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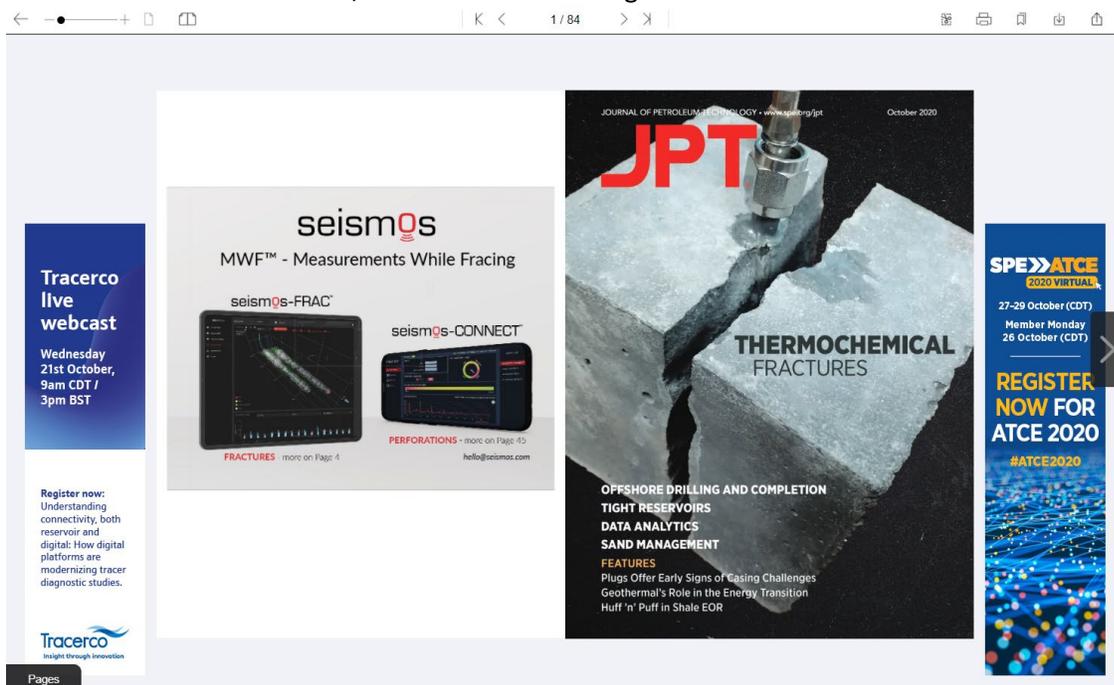
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Bringing the Heat

Aramco Field Tests High-Temperature Chemistry To Slash Tight-Gas Completion Costs

Trent Jacobs, JPT Digital Editor



On the left, a core plug from the Eagle Ford shale after being hydraulically fractured with slickwater. On the right, another sample from the same formation that has been split in half using a new thermochemical formula that may displace large numbers of pressure-pumping units. Source: URTIC 2429.

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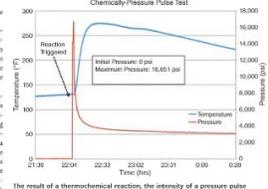
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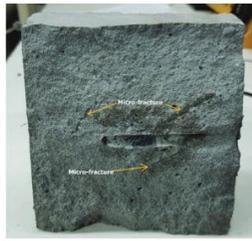
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By turning up the temperatures downhole, you need less of everything up on the surface. This is what is hoped to be proven soon with an experimental chemical technology that is seeing some of its first field tests in Saudi Arabia's emerging tight-gas formations like you. The innovation centers around reactive chemicals known as thermochemicals that researchers at Saudi Aramco and King Fahd University of Petroleum & Minerals (KFUPM) in Dhahran spent much of the past decade developing. When it comes to unconventional applications, the world's largest upstream company has two big ambitions. First, it is introducing a new hydraulic fracturing fluid that shares millions of dollars off the cost of horizontal wells by more than halving the amount of equipment and water typically needed to stimulate the wells. Second, it aims to reduce the number of proppantive fracture stages and the required number of stages by improving stage productivity. "It's like a hybridization of pulse fracturing and hydraulic fracturing," explained Ayman Al-Nabkhi, a chemist and petroleum scientist at Saudi Aramco's EXPEC Advanced Research Center. "The thermochemical will create a pressure pulse downhole to break down the rock, then we can propagate the fracture with hydraulic fluids." Al-Nabkhi recently shared more details about the technology at the virtual 2020 Unconventional Technology Conference (UTC) "Bringing the Heat" (UTC 2429) that he attended with colleagues and university partners. The paper outlines laboratory tests in which samples of shale rock from the US and elsewhere were fractured using traditional slickwater fluids alongside the thermochemical approach — or what Al-Nabkhi calls the "Eco-Frac."

