Last winter's test confirmed Laricina's reservoir model, which assumes permeabilities of about 100 darcies.

Analysis of the results continues, but the paper's authors wrote that some early conclusions can be drawn: "From this test, we can extrapolate that commercial production rates, especially from a horizontal well, are achievable with non-thermal methods at Saleski," they wrote.

Oil was mobilized and produced in bulk. Production was

Credible challenger

The paper also presented the results of a cold solvent test on Grosmont core conducted last year by the University of Calgary's Tomographic Imaging and Porous Media (TIPM) lab. The test was run at reservoir temperature and pressure on an 80-centimetre length of preserved core.

A non-condensable carrier gas was saturated with propane to the dewpoint. The saturated gas flowed into the top of the core holder and circulated out the bottom, along with produced bitumen. X-ray tomography was taken before and after the test to visualize the depleted zones.

Of the bitumen initially present in the core, 54% was recovered after 10 days, the authors reported. The first half of this volume was recovered in the first 60 hours. When corrected for bitumen that was lost during core recovery, the overall recovery from this test exceeded 60% of the original oil in place.

Little deasphalting was observed, although the test conditions were expected to promote this, especially in the matrix. Produced oil gravity increased by about one-degree API, and the gravity of the residual oil in the core decreased by about the same.

Laricina is pursuing a program of "stage-gated" development of the cold-solvent technology at Saleski. Positive results at each stage have given confidence for increased investment at the next stage.

The paper said the result of the field and lab tests — in parallel with apparent success in the use of simulation to reproduce experiments at core and field scale — has boosted Laricina's confidence for a larger-scale investment.

"At this stage, cold solvent looks like a credible challenger to SAGD as the primary commercial technology for Saleski," the paper said.

Laricina's co-authors wrote that the highly developed, finely

SWEET SPOT
At Laricina's Saleski project, the geology is characterized by fracture and vuggy porosity.

disseminated secondary porosity in the Grosmont suggests a unique possibility for recovery by injecting a suitable cold solvent.

"Within the fractures and vugs, convective transport should be easy and rapid. About half of the oil in place occurs in the secondary porosity, which will have negligible residual saturations. It therefore seems likely that this much oil will be readily recoverable; and in a non-thermal context, that is enough to be economically viable," they wrote.

"In the matrix porosity [which holds the other half of the Grosmont resource], molecular diffusion will control solvent transport. Inspection of core suggests that such diffusion need only span distances of centimetres between the larger porosity. Over this distance only a week or so is required to substantially saturate the matrix bitumen," the paper continued.

"Bitumen in the matrix will therefore absorb solvent rapidly and swell, forcing much of it into the secondary network, from where it can be drained and recovered."

So what's next? Laricina is preparing an application to inject another, larger solvent slug at 2-26 next winter. The goal would be to demonstrate production parameters reasonably in line with predictions.

That, in turn, would justify a full pilot with solvent recycling facilities.

For a potential commercial application, Laricina is studying a number of configurations (including vertical and horizontal wells) as well as the question of CSS versus continuous injection of solvent.

A full-fledged solvent pilot would proceed in parallel with a Saleski steam pilot for which Laricina has already applied. ntm