GISERA
Gas Industry Social and Environmental Research Alliance

JUNE 2020
GREENHOUSE GAS FOOTPRINT FACTSHEET

Mitigating fugitive gas emissions from well casings

This project will help reduce fugitive methane emissions by improving the integrity of gas wells through the development effective materials and best practice techniques for sealing microscopic fractures and gaps in well casing cement.

KEY POINTS

- Fugitive gas emissions from gas wells is a significant public concern associated with unconventional gas development in the Northern Territory.
- Gas wells comprise a steel production tube surrounded by cement casing which seals the gap between the production tube and the wellbore.
- Microfractures and microscopic gaps (microannuli) in gas well casing cement can provide a pathway for methane to escape as fugitive emissions.
- The most common well integrity risk is slow leakage of methane around the external casing, although the frequency of substantial leaks is low and leakage rates are low.
- This project will identify novel material types that could permanently seal microfractures and microannuli.
- A comprehensive literature review has improved understanding of new materials and emerging technologies used to seal microfractures and microannuli in leaking wells.

Project objectives

The main objective of this project is to evaluate novel materials developed by CSIRO designed to improve well integrity and decommissioning practices by reducing methane gas migration and emission along microfractures and microannuli within gas well cement casings.

CSIRO has been developing novel materials for civil and oil and gas applications for many years.

The project will leverage this expertise and intellectual property in material science.

Community concerns

The 2018 Scientific Inquiry into Hydraulic Fracturing in the Northern Territory highlighted community concerns about the potential of onshore gas industry development to contribute to climate change through greenhouse gas emissions to the atmosphere.

The inquiry's final report included recommendations to develop an enforceable code of practice setting out minimum requirements for ensuring well integrity and for decommissioning any onshore shale gas wells in the Northern Territory (recommendations 5.1 and 5.3).

This research will help further improve integrity of gas wells.

CSIRO · Australia Pacific LNG · QGC · origin · Santos · NSW Government · Australian Government Department of Industry, Science, Energy and Resources · Supported by Government of South Australia · Queensland Government · Northern Territory Government · Pangaea Resources Pty Ltd

Well design

Wells are a fundamental component of natural gas developments. Gas is extracted from target formations at depths ranging from several hundred metres to around one and a half kilometres.

A well is a hole drilled from the surface to access the target formation. It consists of a wellbore (the hole itself) and the components placed in the wellbore to maintain its integrity and for the intended purpose. The diameter of a wellbore is around 150 to 250 millimetres.

Within the wellbore is steel tubing called the production casing. This casing is cemented in place by forcing cement into the space between the casing and the wellbore (this space is called the annulus).

The cement is designed to hold the casing in place and to provide an airtight seal separating target formations from the surface and to isolate specific formations, such as aquifers.

Once a well has reached the end of its functional life it is plugged with cement (plugged and abandoned).

Causes of well leaks

Some causes of well leaks relate to well cementing or well operations after the cement is set.

Larger cracks, fractures and voids in well casing cement can be sealed effectively using cement slurry.

However, the microscopic nature of microfractures and microannuli means that they are sometimes smaller than the size of the cement particles.

Microfractures and microannuli are measured in micrometres (µm). There are one thousand micrometres in one millimetre.

Microfractures and microannuli that are around 150 µm will be too small for cement particles, yet can still form an escape pathway for fugitive methane.

In addition to micro-fine cements and polymer resins, there are many other novel materials that have potential as alternative well remediating sealants. These include polymer gels, geopolymers, and low melting point alloys, as well as use of nano-technology to improve performance of existing well sealants.

Next steps

A comprehensive literature review has been completed. This improves understanding of new materials and emerging technologies used to seal microfractures and microannuli in leaking well.

Bench top experiments will evaluate and select the most promising materials for further evaluation under simulated downhole pressures.

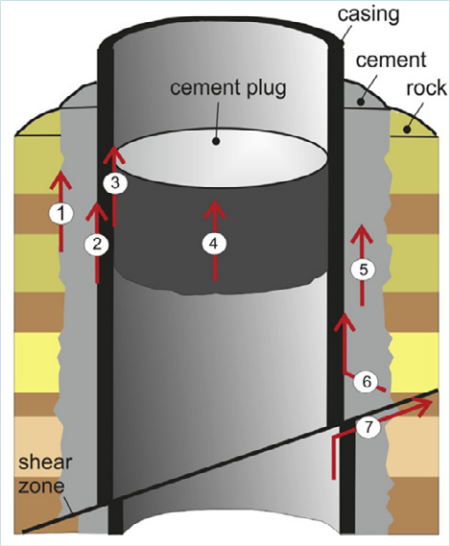
The most promising materials will be evaluated on their capability to seal planar microfractures and curved microannuli under downhole conditions.

Simulations will mimic cyclic wellbore pressure to assess material sealing effectiveness, based on hydraulic conductivity and strengths of sealed fractures.

MORE INFORMATION

Find out more about the project

Explore other GISERA research in the Northern Territory



Pathways for gas and fluid movement in decommissioned production wellbore

1. microannuli between cement and surrounding rock formations
2. microannuli between casing and surrounding cement
3. microannuli between cement plug and casing or production tubing
4. microfractures or mud channels through cement plug
5. microfractures or mud channels through the cement sheath between casing and rock formation
6. microannuli or mud channels across the cement outside the casing and then between this cement and the casing
7. fractures along a sheared wellbore

(after Davies et al. 2014).

ABOUT CSIRO's GISERA

The Gas Industry Social and Environmental Research Alliance (GISERA) is a collaboration between CSIRO, Commonwealth and state governments and industry established to undertake publicly-reported independent research. The purpose of GISERA is to provide quality assured scientific research and information to communities living in gas development regions focusing on social and environmental topics including: groundwater and surface water, biodiversity, land management, the marine environment, and socio-economic impacts. The governance structure for GISERA is designed to provide for and protect research independence and transparency of research. Visit gisera.csiro.au for more information about GISERA's governance structure, projects and research findings.

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