

ProTechnology

COMPLETION DIAGNOSTICS NEWS FROM PROTECHNICS

PROTECHNOLOGY IS A REGULAR TECHNICAL REVIEW FOR CLIENTS OF PROTECHNICS, A DIVISION OF CORE LABORATORIES, L.P. FOR MORE INFORMATION, OR TO COMMENT ON THIS NEWSLETTER, PLEASE CONTACT US AT 713-328-2320, OR VISIT OUR WEBSITE AT WWW.CORELAB.COM/PROTECHNICS.

TEAMING UP FOR SUCCESS SPECTRACHEM HELPS OPTIMIZE BOSSIER SAND COMPLETIONS

It is widely accepted that the effective fracture length experienced following a fracture treatment rarely equals the created fracture length. It is further accepted that a major aspect of this under-performance of the fracture treatment is inadequate cleanup of the fracturing fluid and residual gels causing significant reductions in proppant pack conductivity. Laboratory studies have concluded that proppant packs can experience significant, up to 90%, loss of conductivity if the gels are not properly broken and cleaned up. The industry has invested in much research and additive innovations to help break these crosslinked fracturing fluids and improve fracture performance.

The key to mitigating the damaging effects of fracturing fluids on the effective fracture length and subsequent production is to maximize recovery of the fracturing fluids during initial flowback. To do this, one must first understand the mechanisms of fracture cleanup and, just as important, how much of the fracture fluid load is being recovered. Once flowback efficiency is measured and understood, the completion engineer can undertake a systematic approach to alter the fluid chemistry and flowback procedures to improve the cleanup process. Chemical tracer techniques are now being used to provide a simple, economical and safe method to gain this vital knowledge.

As the leader in tracer technologies, ProTechnics developed and patented a unique process for injecting, at very low concentrations (1 ppm), different chemical tracers into unique segments of the fracturing fluid. This patented process known as SpectraChem™ has generated much interest among fracturing experts and operators. SpectraChem employs a family of up to 21 different HSE friendly chemicals that can be detected and measured via a gas chromatograph with mass spectrometer analysis at the parts per trillion (ppt) level. This low detection limit and the fact that a single analysis can determine the presence and

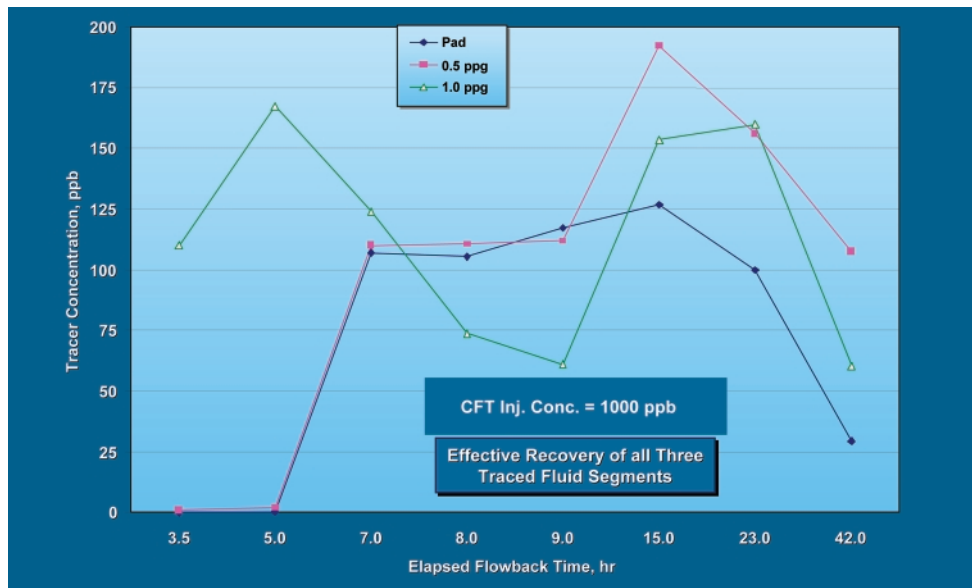


FIGURE 1 (WELL #7)

