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Quick Clay: A novel alternative for well decommissioning

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At the end of a production well's life cycle, the facility must be shut down and prepared for decommissioning. This process ensures that the well site is properly sealed to prevent the migration and emission of remnant hydrocarbons that may reside within the well. This procedure is known as plug and abandonment and sees the emplacement of a series of cement-based plugs to act as this sealing mechanism. This process is also closely followed during carbon-capture-and-storage (CCS) procedures, where at the conclusion of CO2 injection into the reservoir stores, the site must be reliably sealed to prevent the extrusion of the stored carbon. These cement plugs are prone to cracking, shrinkage, and detachment from the well interface, potentially resulting in the formation of preferential pathways in which the hydrocarbons can migrate. The consequences are the emission of fugitive CO2, CH4 and H2S into the surrounding environments leading to damage to ecosystems and the atmosphere. This is particularly problematic with the current global push towards net zero carbon. We propose the use of a novel material as an alternative sealant to replace standard cements that should eliminate the formation of these pathways and improve the well's integrity over time. The material, known as Quick Clay, is a naturally occurring, post glacial marine clay of high sensitivity. The clay is from the Quaternary era (2.6 million y.a. –present) and has undergone substantial weathering as a product of glacial retreat and isostatic rebound. The clay is mainly found in northern Russia, Norway, Finland, Sweden, Canada and Alaska and is sometimes referred to as Leda or Champlain clays. The specific conditions in which this clay forms provides it with the unique ability to shift from a rigid solid to a free-flowing fluid near instantaneously, before returning to a relatively strong remoulded state. The project aim is to provide a long-term barrier to limit the emission of remnant hydrocarbons within abandoned wells. In this research work, we investigate the effects of clay density (water/clay ratio) and pore-water chemistry on the mechanical and hydraulic properties of the proposed barrier material. Initial testing indicates that the clay can be pumped at densities similar to that of cement but at much lower viscosities, aiding in the ease of placeability, and preserving its low permeability. Once placed, the clay remains ductile enough to be remoulded and reshaped upon significant deformation, providing a barrier with a self-healing capability. The presentation will show a fundamental characterisation of the quick clay (pH, liquid/plastic limits, mineralogical composition, and particle size), and a parametric study on the pumpability, penetration, compressibility, and shear strength towards a proof of concept for the clay to act as a new sealing element.

Participation

In-Person

References

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