preprocessinc

Chemical Engineering for Entrepreneurs

Water Recovery from Brines and Wastewater

Production water is a product of natural gas and natural gas liquids recovery operations. It is primarily derived of flow back water from the well operations. The recovery, processing and reuse of production water is becoming increasingly the key to unlocking the potential of the California natural gas resources in both the Monterey and Santa Maria plays. Without the ability to process the volumes of production water, the use of water for the natural gas recovery operation becomes limited. The natural gas and the natural gas liquids that can be brought to market using the emerging drilling and recovery methods represents a significant long term opportunity for the California economy. Preprocess is engaged in developing and delivering engineered system solutions throughout the state for energy and critical resource recovery chemical engineering applications.

Typical Assigned Evaluation Scope

Design a production water processing system. The system shall be integrated with each constituent disposition identified and resolved. The final products shall be water meeting both re-injection and surface water reuse quality specifications. The removed constituents shall be produced in a form made available for feedstock to other downstream chemical operations. The non-recoverable wastewater and constituent sludges shall be minimized. The economics of the system design must meet generally accepted financial metrics for chemical operations investment.

Unit Operation Sequence

Typically production water is recovered and collected. Gross separation of the total suspended solids (TSS) is completed by either settling or filtration. The solids are separated using heavy filtration equipment. The filtrate or overflow is reacted with various precipitating constituent service chemicals in agitated reactors to remove the total dissolved solids (TDS). The series of precipitations follows roughly the same order but the detail mass balance and reaction rates depends entirely on the make up of the production water. The precipitated solids are removed using similar techniques and equipment as the original gross TSS removal. The TDS constituent precipitation effectiveness is limited by the solubility products of the process chemistry in the system at each precipitation step. The filtrate or overflow from the TDS precipitation constituent separation is then run through reverse osmosis (RO) systems to further reduce the constituent levels to meet the various reuse and reapplication specifications of the product streams. The RO reject is typically recycled into the precipitation feedstock. Granulated Activated Carbon (GAC) is typically used as a selective adsorbent to remove any organic constituents (TOC). In many cases, Powdered Activated Carbon (PAC) is added to one of the precipitation reactors and the PAC is removed in the filtration step that follows. The economics of the recovery is usually driven by the use of GAC and/or PAC and the use of each is critically dependent upon the level of TOC removal required. This evaluation determines the unit operation order in which the PAC and/or GAC operations are placed. The economics of the recovery is also dependent upon the volume of service chemicals required in the precipitations. The unit operation sequence may take advantage of various step wise synergies in the process stream characterization resulting from different precipitation unit operation order.

Deliverables

The typical deliverables from a feasibility study required to evaluate the application would include the following components.

A. The definition of the business opportunity including a history and summary analysis of previously implemented comparable technical options and the current market opportunities for offtake of the recovered materials
B. A system safety evaluation
C. Process Flow Diagrams (PFDs)
D. The complete process chemistry of each unit operation
E. A live constituent level mass and energy balance with performance based reaction and precipitation product modeling
F. Feedstock and product characterizations for each unit operation and the overall system. These are to include the validated test method accuracies and precision on each analytical method used in each stream characterization
G. A project milestone schedule (+/- 3 months)
H. A project CapEx and anticipated OpEx estimated cost model to a +/- 30% accuracy tied to the live working mass and energy balance
I. A functional system space allocation layout
J. The control system automation strategy and critical control point parameter needed on line or off line sampling and measurement accuracy and precision. Identify each measurement's operating control set point range limit.
K. A permit strategy identifying the design's effect on each required program and outlining approaches for meeting the requirement of each
L. Detailed major equipment specifications. Typical commodity equipment item specifications for repeatedly applied equipment.

