Mitigation of Greenhouse Gas Leakage From Oil and Gas Wells

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Abstract

Pre-existing oil and gas wells and well bores represent highly permeable pathways for leakage of greenhouse gases; in Alberta alone leaks have been estimated to provide the equivalent of 3.5 million tonnes of CO2 per annum. In addition to abandoned wells without plugs, gas leakage may occur when the integrity of wells is compromised by a variety of factors including incomplete construction or failure of the cement plug, overpressure in the well and corrosion of the well plug. Gas leakage due to surface casing vent flow (SCVF) through the cemented annulus between the production casing and the well bore wall has been estimated to occur in 14% of Alberta wells and is difficult and expensive to repair. To prevent long term damage, permanent solutions for sealing wells are required with minimum service lives of 3000 years being sought for gas sequestration projects.

To permanently seal wells emitting greenhouse gases, Seal Well has developed technology to provide in-situ molding of a seal between the well casing and cemented annulus. A low melting point bismuth-tim alloy is heated and allowed to flow into the fissures, cracks and cavities; on cooling the material expands to provide a permanent seal. To accelerate development and deployment of Seal Well's technology, a computational model has been developed using COMSOL Multiphysics® software to analyze the conjugate heat transfer occurring during heating and cooling and the thermomechanical stress developed during solidification, an example is provided in Figure 1.

Figures used in the abstract

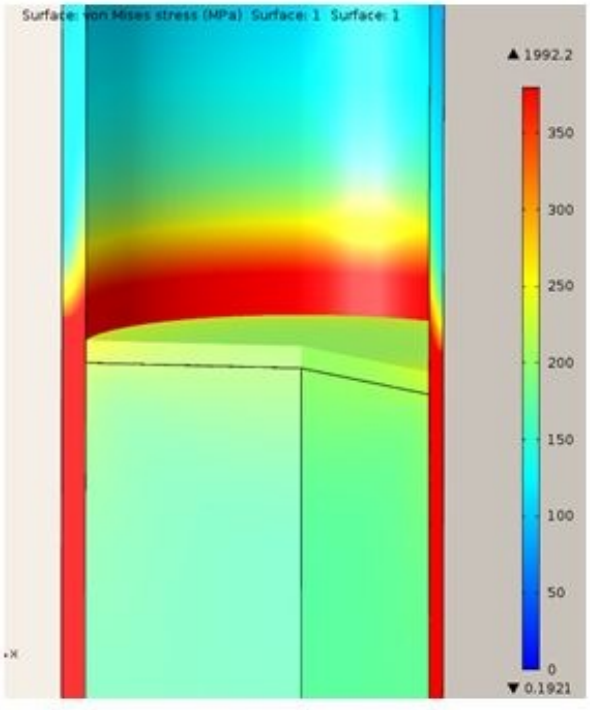

Figure 1: Figure 1: Stress distribution associated with melting/solidification around well casing and cemented annulus.

Figure 2

Figure 3

Figure 4