While validation awaits, the year-long research and development project is a reminder that as Saudi Aramco seeks to develop the Kingdom's tight-gas resources it is not relying solely on the North American experience or its suite of established technologies. The tests highlighted during the conference showed that when pumped into core and other rock samples at the initiation of small-scale hydraulic fracturing treatments, the chemical agents undergo an exothermic reaction that creates a pressure pulse strong enough to induce a fracture in the rock. Meanwhile, as the chemical rock temperatures that may reach 250°C, nitrogen gas is rapidly generated inside the fractures which increases its influx process. As it is drawn up for a real-world application, pumping the thermochemicals downhole would take roughly 5 minutes. Once the reaction is initiated, the pressure pulse lasts only with seconds. The high-temperature reaction conditions for an hour than 30 minutes before all the heat is absorbed into the surrounding formation. However brief this action may be, the researchers believe that the pressure pulse and subsequent expansion of gas can be engineered to leave behind a lasting impression in the form of a much weaker rock fabric. "The next thing to do is to follow up with a slickwater treatment, typical in everything except for its abbreviated duration. With more chemical energy leveraged downhole, Al-Nabkhi said for less hydraulic energy is needed to be generated mechanically. He added that one difference with this pressure-pulse technique and existing methods is that it requires no proppants or waters of injection — the thermochemicals are expensive. Saudi Aramco has covered much of its research efforts by developing the addition and extraction that allow it to control reaction times and pressures. The company has several formulas with a capability to produce pressure pulses that range from 2,000 psi on the low end to 20,000 psi on the extreme.



The result of a thermochemical reaction, the intensity of a pressure pulse is shown here during a test conducted in a high-temperature/high-pressure reactor. Source: URTIC 2429 presentation.



A cutaway of a cement block used during testing shows the presence of microfractures around the borehole due to the thermochemical treatment. Source: URTIC 2429.

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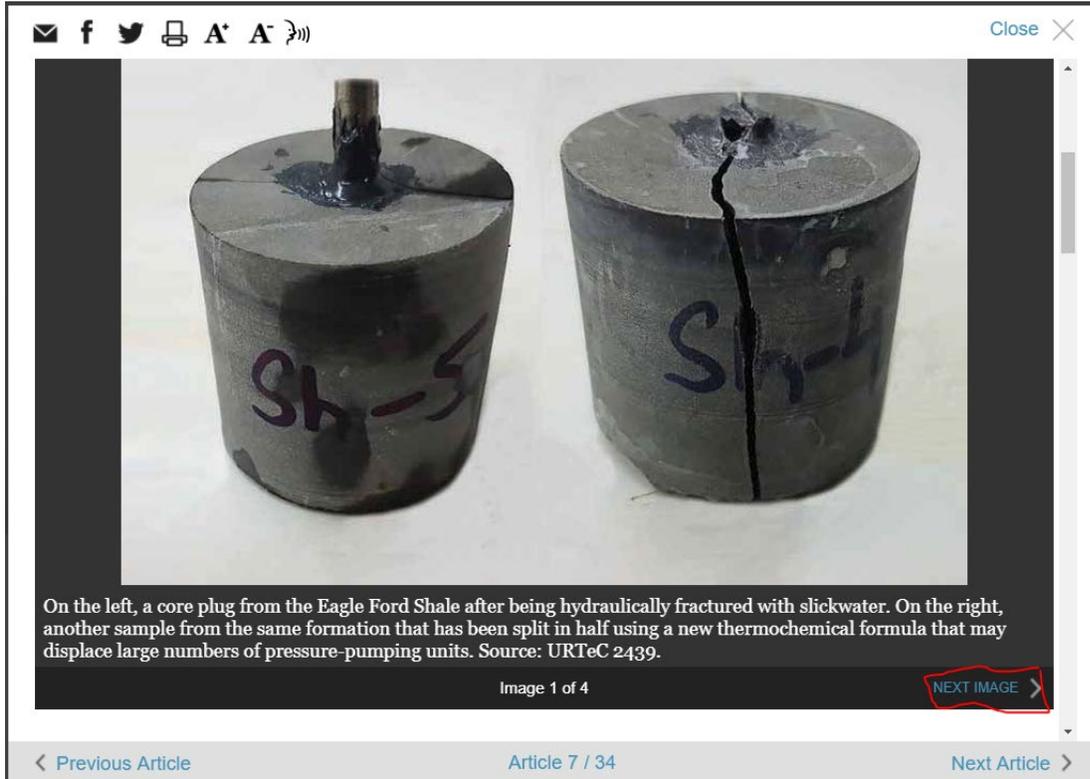
Bringing the Heat