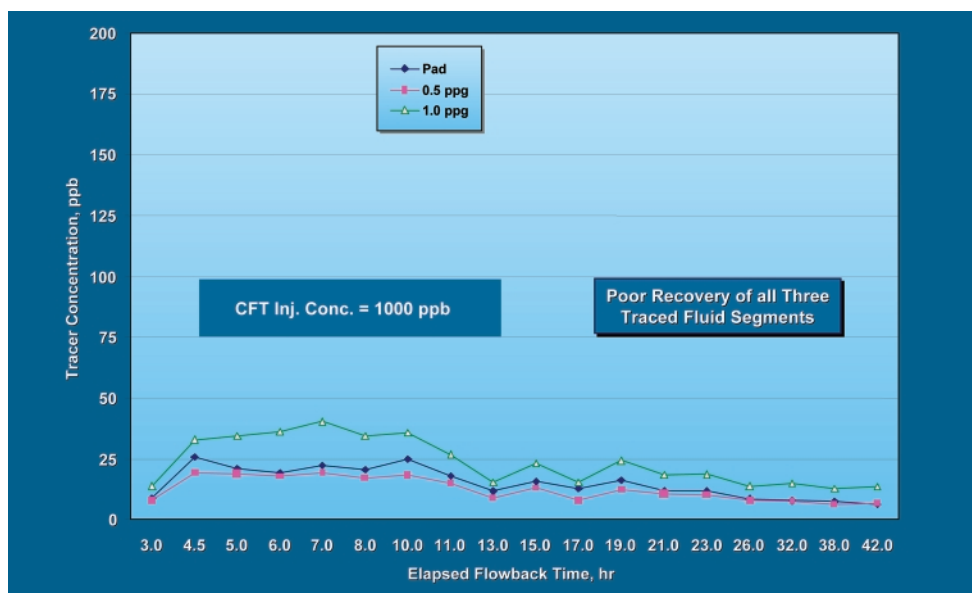


FIGURE 2 (WELL #10)

concentration of each individual tracer makes this process simple and economical.

Recently Anadarko Petroleum Company and ProTechnics teamed up to apply the SpectraChem chemical tracers in the Bossier Sand in Robertson County Texas. Two separate comparative studies were designed, implemented and analyzed. The first study investigated the benefits to

cleanup efficiency and production of incorporating a strong oxidizing breaker in the slickwater prepad of a hybrid waterfrac treatment. The second compared the cleanup performance of two traditional crosslink fluid types using borate and zirconate crosslinkers in a hybrid waterfrac design.

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Two separate tests were designed to place 7-8 chemical tracers (CFT's) throughout the hybrid system in both well #7 and well #10. The only difference between the two wells was that well #7 employed 2 gpt sodium hypochlorite bleach solution in the slickwater portion. Study of the SpectraChem flowback plots (figures 1 and 2) clearly show that the CFT recovery from well #7 was 4 times higher than from well #10. Analysis of the production performance (figure 3) of the two wells normalized for kh demonstrates a modest improvement in production. A second set of wells was compared with similar results.

SpectraChem tracers were also used to compare the cleanup and resulting production for a conventional borate-crosslinked gel fluid and a zirconate-crosslinked gel fluid. A total of 8 CFT's were added to the individual pad and proppant fluid segments in two separate wells. Comparison of the tracer concentrations revealed that the tracer recovery was 3 times greater with the borate-crosslinked fluid, well #17, versus the zirconate-crosslinked fluid, well #15. A comparison of 30-day post-frac production (figure 4) reveals that production trends matched the flowback trends observed by the SpectraChem analysis.

Take-Away Thought

Chemical frac tracers, in conjunction with postfrac well performance monitoring, can be used to assess segmented fracturing fluid flowback/cleanup and aid in fracturing fluid design optimization.

