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Title: An Effective Mobile Technology for the Treatment of Saline Sludge from Oil and Gas Exploration

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Abstract: The particle size distribution of the saline sludge samples indicated the presence of very fine sand and clay. The electrical conductivity of the sludge was 42.2 dS/m indicating very saline sludge and the cation exchange capacity (CEC) was 40 cmol/kg which was very suitable for ion-exchange. A flushing process followed by a zeolite based ion-exchange process was developed for the treatment of saline sludges from oil and gas exploration sites. A 500 g sample of saline sludge (containing CaCl2:MgCl2:NaCl ratio as 1:1.16:32.86) was washed using demineralized water in a mixed reactor and allowed to settle. The optimal number of washes was determined to be two washes with an overall salt removal efficiency of 94.47 %. The treated sludge contained 515 mg salt/kg sludge (or 0.05 % w/w) and was suitable for agricultural application. The washwater was passed through a Mountain Stronach zeolite (chabazite) based ion-exchange column for salt reduction. A single chabazite based ion exchange column achieved a salt removal efficiency of 75.34 %. This was increased to 99.79 % when using two ion-exchange columns. The final salt concentration in the wash water was 314.0 mg L- 1 which is below the limits established by the Canadian Guidelines. The chabazite used in this study had a maximum window dimension of 5 Å. The removal of ions (Mg2+, Ca2+, Na+ and Cl- ) in this study was mostly by molecular sieving due to the large diameters of these ions (10.8, 9.6, 7.9 and 6.6 Å for Mg2+, Ca2+, Na+ and Cl- , respectively. The developed sludge desalination system achieved high salt removal efficiency (98%).