The CONTACTOR™

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Forecasting the Future: Tarot Cards, Palmistry, or Simulation?

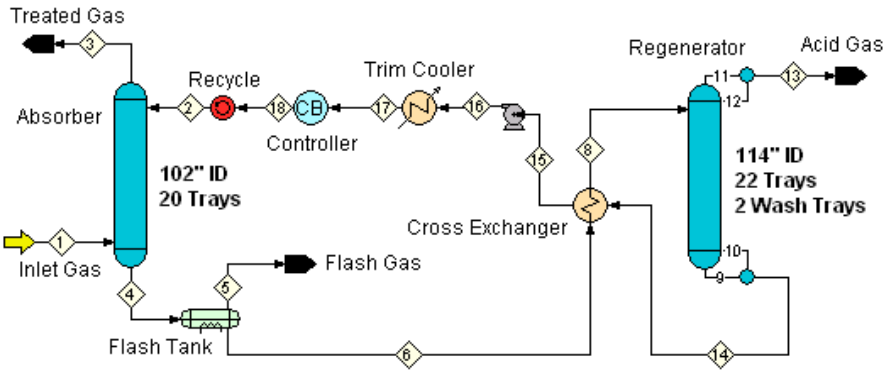

Figure 1 PFD of High Pressure CO_2 Removal Unit

Comparisons of real process data with a good simulation will often reveal areas of performance shortfall or identify opportunities for optimization. Simulation can also be used to make economic decisions and how best to utilize existing assets.

The plant in this study uses a conventional scheme to remove CO_2 from high-pressure coal-bed methane. The facility was originally designed to reduce 450 MMscfd of gas containing 5 mol% CO_2 to 3%. Pipeline specifications were met by processing *part* of the raw gas to a low CO_2 content and then blending it back with the remaining untreated gas to a 3 mol% CO_2 product. Originally sized to use either DEA or a specialty solvent, just prior to startup the operator decided to use MDEA instead. After a year of operation on 4.25% gas, operations became concerned with handling future increases in CO_2.

To test the plant's performance, INEOS Oxide and an engineering contractor helped the operator to run a set of trials. ProTreat was used to benchmark the performance data. A simplified PFD is shown in Figure 1 and conditions for the three tests are shown in Table 1. Test 3 was run at maximum design rates for the amine plant; Tests 1 and 2 were run at higher gas rates and in the case of Test 2, at reduced solvent rate. Thermocouples located on trays 3, 6 and 15 from the top of the 20-tray column enabled ProTreat simulations to be checked against the overall treating performance, and measured tower internal temperature profiles.

Table 1 Operating Conditions for Plant Trials

	Test 1	Test 2	Test 3
Raw Gas			
Flow (MMscfd)	211	208	180
Temperature (°F)	104	104	104
Pressure (psia)	998	998	997
CO_2 (mol%)	4.29	4.29	4.21
Lean Solvent			
Flow (gpm)	1000	819	998
Temperature (°F)	104	110	101.8
MDEA (wt%)	48	48	48
Acetate (ppmw)	975	975	975
Formate (ppmw)	225	225	225
Chloride (ppmw)	45	45	45

Table 2 compares simulated overall performance of both the absorber and regenerator with measured test data and Figure 2 shows measured temperature profiles. CO_2 treat is quite accurately reproduced by the models, and even the

calculated lean loads are remarkably close to measurements. Predicted temperature profiles do not agree perfectly, but they fall through the data.

Table 2 Overall Performance vs. Simulation

	Test 1	Test 2	Test 3
Treated Gas			
Measured CO_2 (mol%)	1.54	1.98	1.20
ProTreat CO_2 (mol%)	1.57	1.95	1.20
Lean Amine			
Measured CO_2 Load (m/m)	0.008	0.008	0.007
ProTreat CO_2 Load (m/m)	0.0075	0.0059	0.0046
Rich Amine			
ProTreat CO_2 Load (m/m)	0.310	0.403	0.294

The next step was to simulate future conditions with higher CO_2 content gas. For this study, the target CO_2 level for the gas from the contactor is 2 mol% and the blended gas is 3 mol%.

