Title:

Pressure-Assisted Ozonation of Produced Water and Process Water of Oil Shale

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Produced water is generated when oil or gas is produced and is commonly increasingly generated as an oil well nears its end. Surface tailings and in situ extraction of kerogen from oil shale also result in waters potentially containing hydrocarbon contaminants. Produced water and process water contain dispersed and dissolved oils and hydrocarbon contaminants that present problems for subsequent water uses and disposal. When discharged, produced water with even trace oil can result in sheen formation at the water surface. In practice, low levels of dissolved and dispersed hydrocarbons in such water are very difficult to remove. Existing best available technologies (BAT) are often not satisfactory.

This research explores the beneficial use of ozone deployed with a new pressurizing technique to treat produced water for oil removal as well as prevention of oil sheen. Unlike ordinary ozonation practice, the new technique involves ozonation under rapid, successive compression and decompression cycles, which create additional mechanisms to achieve removal of dispersed and dissolved oils. The process creates abundant nano/micro bubbles and reactive zones at the gas-liquid interface that heighten chemical conversions, most notably the conversion of hydrophobic hydrocarbon molecules into hydrophilic organic acids. This study has examined the reduction of dissolved and dispersed hydrocarbons as well as prevention of oil sheen according to treatment extent and varying treatment parameters. The influence of factors such as varying salinity, temperature, and solid concentration on oils removal has also been studied. A 2-stage treatment design has been conceptualized and used to test the removal of dispersed oil and dissolved oil, respectively; the separate mechanisms of removing dispersed oil and dissolved oil will be discussed and the efficiency evaluated in this presentation. Experimental results have shown that formation of oil sheen is prevented and both the dispersed and dissolved oils are greatly reduced. The new technique has potential to treat tailings waters from surface processing of oil shale, as well as water produced during or after in situ production, achieving the goal of safe discharge to the environment as well as making high-value reuses of the water possible.

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