

# Coal Seam Gas Hydraulic Fracture Stimulation



Coal Seam Gas (CSG) fracking technology is used to improve the flow of natural gas from coal seams. CSG fracking increases well productivity, meaning fewer wells are required to extract the gas.

Origin's CSG fracking activity occurs in field development areas associated with our role as upstream operator for Australia Pacific LNG's CSG to liquified natural gas (LNG) operations in Queensland.

The use of fracking technology in Queensland is well established and subject to comprehensive government regulation.

Fracking technology involves pumping a fluid, under pressure, down the wells and into target coal seams.

The fluid is a mixture of predominantly water, sand and a small volume of common chemical additives (between approximately 0.1 and 1.2 per cent).

The pressure creates fractures in the rock and widens existing rock fractures which help to create better pathways for gas to flow. The additives help to keep the sand in suspension. When the fluid is removed, most of the sand remains to help keep the fractures open.

The resulting fractures are approximately 1 to 20mm wide.

A higher viscosity, or thicker, CSG fracking fluid – known as a gel fracking fluid – has an additive content ranging from around 0.33 per cent to 1.2 per cent, depending on whether fresh water or produced water from the coal seam is used.

Our CSG fracking fluids are regularly sampled by National Association of Testing Authorities certified laboratories, to ensure compliance with regulatory requirements.

A list of additives typically used in fracking fluid is shown in the table on the next page, with each component's unique Chemical Abstracts Service registry number and their use in household products.

We do not use BTEX (benzene, toluene, ethylbenzene and xylene) in our CSG fracking fluids or additives.

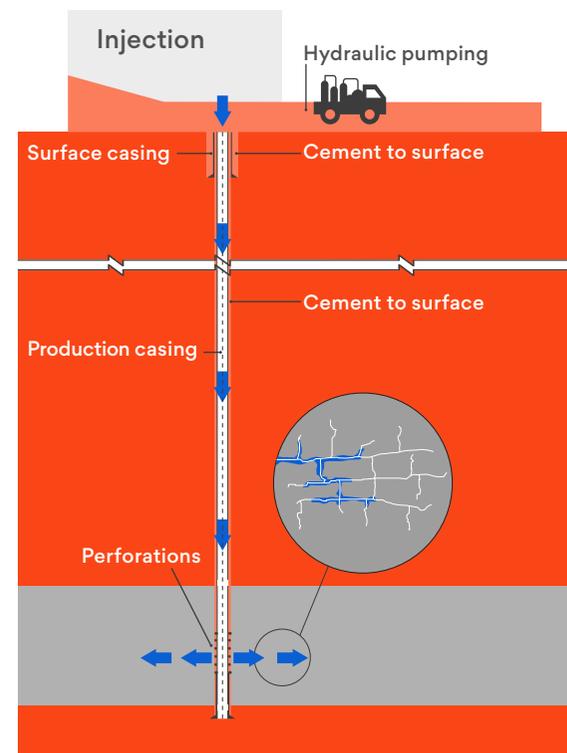
## Testing, monitoring and communications

Prior to commencing any CSG fracking activity, we undertake comprehensive testing and monitoring activities, in line with our policies and procedures, and government regulation.

Any active water bores that are within 2 km of a CSG fracked well and draw water from an aquifer that is near the target coal seam are baseline tested prior to fracking.

Once CSG fracking has been completed, we regularly test the water from these water bores and water produced from a representative selection of fracked wells in line with regulatory requirements.

Where CSG fracking is required we discuss all proposed activities with landholders before any work takes place. Once the activity is completed, we provide a report to the landholder and the regulator within 10 days, with a comprehensive final report provided to the Queensland Department of Natural Resources, Mines and Energy.



## CSG fracking fluids and additives

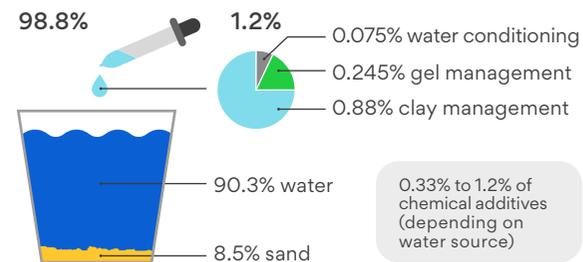
All additives used in CSG fracking fluid are found in typical household items such as food and cleaning products.

The combination of additives can influence characteristics of fracking fluid, such as viscosity or thickness, and pH.