Figure 3 shows the effect of the inlet CO_2 content on plant capacity and why MDEA makes sense when the CO_2 level is low. At CO_2 concentrations below 4.1 mol%, the plant can easily fill the trunk line system with its design capacity of 450 MMscfd. However, increasing CO_2 level can significantly reduce the capacity of the facility. At 5.5% CO_2, for example, with MDEA the combined gas volume to the trunk line is cut in half.

To maximize gas production, the operator is now considering a proposal to convert from MDEA to GAS/SPEC* CS-2010* specialty solvent. CS-2010 will be used to reduce the CO_2 level to 1000 ppmv instead of 2 mol%, requiring lower gas flow through the amine plant and enabling the facility to meet the 3 mol% CO_2 specification with a higher by-passed gas flow. Figure 4 shows the projected treating capacity as a function of CO_2 content of the raw gas.

ProTreat simulation is a very powerful tool in retrofitting existing facilities to new process conditions using either the existing treating solution or new specialty solvents. ProTreat's capabilities are also invaluable in troubleshooting operating problems and it allows the engineer to carry out a wide ranging what-if study to find better, more energy conserving operating conditions or to determine the cause of malfunction or poor performance.

An existing plant can be revamped with a new solvent and have its performance improved in several ways. Design errors, or premature decisions that prove limiting can be overcome and new gas streams and changed treating goals can be accommodated sometimes by relatively simple changes, suggested by using the ProTreat process simulation tool.

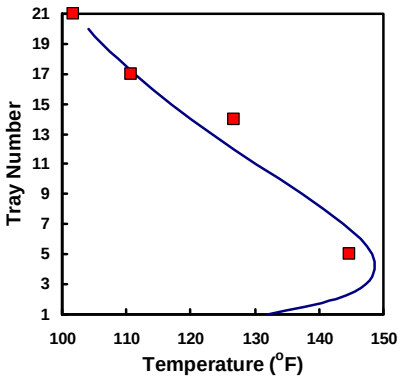

Figure 2 Absorber Temperature Profiles, Measured (■) and Simulated (—)

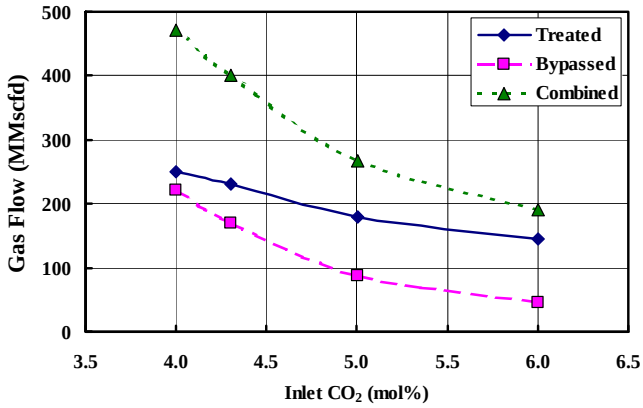

Figure 3 Plant Capacity With 50 wt% MDEA

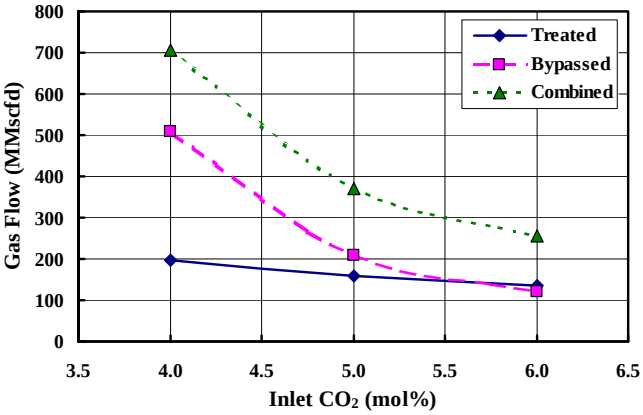

Figure 4 Capacity With GAS/SPEC CS-2010

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