



## Fact Sheet: Hydraulic Fracturing

### KEY POINTS:

- Hydraulic fracturing involves injecting water-based fluids at high pressure into rock formations deep underground to create tiny fractures that enhance the flow of oil and gas.
- This highly-technical process requires detailed engineering and design and careful monitoring.
- The process is well-understood and thoroughly researched. Hydraulic fracturing has been continuously improved since its first application in 1949.

### THE FACTS:

#### Enhancing oil and gas flow

Permeability is a measure of the interconnectivity between pores within a rock. It determines how well oil, gas or fluids to flow through the rock. High permeability makes it easier to extract oil or gas from a reservoir. All shales have low natural permeability, but tightly compacted sandstone and coal formations can also have low permeability.

Permeability can be artificially increased by using hydraulic fracturing, or fracking. This will enhance the flow of oil and gas from rock types.

The first hydraulic fracture was completed in the United States in 1949. Since then, more than two million fracs have been performed worldwide. In Australia, the first frac was carried out in the 1960s.

Fracking involves pumping water-based fluids down a well bore at high pressures into specific, isolated sections of rock under carefully designed conditions. This creates fractures, usually a few millimetres wide, that can extend up to a hundred meters from the borehole (Fig 1: Frac Basics).

A proppant, typically sand but sometimes small ceramic beads, is used to keep the fractures open after the pumping has stopped. Some chemicals are added to increase viscosity to carry more sand to the ends of the fractures, neutralise any acidity, and help maximise the flow to the borehole.

When the fracture is set, fluid is allowed to flow towards the well bore to clean up the fractures and establish the pathways for the petroleum to travel to the bore hole.

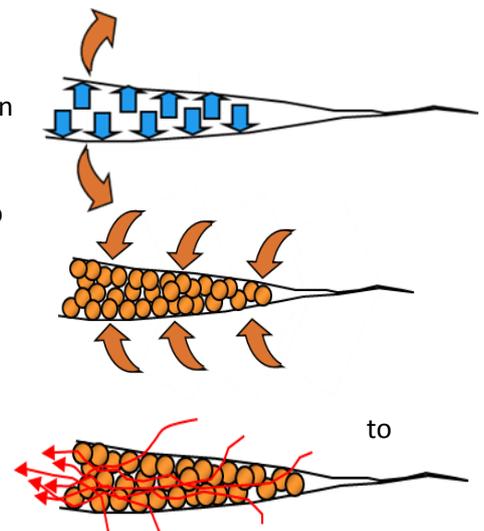


Fig 1: Frac Basics

#### Hydraulic fracturing requires detailed engineering and design

Fracture treatments vary according to the properties of targeted rocks and are based on decades of process optimisation. Petroleum professionals use several tools and processes to design a frac and guide its successful implementation.

Borehole measurements (or logs) and geologic models are used to select the fracture treatment based on the targeted rock properties. Changes in the stiffness or elasticity of the rock as well as the underground forces acting on each layer (known as 'in situ stresses') provide contrasts which are used to control the fracture during a treatment. These contrasts have been proven in laboratory studies, engineered well



experiments, and underground mining out of fractures to give pressure signatures to indicate fracture length and growth. The fracture initiation layers are selected by lower stresses, determined by logs.

Well integrity is assured by pressure-testing the casing and well head valves and, where applicable, running cement bond logs. Fracturing fluids are tested with the drilling cuttings or cores to achieve compatibility with the rock and protect the well using the minimum required additives.<sup>1</sup>

Based on the logs, the lowest stressed (ie least-pressured) section of rock in the sections targeted for stimulation is selected as the fracture start or initiation point and used in the hydraulic fracturing model.<sup>2</sup>

Geologists, frac engineers and reservoir engineers determine a diagnostics plan that lets them evaluate the fracture execution, and optimise future frac operations. The frac and completion engineers prepare a comprehensive operational plan that includes safety and environmental management plans and contingencies.

### **Execution of a successful frac is carefully monitored to ensure alignment with design**

Once the frac design has been finalised, completion and frac engineers manage the operational and technical execution on-site. The frac model is verified by performing initial injections in the targeted rock sections known as diagnostic fracture injection tests (DFIT), or mini-fracs, and comparing those results to the frac model predictions. The final frac design may be adjusted based on the mini-fracs and collected onsite diagnostics data.

### **Low-concentration chemicals are used to enhance efficiency**

Fracing fluids comprise between 97 and 99 per cent water and sand. The remainder is made up of chemical additives needed to reduce friction, remove bacteria, dissolve some minerals and enhance the fluid's ability to transport sand. Chemicals used in Australian fracing operations include sodium hypochlorite and hydrochloric acid (both used in swimming pools), cellulose (used to make paper), acetic acid (the active part of vinegar) and small amounts of disinfectants.

A typical Queensland Surat Basin coal seam gas (CSG) fraced well may use about one million litres (ML) of water per well<sup>3</sup> and a tight gas or shale gas well may require about 4.5 ML per well.<sup>4,5</sup> An Olympic-sized swimming pool holds roughly 2.5 ML.

### **New technologies encourage continuous improvement**

Over the decades, the development of new technologies such as micro seismic monitoring and advanced 3D modelling has driven the continuous improvement of hydraulic fracturing.

The fracing process is well-understood and thoroughly researched with more than 10,000 references published by universities, consortia and public and private scientific organisations.

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<sup>1</sup> Crane, et al: "Fracturing Fluid Testing for Design Purposes and Regulatory Oversight in a Shale Gas Project," Society of Petroleum Engineers (SPE) 167107, 2013.

<sup>2</sup> [http://www.slb.com/~media/Files/resources/oilfield\\_review/ors13/sum13/04\\_stim\\_design.pdf](http://www.slb.com/~media/Files/resources/oilfield_review/ors13/sum13/04_stim_design.pdf)

<sup>3</sup> Johnson, et al. "Evaluating Hydraulic Fracture Effectiveness in a Coal Seam Gas Reservoir from Surface Tiltmeter and Microseismic Monitoring," SPE 133063, 2010.

<sup>4</sup> Pitkin, et al. "Taking the First Steps: Stimulating the Nappamerri Trough Resource Play," SPE 160307, 2012.

<sup>5</sup> Durant, et al. "Investigating Hydraulic Fracturing in Tight Gas Sand and Shale Gas Reservoirs in the Cooper Basin," SPE 167073, 2013.