FOR MORE INFORMATION OR INQUIRIES, PLEASE CONTACT
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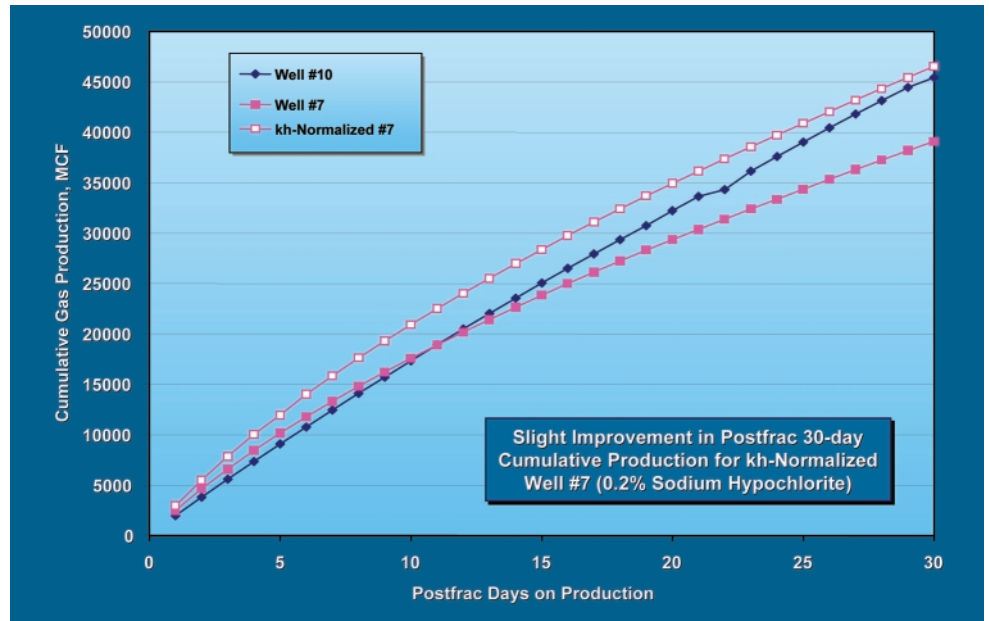


FIGURE 3

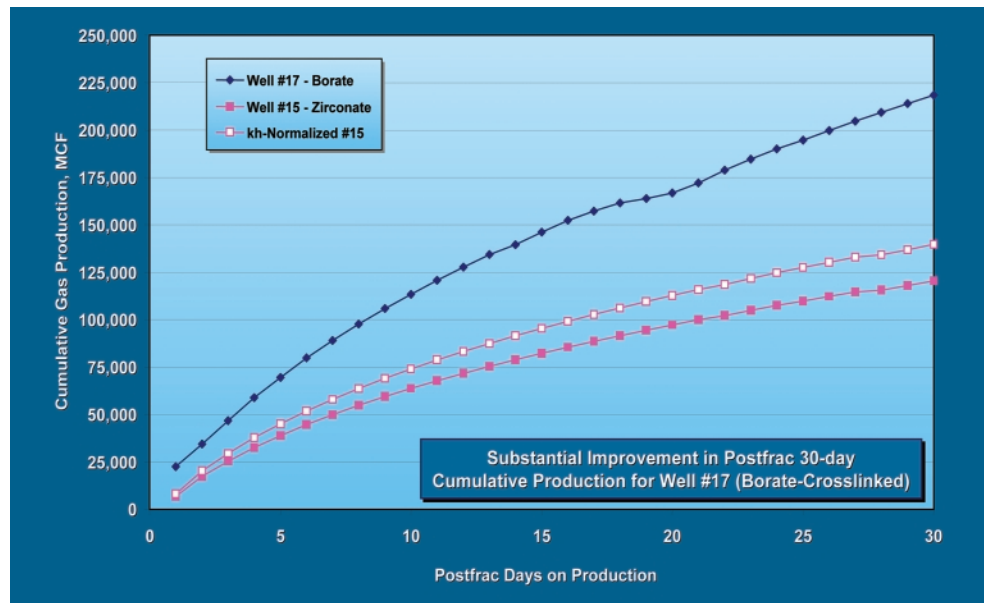


FIGURE 4

IT'S AUTHENTIX!!!

