CCR Technologies Inc.
Technical Bulletin
Amine Deficiency & Nitrogen Balances

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When performing basic amine analysis it is difficult to get a complete identification of all components in a sample. It is not unusual for the sum of all identified components (often called "recovery" or "closure") to be less than 100%. The unidentified components that make up the remainder of the solution are often ignored because they would be too expensive to identify analytically. Amine and nitrogen balances can provide an economical way to better understand the nature of these unknown components and to assess the effect of their presence on amine system performance.

Amine Deficiency

Using DEA as an example, an amine deficiency balance compares the amount of DEA specifically measured in a sample to the reported "amine strength" or "alkalinity" of that sample. The resulting "amine deficiency" is material that has base strength but is not a DEA molecule. Certain degradation products of DEA (THEED and Bis-HEP) also have base strength but do not perform as well in removing acid gas as DEA. THEED is also considered ***corrosive*** so there are additional concerns with it being present in the solution. A high amine deficiency simply means that the actual amount of useful amine in the solution is less than the measured alkalinity (or implied amount of amine in the solution). A high amine deficiency may lead to system performance issues if heavily optimized from a rich loading standpoint, which could lead to treated gas quality issues and corrosion concerns. The attached table shows additional degradation products that will analyze as "amine deficiency".

Excess Nitrogen

A nitrogen balance measures the total amount of nitrogen in the sample then subtracts the amount of nitrogen attributable to the identified components in the sample. The difference between these two numbers is "excess nitrogen", and is generally attributed to high molecular weight, high boiling point degradation products (polymeric material).

Removal of Degradation Products

Removal of amine degradation products should be considered, especially for systems where they exist in high percentages and where operational problems persist. If you have an amine deficiency in your system greater than 2.5% you need to consider removing amine degradation products to restore the solution quality. Vacuum distillation is the only technology available from a merchant reclaimer that is able to remove these types of degradation products from your solution. If you have excess nitrogen in your system greater than 2.0% you need to consider removing these degradation products. Once again vacuum distillation is the only technology available from a merchant reclaimer that is able to remove these types of degradation products from your solution.

Summary

When evaluating merchant reclaiming options, remember that HSS (heat stable salts) is not the only issue to consider, and may not even be the biggest one. It is important to look at the full amine analysis and the excess amine and nitrogen calculations so that total solvent quality improvement may be achieved. For more information or to inquire about a *complete* sample analysis contact CCR Technologies Inc. in Houston at 281-988-5800, or visit us at www.reclaim.com.

Examples of DEA Degradation Products Containing Nitrogen

Compounds That Could Analyze as Amine Deficiency

THEED	Base	Corrosive
Bis-HEP	Base	Benign
Polymeric Material (Low molecular weight analogs of THEED)	Base	Relatively Benign
Polymeric Material (Higher molecular weight analogs of THEED)	Base	Relatively Benign

Compounds That Could Analyze as Excess Nitrogen

Polymeric Material (Higher molecular weight analogs of THEED)	Inert	Relatively Benign
Formamide (DEAF or NFDEA)	Inert	Benign
HEOXD (HE Oxazolidone)	Inert	Benign
Bicine (bis-hydroxyethyl glycine)	Inert	Corrosive

Examples of MDEA Degradation Products Containing Nitrogen

Compounds that Could Analyze as Amine Deficiency

DEA	Base	Benign
MMEA	Base	Benign
Polymeric Material (Low molecular weight analogs of THEED & DMHEED)	Base	Relatively Benign
Polymeric Material (Higher molecular weight analogs of THEED and DMHEED)	Base	Relatively Benign

Compounds That Could Analyze as Excess Nitrogen

Polymeric Material (Higher molecular weight analogs of THEED and DMHEED)	Inert	Relatively Benign
Formamide (DEAF or NFDEA)	Inert	Benign
Bicine (bis-hydroxyethyl glycine)	Inert	Corrosive
HE Sarcosine (hydroxyethyl methylglycine)	Inert	Corrosive

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