

SEAL WELL

Tier 1's Seal Well system is a revolutionary and highly reliable plugging and sealing system through the use of a metal alloy that can be melted in the well in situ, squeezed into perforations by the simple application of pressure, and then expands as it solidifies. What is left behind is a permanent barrier to surface casing vent flow that is completely inert and lasts for literally 1000s of years!

The Seal Well alloy plugging system is a replacement for traditional cement squeezes for wells with surface casing vent flows and gas migrations. Its proprietary process uses an alloy with a low melting point that is run in on wireline. This alloy, with a high specific gravity and low viscosity displaces existing fluids and easily flows through existing perforations into cracks, channels, microannuli, or permeability. When it re-freezes it expands by 1.4% creating a permanent barrier to flow.

Once the suspected source is identified, the first non-permeable rock above the suspected source is perforated, ideally with DynaEnergetics DynaSlot gun to ensure full 360 degree coverage. A retrievable bridge plug is set just below the perforation and sand dumped on top to protect the plug. The Seal Well tool is run in on wireline and the alloy melted in place, where subsequently refreezes. The regulating authorities in both Saskatchewan and Alberta have approved this methodology. The entire operation, from identification to mitigation can be done 100% rigless.

The alloy has been tested at the University of Calgary and has been shown to have a life expectancy greater than 10,000 years. This exceeds the design criteria for any abandonment or CO₂ sequestration system.

Seal Well is also suitable to be used to set permanent plugs inside casing when issues exist getting traditional plugs to set. Additionally, the system can be used to seal off existing perforations, and the plug can easily be drilled out to give full bore access. Tier 1 currently has tools to remediate wells from 114.3mm up to 177.8mm, with remediation is larger and smaller casing sizes possible.

When the Seal Well system is combined with Tier 1's array of Surface Casing Vent Flow and Gas Migration logging tools and perforating system, we offer our customers an unmatched ability to diagnose and mitigate these issues using one unit in a single attempt.



TIER 1

FEATURES

- Permanent leak-free well abandonments
- Repair of vent gas flows by sealing the well annulus within cap rock
- Repair of casing leaks
- Precision plugging of perforations
- Zonal isolation
- Permanent containment of geologically stored greenhouse gases

BENEFITS

- The molten alloy expands volumetrically over 1% as it solidifies whereas most cement mixtures shrink slightly. Expandable cements do so at a much lesser degree (0.3%) than the alloy
- It does not go through a weak transition phase when setting, eliminating micro channels that can form when traditional cement sets
- It is approximately 9 times heavier than water, so it displaces any wellbore or annular fluid, and does not mix with them
- It is a low viscosity single phase system, so does not filter out when squeezing into permeable formations making it more effective in shutting off gas flow at the source
- The low viscosity and high specific gravity flows more readily into narrow cracks, fissures, and micro-annuli
- Has a 137°C melting point, allowing it to be melted in situ without harming the casing or any cement in the vicinity. This can be increased by changing alloy.
- Is completely non corrosive, and has life expectancy of >10,000 years
- Is ideally suited to use in blocking flow at non permeable zones, and has obtained AER approval for this technique
- Is deployed on wireline, saving the use of conventional cementing units and as such offers very significant cost savings

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TIER 1

CASE STUDY 1

Surface Casing Vent Flow in Western Canada

3 wells in Southern Alberta in a CO₂ Flood field exhibited small but measurable gas leakage through the wellhead vent, all on the order of 0.1 m³/day leakage.

Through consultations with the company representative, a non-permeable zone above the leaking formations were identified and perforated with a 1m interval, with a plug with sand on top just below the perforations. The SealWell tool was run in and enough material to fully cover the perforations was melted in hole. The tool was removed and the plug depth was confirmed a few hours later after the material had frozen. In all three wells the vents flows were dramatically reduced and subsequently ceased on all wells. These well were cut and capped, completing the abandonment process.

One of the wells deserves special mention. Above the suspected leaking zone there was no cement to surface. The material in the annulus was assumed to be old drilling mud and/or water. To determine if SealWell could be deployed into an annulus void of cement a test was run pouring liquid alloy into a perforated pipe immersed in water.

The picture below shows the outcome of this test:



Based on these results it was decided to try in the well, using the same methodology as above. The SealWell tool was run and material melted into the well, and the vent was dramatically reduced and subsequently stopped completely.

CASE STUDY 2

Leaking Abandonment Plugs in Western Canada

3 Shallow Gas Wells in Southern Alberta all had leaking casing abandonment plugs. As this issue was likely due to corroded casing, instead of setting new plugs the operator applied to the provincial authority to allow the melting of a 4 to 1 aspect ration bismuth alloy plug on top of the existing plugs. The authority agreed under the stipulation that the plug had to pass the 7 Mpa pressure test initially and again in 6 months before the wells could be fully abandoned. The amount of material to set these plugs in the 4.5" casing was calculated and melted on top of the plugs. In all three cases the leaks stopped and pressure tests held both initially and 6 months later.