Chemical Tracer Capabilities Grow

ProTechnics is proud to announce the acquisition of the Authentix upstream oil and gas division. As the leader and innovator in tracer technologies, we know that chemical tracers are one of the most sought after tracer technologies for completion diagnostics. This acquisition will increase our analytical capacity and bring additional expertise and many exciting new opportunities for innovation to the ProTechnics SpectraChem™ service line.

King Anderson has joined us from Authentix as a product champion for SpectraChem. He will continue to innovate and pursue an ever-expanding list of applications for chemical tracing. One of the most exciting examples of this is the development of a methodology using chemical tracer flowback analysis to estimate production from multi-interval completions. Some very promising work has been done in this area. Additionally new techniques and products for tracing oil-base mud systems during coring have been developed. With these advancements, more accurate fluid invasion studies are now possible.

The newly expanded SpectraChem line of services and products is available to diagnose your well problems. Call your ProTechnics representative for a lunch and learn presentation on;

- Flowback/cleanup mechanisms and efficiencies
- Production estimation
- Multi-zone production performance
- Flow-through bridge plug performance assurance
- Oil-based mud core invasion studies

FOR MORE INFORMATION ON SPECTRACHEM PLEASE CONTACT
KING ANDERSON AT 713-328-2348 OR
E-MAIL AT KING.ANDERSON@CORELAB.COM .

WHAT'S GOING ON WITH GOHFER

GOHFER Frac Model Update

GOHFER is quickly becoming the most sought after numerical fracture model by both operators and service companies alike. It is the first of its kind true 3D fracture simulator. Its reputation as the most rigorous and sophisticated mathematical solution has placed GOHFER as a must have tool in the toolbox for understanding and optimizing fracture stimulations. Utilizing a grid solution, both in the vertical and horizontal plane, GOHFER is the state of the art fracture model in the industry and has been providing a unique and trusted high end design for the past 15 years.

In the last issue of ProTechnology we introduced the addition of Kevin Svatek to the ProTechnics' team. Kevin has been tirelessly building a much needed bridge to bring GOHFER into the mainstream of fracture models. Building this bridge entailed becoming familiar with many detailed aspects of GOHFER, and as such, I have asked Kevin to comment on a few current issues concerning GOHFER for our ProTechnology readers.

Q: Please give our readers a quick insight of your experience with fracture models?

A: Since leaving Texas A&M with a Petroleum Engineering degree I have spent my entire career with several major pumping companies and as a consultant for various operators working in the area of well stimulations and completions. This experience has provided me an opportunity to work with all the major fracture models currently in use in the industry.

Q: What is the current relationship between ProTechnics and Barree and Associates?

A: Barree and Associates, the owner of GOHFER, entered into an exclusive contractual agreement with the Stim-Lab Division of Core Laboratories. ProTechnics, through its relationship with Stim-Lab, has taken on the responsibility to maintain, market and support the GOHFER software.

Q: GOHFER has been undergoing a front end upgrade for the past 6 months. Would you describe some of the new features and enhancements in the upcoming new release?

A: The graphical interface has been made significantly more user-friendly and will be a welcomed improvement. Additionally, a new production prediction module has been imbedded in the software. With a few additional inputs, users can now simulate anticipated production, with and without fractures in place.

Q: When do you anticipate the new release to be ready to roll out to the industry?

A: The new version should be ready to release to current users of GOHFER by the end of January 2005.

Q: How do you anticipate the users of GOHFER will find the new version compared to what they are familiar with?

A: The graphical user interface will still look familiar for the most part. However, users will find it easier to navigate with a more natural flow through the program. The modules and inputs have been re-organized for better flow to take advantage of GOHFER's log-centric nature. GOHFER is now more user-friendly and intuitive.

Q: Are there any future improvements and enhancements on the horizon?

A: We are always striving to improve GOHFER. A next generation version is already under construction that will enhance the log-centric nature of GOHFER for improved log processing and usability. We are also improving the data handling and analysis portions of the software.

Q: What are some of the enhanced services that users of GOHFER can expect?

A: The next release of GOHFER will have an improved Help section as well as automatic internet updating. This means registered users of the software will be made aware, via pop-up messages, of available updates whenever they are connected to the internet.

