CASE STUDY

eROI℠ by Ecolab

Amine Corrosion Control Program Helps Industry-Leading Midstream Gas Processor Reduce Operating Costs

ANNUAL SAVINGS

PRODUCTIVITY

Savings from fewer amine change outs

$90,000

COSTS

Savings from reduced chemical consumption

$80,835

TOTAL VALUE DELIVERED

$170,835

BACKGROUND

The first step in drilling a new natural gas well is "spudding in." A large drill bit clears away rock, dirt and other sedimentary materials. The resulting hole is lined with concrete to protect groundwater and then the larger bit is replaced with a smaller diameter bit which completes the drilling to the well's total depth. The date of that bit replacement is the spudding in date. New horizontal drilling techniques have reduced drilling time to less than a week and allowed drilling companies to achieve full production in less than a month from the spudding in date. This fast "spud-to-production" cycle in the drilling basins has increased the number of new wells, commissioning activities of new gathering lines and field production units. It has also increased trace oxygen levels in midstream natural gas.

Positioned at the end of the drilling basins, midstream gas plants typically use methyl-diethanolamine (MDEA) blended amines for complete removal of sour gases (H_2S and CO_2). The increased trace oxygen levels in the new gathering systems, 30-50 ppm, degrade these amines to corrosive amino acids and heat stable amine salts.

In 2000 shale gas provided only 1% of U.S. natural gas production. By 2010 new drilling techniques and the rapid growth of hydraulic fracturing (fracking) increased shale gas production to over 20% of national production. By 2035, 46% of the United States' natural gas supply will come from shale gas.

[1] The gas plant receives unprocessed gas flows with a composition of 80% methane, 5.5% ethane, 1.8% propane,
10% CO2, 1.7% nitrogen and 0.5 % oxygen at a flowrate of 5-7 MMSCFD.
[2] 10% of amine strength
[3] 27,800 ppm

SITUATION

An 80 gpm gas plant located in Southern California processes gas gathered from several oil wells and processes the gas to extract natural gas liquids (NGL) using propane refrigeration or turbo expanders.[1]

Because the gathering system operates under vacuum, air leaks contaminate the gas with as much as 850 ppm oxygen.

In 2017, the high inlet O_2 in the sour gas stream degraded the amine to such a degree that neutralization could not reduce its corrosivity. Within three months of operation, the heat stable salts and amino acids climbed as high as 4 wt%.[2] Bicene, a strong iron chelator and highly corrosive, composed 70% of those degradation compounds.[3]

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Every three months, the plant was shut down for 7-8 hours and the amine system flushed. A fresh 1300-1500 gallons of amine was then charged to the plant and restarted.

The high bicine concentrations, never less than 9,400 ppm, generated very high corrosion rates. Corrosion-induced leaks in flanges and pipe spools were commonplace. Baseline free iron levels in the amine were 330 ppm, with peaks prior to 3-month purges as high as 1,800 ppm. When equipment failed, it was replaced with higher cost, corrosion resistant stainless steel. Frequent shutdowns, constrained production and high costs associated with amine plenishment prompted the plant engineering staff to work with their Nalco Water representative to find a solution.

SOLUTION

The plant used PuraTreat® AGX1600, an amine blend from Nalco Water. The amine was enhanced with PuraTreat Stabilizer — an additive designed to shield the MDEA from the oxygen-free radical and to stabilize the amine from degradation into bicine and other heat stable amine salts — and Nalco Water's corrosion inhibitor. The combination of the stabilizer, inhibitor and monitoring using Nalco Water's Amine Corrosion Control Program delivered dramatic results.[4]

[4] The initial PuraTreat Stabilizer dose was added via an LMI Milton Roy injection pump from a drum over the course of one day and the Nalco Water corrosion inhibitor was then added at a slow rate, using the same pump.

RESULTS

Without the additives, bicine concentrations increased about 190 ppm/day to concentrations of about 17,000 ppm, concentrations sufficient to drive the serious corrosion the plant experienced. After three months of operations with the additives, bicine increases were reduced to no more than 5 ppm/day with peak concentrations of 400 ppm, a decrease of 98%. Even with total anion levels greater than 5,000 ppm (acetates, formates and bicine), free iron levels in the amine dropped to less than 70 ppm, a 79% decrease. (Figure 1)

An amine Process Corrosion Analyzer continuously monitored inlet oxygen, corrosion rates and pH, compared them to plant performance targets and gave the operators the insight they needed to make quick decisions to prevent operational problems. The plant has seen verification of the effectiveness of the Nalco Water solution and have been able to identify potential problems, accelerate decision-making and troubleshooting as well as mitigate oxygen related problems. (Figure 2).

Prior to the introduction of the Nalco Water Amine Corrosion Control Program, the plant spent about $300K/year on amine change outs. With the combination of the AGX1600 and Nalco Water's corrosion inhibitor, the plant reduced amine consumption from 7 lbs/MMSCFD to 5 lbs/MMSCFD and extended the time between amine change outs from 4 months to 2 years. Overall, the program helped the plant save over $170K/year.

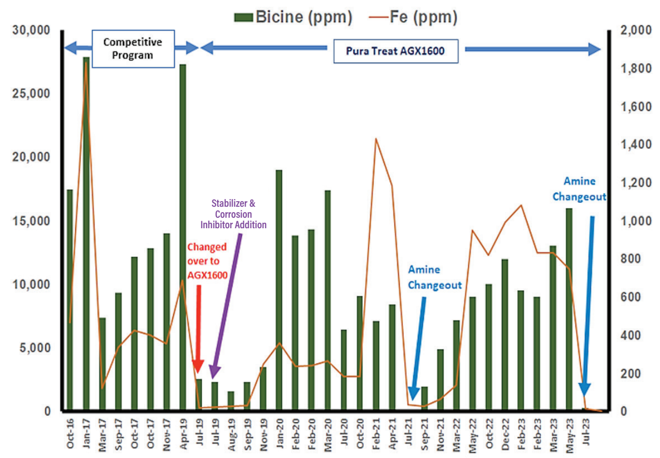

Figure 1:
Bicine levels of amine system pre and post program change.

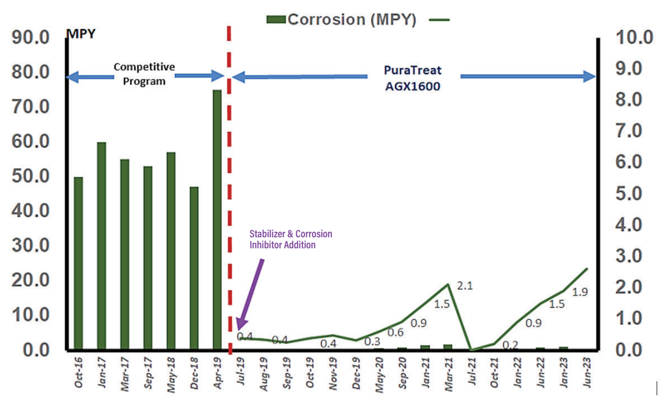

Figure 2:
Corrosion levels of amine system pre and post program change.

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