These CSG fracking fluid characteristics can be varied to suit the specific CSG formation and the water in the coal seams.

A low viscosity, or low thickness, CSG fracking fluid consists of treated water, sand and approximately 0.1 per cent of additives such as acetic acid (vinegar) and calcium chloride (found in sports drinks).

## Composition of gel frac fluid



## CSG fracking fluid additives\*

				Common use	Range of volumes in frac fluid	
Group/ Function	Chemical abstracts services registry number	Chemical type or name	Commonly found/used in household products	% Volume of chemical in household items	Group % by volume (average)	% Volume range of chemical in frac fluid
Sand (Proppant) /Water	7732-18-5	Water Silicon Dioxide (quartz/sand)	Irrigation, drinking, bathing, cooking, hand cleaner, arts and crafts, glass	1 to 100%	98.79% to 99.9%	88% to 97.6%
	14808-60-7			1 to 100%		
Water Conditioning (Microbial/pH Control)	7681-52-9	Sodium Hypochlorite	Disinfectant, bleaching agent, cleaners, cleaning of milking equipment, water treatment, medical use, mildew remover, anti-bacterial cleanser	0.1% to 20%	0.075% to 0.1%	0.01% to 0.02%
	1310-73-2	Sodium Hydroxide (caustic soda)	Food preparation, soaps, detergents, toothpaste, aftershave, face mask, teeth whitening strips, eau de cologne, body wash, face cleaning pad, hair remover, cocoa processing	0.1% to 5%		0.002% to 0.1%
	497-19-8	Sodium Carbonate	Household and laundry/dishwasher cleaners, toothpaste, fish aquarium, hair care, spa water clarifier	0.5% to 85%		0.0% to 0.025%
	144-55-8	Sodium Bicarbonate	Baking powder, cakes, household cleaners, vegetable cleaner, toothpaste, fish aquarium, baby powder, deodoriser	1% to 100%		0.0% to 0.006%
	64-19-7	Acetic Acid	Vinegar, food preparation and manufacturing, salad dressings, pickled onions, relishes and spreads, household cleaning products	1% to 5%		0% to 0.1%
Clay Management	7447-40-7	Potassium Chloride	Table salt substitute, medical use, hair products, pet supplements, african violet food	0.5% to 40%	0.0% to 0.91%	0.0% to 0.91%
Gel/Viscosity Management	6410-41-9	Cl Pigment Red 5	Food colouring, colour pigment in cosmetics, soaps ink, paint	0.01% to 30%	0.0% to 0.25%	0.0% to 0.00009%
	100-43-52-4	Calcium Chloride	Detergents, cosmetics, deodorant, pet products, desiccant, food additive, sports drinks, pickles	0.1% to 90%		0.0% to 0.0002%
	Natural Mixture	Walnut Husk	Hair dye, polishing material, exfoliate in facial and body scrubs, aquarium and aquaculture	3% to 50%		0.0% to 0.006%
	9000-30-0	Guar Gum	Cosmetics, baked goods, ice cream, toothpaste, sauces, salad dressing, substitute for wheat intolerant people to use instead of flour, cattle food, and medical use	0.5% to 20%		0.0% to 0.2%
	14808-60-7	Silica	Hand cleaner, arts and crafts, glass	1% to 100%		0.0% to 0.02%
	9025-56-3	Hemicellulase Enzyme	Wine additive, soybean paste, fibre additive, commercial baking and food processing, farm feed additive	0.1% to 25%		0.0% to 0.0005%
	26038-87-9	MEA Borate	Cosmetics, hair texturiser, hairspray, antiseptic, laundry detergent	0.1% to 5%		0.0% to 0.1%
	Proprietary Information	Acrylic Resin	Disinfectant cleaner, FDA approved colourant, paint, food packaging, medicinal chemistry	<0.01% to 2%		0.0% to 0.002%
	7647-14-5	Sodium Chloride	Food production, table salt, food additive, detergents, hair products, water softener and medical saline drips	0.03% to 99%		0.0% to 0.004%
	Proprietary Information	Enzyme	Laundry detergent, laundry stain remover, silverware cleaner, agricultural feeds, instant coffee production	~0.1%		0.0% to 0.0002%
7772-98-7	Sodium Thiosulfate	Personal care, food production, home aquarium health/commercial aquaculture, medical use for over 100 years	0.1% to 30%	0.0% to 0.04%		

\* Additives shown are typically used in CSG frack fluid fluid (>0.0005% concentration) material data sheets of additives available from Australia Pacific LNG website.