GROUND AND SURFACE WATERS

GISERA | Gas Industry Social and Environmental Research Alliance

Understanding the lifecycle of hydraulic fracturing fluids

CSIRO scientists have completed a project that improves understanding of what happens to chemicals used in hydraulic fracturing fluids, along with naturally occurring (geogenic) chemicals that are found in water that flows back out of a shale gas well.

Key points

- CSIRO scientists undertook this work to understand the lifecycle of chemicals used in hydraulic fracturing in the Northern Territory.
- The researchers studied how the chemicals move and degrade in the subsurface, in flowback water and in surface facilities like storage tanks and holding ponds.
- Four chemical compounds used in hydraulic fracturing operations that had high levels of toxicity or knowledge gaps about their behaviour in the environment were selected for study.
- Results show that of the four compounds studied, three degrade rapidly and pose little to no risk to the broader environment.
- Similarly, the majority of organic geogenic compounds returned in flowback water were rapidly degraded.
- One of the compounds – a biocide – was detected at low levels in water samples after three months and may require further studies if it is intended for wider use.

This project, conducted through CSIRO's Gas Industry Social and Environmental Research Alliance (GISERA), responds to community concerns about the potential impacts of hydraulic fracturing on groundwater in the Beetaloo Sub-basin.

The project improves understanding about what happens to specific chemical compounds used in hydraulic fracturing fluids, including how they move and degrade in the subsurface, and what happens when they return to the surface in flow-back water.

CSIRO scientists also examined the fate of organic geogenic (naturally occurring) chemicals that are mobilised by hydraulic fracturing and return to the surface with flowback water.

The Beetaloo Sub-basin

The Beetaloo Sub-basin is around 180 km southeast of Katherine in the Northern Territory and spans approximately 30,000 square kilometres. The estimated gas resources for the Beetaloo Sub-basin are of similar size to other major gas producing basins in Australia, such as the Surat Basin in Queensland and the Bonaparte/Browse Basins in Western Australia.

The results of this project provide key information to help assess potential hazards associated with hydraulic fracturing in the region.

Banner image: Carpentaria Highway, Northern Territory.

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Hydraulic fracturing

The hydraulic fracturing process involves injection of fracturing fluids into target formations in the subsurface under high pressure in order to increase gas production. The fluids comprise water, proppant (silica/sand) and a small proportion (around 0.5 – 1%) of chemical additives.

These chemicals are used to improve the transportation of sand, prevent the growth of bacteria, reduce mineral or chemical blockages and to avoid well corrosion.

Hydraulic fracturing fluids are required to be contained in a closed system, designed to prevent release to the environment or exposure to people.

After hydraulic fracture treatment of a well, there is a period of production called flowback where fluids are produced from the well. This recovers a proportion of the hydraulic fracturing fluids along with geogenic chemicals that are mobilised by hydraulic fracturing.

The flowback water that returns to the surface is contained in industrial facilities such as holding tanks and storage ponds.

Studying the fate of chemicals

The compounds selected for the study have been used in hydraulic fracturing activities in the Northern Territory and either had high levels of toxicity or had knowledge gaps about their behaviour in the environment.

The compounds selected were two biocides: glutaraldehyde and tributyl tetradecyl phosphonium chloride (TTPC), and two surfactants: ethyoxylated/propoxlated alcohols (AEP) and cocoalkyl dimethyl amine oxide (CDAO).

Laboratory experiments replicated subsurface conditions – high pressure and high temperatures – and also examined the behaviour of the selected compounds and organic geogenic chemicals that return to the surface in flowback water and stored in surface ponds or holding tanks.

CSIRO scientist labelling aquifer water samples in the Beetaloo Sub-basin.

Results

Results demonstrated that of the four compounds examined, three of these compounds (glutaraldehyde, AEP and CDAO) either degrade abiotically in the subsurface, adsorb to the formation in the subsurface or are rapidly biodegraded at the surface in water holding tanks. These results indicate that glutaraldehyde, AEP and CDAO likely pose little to no risk when used as intended and pose very limited risk to the broader environment.

TTPC resisted degradation in the subsurface, though it was highly immobile in the subsurface as it readily adsorbed to formation rocks. Similarly, on its return to the surface in flowback waters, TTPC was comparatively resistant to biological decomposition and was still detected in water samples from holding ponds at significantly reduced concentrations after three months.

In controlled laboratory experiments CSIRO researchers added 13 parts per million (ppm) of TTPC to water sourced from a surface-facility water tank. After three months of incubation, TTPC concentration in the sample was 0.13 ppm, representing degradation of 99% of the added TTPC.

Even though the residual TTPC represents 1% of the original dose, its persistence after three months suggests that further studies into its behaviour in the subsurface and in surface facilities may be required if it is intended for wider use in the Beetaloo Basin.

The study also demonstrates that the majority of organic geogenic compounds returned in flowback water were rapidly degraded, though this depends on individual chemical compounds, and some may be more resistant to decomposition than others.

More information

Read more about this project

Learn about other GISERA studies in the Northern Territory.

Further information | 1300 363 400 | gisera@csiro.org.au | gisera.csiro.au

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