Australia's National Science Agency

GREENHOUSE GAS AND AIR QUALITY – AUGUST 2021

GISERA | Gas Industry Social and Environmental Research Alliance

Mitigating fugitive gas emissions from well casings

CSIRO research into the development of effective materials and best practice techniques for sealing microscopic fractures and gaps in gas well casing cement have delivered promising results. This project aims to help reduce fugitive methane emissions by improving the integrity of gas wells.

Key findings

A comprehensive literature review identified potential new materials and emerging technologies that could be used to seal microfractures and tiny gaps (microannuli) in gas well casing cement.

Desktop research selected promising materials for further testing under simulated downhole pressure and temperature conditions.

These included two geopolymers and three thermal-activated polymer resins, all of which were evaluated on their capability to seal microfractures and microannuli.

The study demonstrated that one of the thermal-activated polymer resins shows strong potential for effectively sealing small fractures where conventional well cement would likely fail to seal.

CSIRO will conduct further laboratory experimental studies to evaluate the performance of thermal-activated polymer resins in sealing small/micro fractures.

CSIRO will make available findings from the further laboratory experimental studies on the GISERA website when available.

Addressing 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 directly addresses those recommendations.

Project aims

This research project was established to identify and evaluate the performance of five novel materials that could be used to permanently seal microfractures – particularly in instances where the cracks are so tiny that conventional well cement slurry may not be effective.

The materials have been developed by CSIRO to improve both well integrity and decommissioning practices. One of the most promising materials is a thermal-activated polymer resin.

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

Project background

CSIRO has worked on the development of novel materials for oil and gas applications for many years, as well as for sectors such as building and construction.

This latest project builds on existing knowledge and expertise to help tackle the challenge of fugitive methane emissions – a significant contributor to Australia's annual greenhouse gas emissions.

Fugitive emissions from well casings pose a potential risk in developing unconventional gas resources.

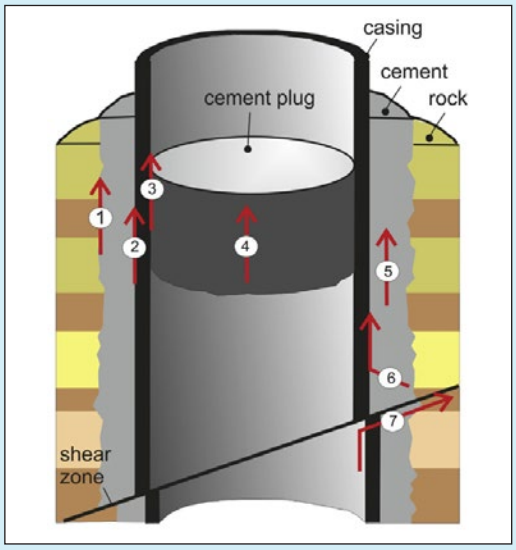
Gas wells are holes drilled from the surface to access a target formation underground. Within the wellbore, which is around 150–250 millimetres in diameter, there is a steel production tube surrounded by casing and cement. This cement seals the gap between the casing and the wellbore, but small fractures and gaps (microannuli) in the cement can provide a pathway for methane to escape.

Next steps

CSIRO will conduct further laboratory experimental studies to evaluate the performance of thermal-activated polymer resins in sealing small/micro fractures.

It is important to understand more about the longevity and effectiveness of the seal under simulated downhole pressures, temperatures, and other adverse conditions, prior to field trials.

The results of these future studies will help inform appropriate policy and management responses to gas development proposals in the Northern Territory and elsewhere.



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).

More information

This project was co-funded by the Federal Government (75%) and CSIRO (25%).

Read the final report and access more information about the project.

Learn about the Scientific Inquiry into Hydraulic Fracturing in the Northern Territory.

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