Q: What is the best way to contact you to get information regarding GOHFER?

A: I would be glad to assist anyone with questions or an interest in GOHFER. I can be contacted at my office in Houston at 713-328-2304 or by e-mail at Kevin.Svatek@corelab.com.

GROWING TO MEET DEMAND

NEW ADDITIONS

ProTechnics continues to increase service capabilities.

Welcome Aboard:

Field Service Representatives—
Tracy Carpenter, Oklahoma City, OK
Ronnie Williams, Kilgore, TX

ON THE GLOBAL STAGE

Dr. Mahmoud Asadi, ProTechnics Technology Development Manager, has been stamping his passport again. His most recent trip was to Moscow, Russia, where he was part of a distinguished panel at the SPE Applied Technology Workshop "Where is the Risk in Hydraulic Fracturing." He shared his chemical tracer expertise and knowledge with the workshop participants and reported a lot of interest from our Russian counterparts.

HOUSTON SALES EXPANSION

Sean Wagner, formerly with Borden Proppants, has joined the ProTechnics sales team and is working with clients in Houston.

You can reach Sean at:
sean.wagner@corelab.com or
713-328-2313.

SPECTRACHEM ADDITION

King Anderson, formerly with Authentix, has joined ProTechnics as consulting executive for our SpectraChem™ product line.

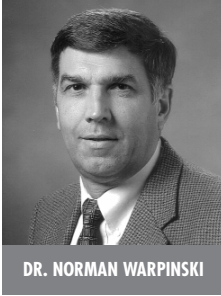
King can be reached at:
king.anderson@corelab.com or
713-328-2348.



EXPERT'S CORNER

Interview with Dr. Norman Warpinski

Expert's Corner is very fortunate to feature an exclusive interview with Dr. Norman Warpinski with Sandia National Laboratories in Albuquerque, New Mexico. He began his 27-plus year career at Sandia



Laboratories studying hydraulic fracturing in "mine-back" tests conducted in tunnel complexes at the Nevada Test Site. From this early work Dr. Warpinski became a recognized expert in the fields of hydraulic fracturing, geomechanics, poroelasticity and in situ stresses.

Leveraging this expertise, Sandia National Laboratory partnered with the Department of Energy and the Gas Research Institute to exploit unconventional tight gas reservoirs through hydraulic fracturing. From these joint ventures, Dr. Warpinski has led many unique research projects, among them some of the first mine back examinations

of actual hydraulically induced fractures at the Nevada Test Site in the late seventies and early eighties. He also helped lead the Multiwell Experiment (MWX) in Rifle, Colorado where actual fractures were created and then cored. More recently, he helped pioneer and develop much of the initial research and work on borehole micro-seismic and tilt technologies.

Dr Warpinski's opinions and conclusions concerning hydraulic fracturing come from a true research perspective. The entire interview with Dr. Warpinski is at www.protechnics.com where you can read his opinions on fracture modeling, completion diagnostics, dipole-sonic data for rock properties and stress, net pressure analysis and fracture height growth.

Notable quotes from the interview

"Information on zones stimulated, fracture lengths, height growth, and complex growth will always be important to the completion engineers."

"I think that completion diagnostics has a huge role to play..."

"I do not think there is any question that fracture height is overestimated in our models."

"I really see very little downside to using tracers"

"There are three primary formation parameters that we need to know to do an adequate job of modeling a fracture."

"Net pressure is a very useful diagnostic if we take it seriously, but I really question how good a job we really do."

Note from the Editor The Expert's Corner is a continuing feature of ProTechnology newsletter. Our objective is to bring you interviews and discussions with industry-recognized experts that examine the latest and most current knowledge and opinions on the subject of stimulation. Because of the length of most interviews, interview highlights are presented in this newsletter, with the entire interview published on the ProTechnics website. **TO SHARE YOUR THOUGHTS, IDEAS AND SUGGESTIONS ABOUT EXPERT'S CORNER, PLEASE CONTACT WADE HUTCHINSON AT WADE.HUTCHINSON@CORELAB.COM.**

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