

Machine Learning based Pilot Plant Optimization using a Water Lean CO₂ Capture Amine Solvent

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This study presents a water lean CO₂ capture solvent having low regeneration energy, viscosity, and degradation. The water lean solvent, KHU-B, is a sterically hindered diamine and the hindered amine site makes KHU-B easily forms bicarbonate resulting the high absorption capacity. The minimum solvent regeneration energy is obtained using Gaussian process Bayesian optimization (GPBO) and bench scale pilot plant experiments. GPBO finds the optimum solution based on the input and output relationship of experiments, thus the expensive first principle model construction can be avoided. According to the pilot plant experiment, the optimum regeneration energy of Monoethanolamine (MEA) and KHU-B respectively shows 4.3 and 2.8 GJ/tCO₂ indicating that KHU-B requires only 65% of regeneration energy of MEA. The number of experiment for finding the optimal pilot plant operating is less than 30 for both MEA and KHU-B experiments. We also present the superior properties of KHU-B in terms of the CO₂ loading, cyclic capacity, regeneration temperature, degradation, and viscosity.