Aramco Field Tests High-Temperature Chemistry To Slash Tight-Gas Completion Costs



< Previous Article
Article 7 / 34
Next Article >

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volumes of its precious freshwater resources as possible. (This has also led to separate research work on fracturing with seawater.) Because less force is needed to successfully break down the reservoir, total pumping time for an Exo-Frac would likely be less than an hour. All told, the water intensity of a thermochemically fractured well should be a small fraction of that for a slickwater treatment.

References

[SPE 196540](#) Reducing Breakdown Pressure of Tight Reservoirs Via in-Situ Pulses: Impact of Mineralogy by Ayman Al-Nakhli, Saudi Aramco; Zeeshan Tariq, Mohammed Mahmoud, and Adulaziz Abdulraheem, King Fahad University of Petroleum and Minerals.

[URTeC 2439](#) A State-of-the-Art Technology To Reduce Fracturing Pressure in Tight-Gas Formations Using Thermochemical Pulse by Ayman Al-Nakhli, Saudi Aramco; Zeeshan Tariq, Mohammed Mahmoud, and Adulaziz Abdulraheem, King Fahad University of Petroleum and Minerals.

< Previous Article Article 7 / 34 Next Article >

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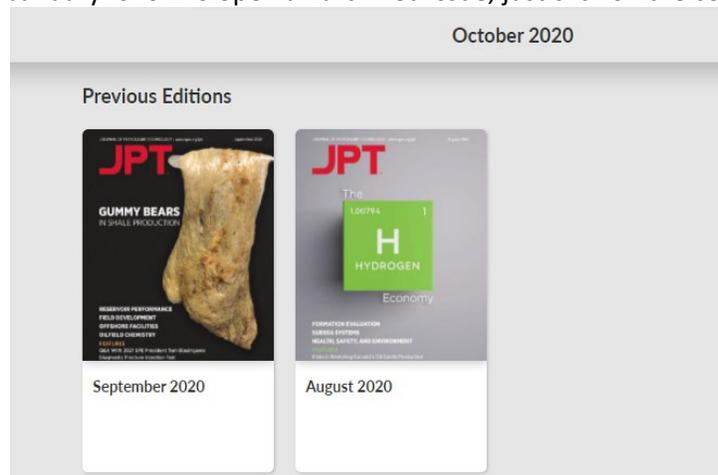
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For example, a search for flow assurance yields results like the following. You can then click into any of the articles of interest.

Q flow assurance

<p>Page 27 Journal of Petrol... October 2020</p>	<p>Page 64 Journal of Petrol... October 2020</p>	<p>Page 17 Journal of Petrol... September 2020</p>	<p>Page 21 Journal of Petrol... September 2020</p>
<p>Page 25</p>	<p>Page 60</p>	<p>Page 63</p>	<p>Page 69</p>

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