Amine Losses Minimization and Amine Recovery

Problem
Amine losses are a prevalent problem in most plants that have amine units for H₂S and CO₂ removal. These units can be in refineries, gas plants, upstream operations, petrochemical plants, metal processing facilities, SO₂ removal plants and CO₂ sequestration plants. The loss of amine solvents (and also physical solvents) are to some extend unavoidable due to issues such as foaming episodes in gas treating, upsets, mechanical entrainment caused by high absorber velocities, absorber flooding or absorber design deficiencies. In liquid streams, amine solvent losses can be caused by solubility of the amine solvent in the treated stream. Losses are also caused by emulsification of the amine solution and the hydrocarbon liquid phase (generally LPG), mechanical entrainment and upset episodes.

The cost associated with amine losses can be staggering and can reach millions of dollars per month. One can consider the following areas of economic impacts in amine losses:

- Amine cost (up to USD 5/lb for formulated amines)
- Amine inventory, storage and replenishment maintenance
- Downstream impacts in fuel gas lines, burners, compressors and turbines
- Downstream impacts in mercaptans removal, alkylation and caustic units

Solution
The Amine Losses Minimization and Recovery Program at Nexo Solutions is a multi-stage approach that includes on-site tests, engineering evaluations and simulations. The program starts with no capital cost initiative initially. The program includes:

- Amine absorber simulations for amine loss minimization
- Instrumentation verification
- Suspended solids evaluation at lean amine stream
- Contaminant profiles at the inlet gas liquid streams
- Amine loss quantification in gas and liquid streams
- Surfactant and hydrocarbon analysis
- Separation system evaluation (filters, coalescers and activated carbon beds)

The program also includes the incorporation of the Exion® Amine Recovery System if there is a need for a high efficiency amine recovery unit. The system was designed to recover amine carryover and to extract residual dissolved amines in the treated streams.

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Exion® Systems for Amine Recovery

Problem
A Gulf Coast refinery wanted to enhance capacity of their LPG amine absorber by more than 50%. Evaluation of the absorber indicated that it could be used at the desired capacity without building a new absorber. The current absorber required some internal modifications, however. Because of the enhanced flow into the same column diameter, liquid velocities inside the absorber would cause higher amine solvent losses. This translates into higher amine replacement costs and contamination of the downstream mercaptans removal unit.

Treated liquid hydrocarbon streams such as LPG will generally carry considerable amounts of amine solvent. This carry-over can be in the form of emulsified droplets, mechanically entrained liquids or dissolved amine. To properly remove and recover amine from treated liquid hydrocarbon streams, a process of removing and extracting all amine residues in all phases has to be in place.

Solution
The Exion® system for amine recovery was designed to recover any carried over amine and extract residual dissolved amine in the treated LPG stream. The system was also designed to protect the mercaptans removal unit downstream, and ensure that treated LPG passed the copper strip test. The LPG treater was initially evaluated for minimizing amine losses. The system was then installed at the outlet of the amine LPG treater and upstream of the mercaptans removal unit. Prior to start-up, amine losses were significant and the mercaptans removal unit experienced intermittent foaming incidents causing amine losses and failing copper strip test results.

The system was adjusted for maximized amine recovery. The installed Exion® system was used to treat the full LPG flow. The refinery is currently using the installed absorber with 50% higher LPG treating capacity. Since installing the Exion® system, no major problems were found in the downstream mercaptans removal unit, and the total amine recovery was nearly 92%. This equates to a cost savings near USD 500,000 in amine recovery, caustic protection and consistently passing copper strip tests. This estimate does not include capital costs savings in avoiding the installation of a new LPG treater column.

Exion® Systems are low cost, compact in size and footprint, flexible in configuration, completely skidded and operate at 90%+ amine recovery rates in treated hydrocarbon streams. The technology can also be used recover amine losses in treated gas streams.

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