



ON-THE-RUN REFINERY MAIN AMINE UNIT CONVERSIONS FROM 2-AMINOETHOXYETHANOL TO MDEA-BASED UCARSOL™ LE 777 SOLVENT

Brimstone Symposium

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AGENDA

1. SYSTEM OVERVIEW
2. DRIVER FOR SOLVENT CHANGE
3. SOLVENT SEARCH
4. ON-THE-RUN CONVERSIONS FROM 2-AMINOETHOXYETHANOL TO UCARSOL™ LE 777 SOLVENT
5. OPERATIONAL IMPROVEMENTS



Amine System Overview

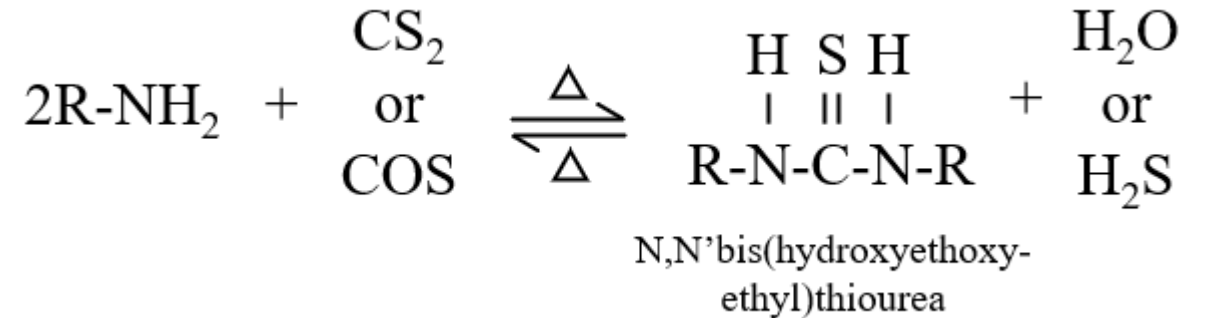
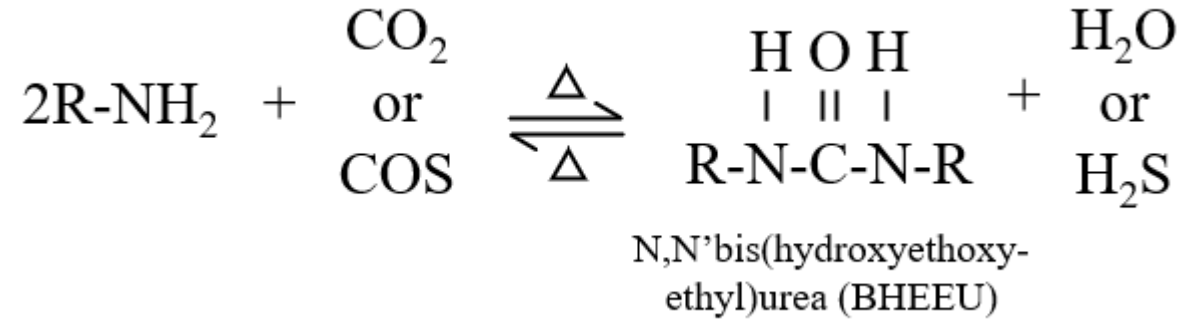
- Large Gulf Coast Refinery
- Conversion completed on two main amine systems (Unit A and Unit B)
 - Units have solvent cross-over capability
- Unit A: tight liquefied petroleum gas sweetening limit for total sulfur (COS and Mercaptan)



