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An innovative approach utilizing reinforced scale and cement as a combined barrier material for well abandonment (SCBarrier)

Development of electrochemical scale and reinforcement of cement-based low-strength mortar

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Scale deposition on the surface of oil and gas production pipes can significantly reduce flow rates and pressure, leading to early failure of downhole equipment. Removing the deposited scale through milling is both time-consuming and expensive, and retrieving the milled material presents additional difficulties. Leaving the scale in abandoned wells to serve as part of the barrier material could be advantageous by eliminating the need for milling. However, scale typically has a low-strength layer structure due to its high porosity and permeability, making it unsuitable as a barrier material for well abandonment. Therefore, strengthening the scale is necessary. A major challenge is obtaining sufficient amounts of scale from oil and gas well operations to prepare specimens for property assessment. To address this, a collaborative research project has been initiated at Aalborg University (AAU) and Aarhus University (AU). AAU produces artificial scale through electrochemical methods and explores the effects of corrosion, oil, high pressure and diammonium hydrogen phosphate (DAP) treatments, while AU focuses on enhancing the strength of porous cement-based mortar, using DAP treatment to promote the formation of hydroxyapatite (HAP) minerals. This technique will eventually be applied to strengthen the combination of scale and cement. Findings from AU demonstrate that DAP treatment significantly improved strength and substantially reduced voids, water absorption, and water penetration in the treated specimens compared to the untreated ones. AAU's electrochemical scaling results show that the mass and composition of the scale are influenced by factors such as the applied potential, electrolyte composition, temperature, and process duration, while the hardness has been increased by DAP treatment. The analysis of electrochemically produced scale samples was conducted using XRD, XRF, UTM, SEM, EDS, and pycnometer techniques.

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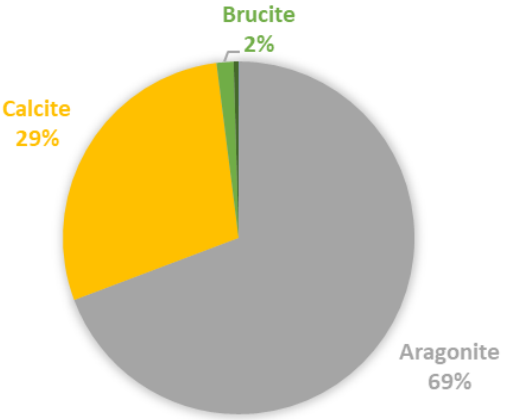
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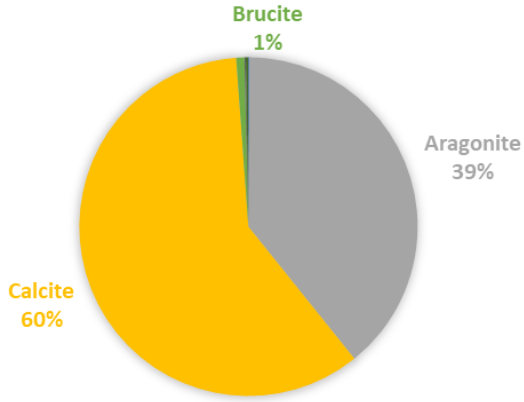
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