DRIVER FOR SOLVENT CHANGE

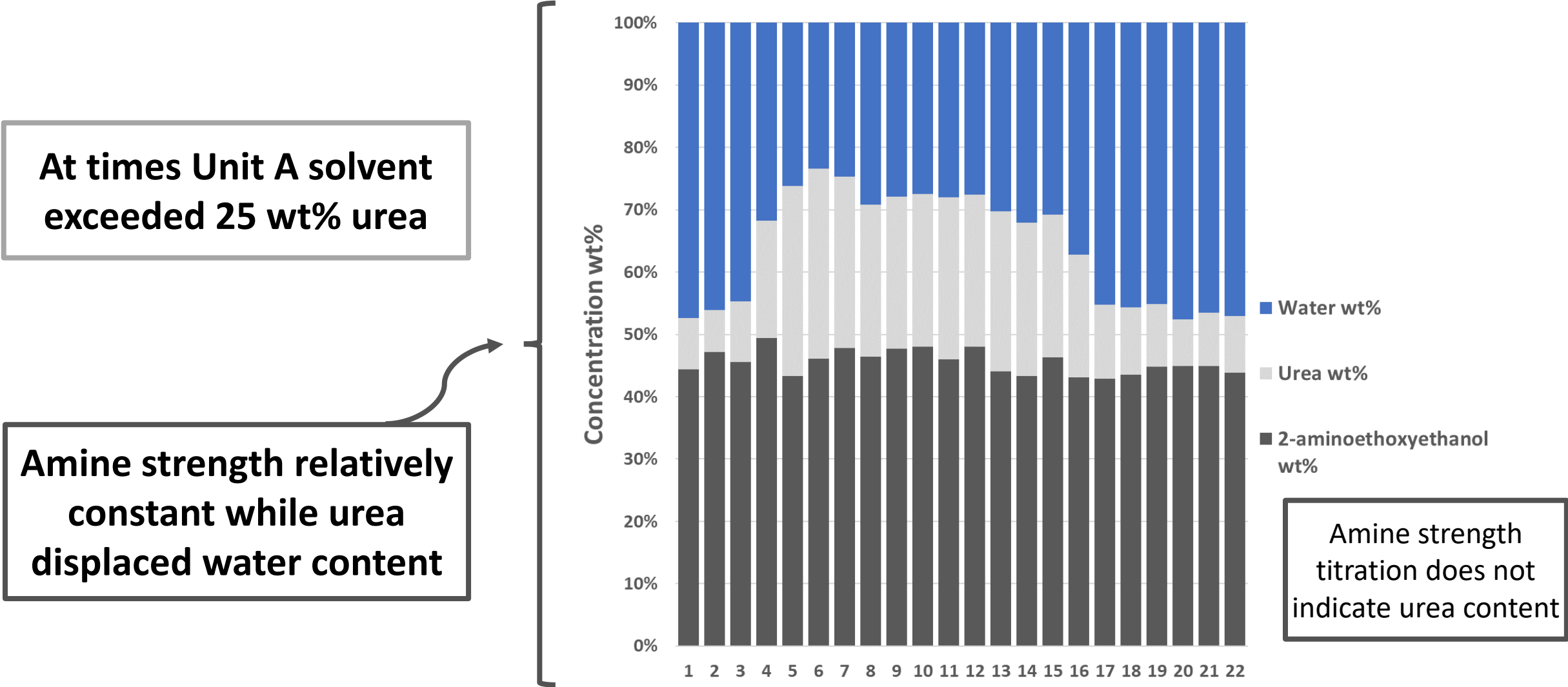
DEGRADATION PRODUCTS

2-aminoethoxyethanol forms urea compounds in the presence of CO₂ and COS



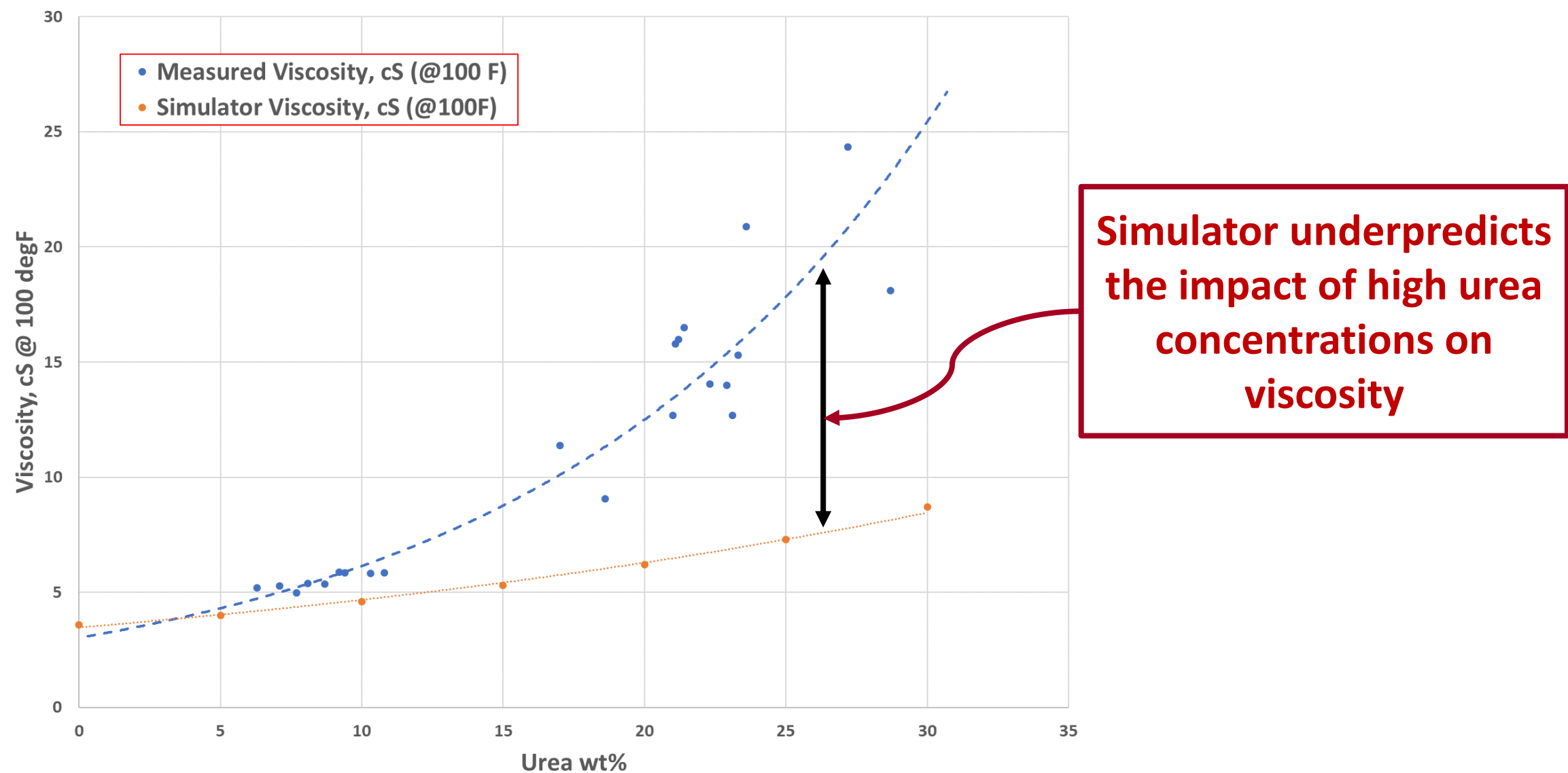
1. Kohl, Arthur and Nielsen, Richard. (1997). *Gas Purification* (5th Ed, pp. 165, 225-226, 233, 239, 241). Gulf Publishing Company.

UREA IN THE 2-AMINOETHOXYETHANOL UNITS



The graphic representations are presented here for illustrative purposes only and should not be construed as product specifications.

UREA IMPACT ON AMINE VISCOSITY

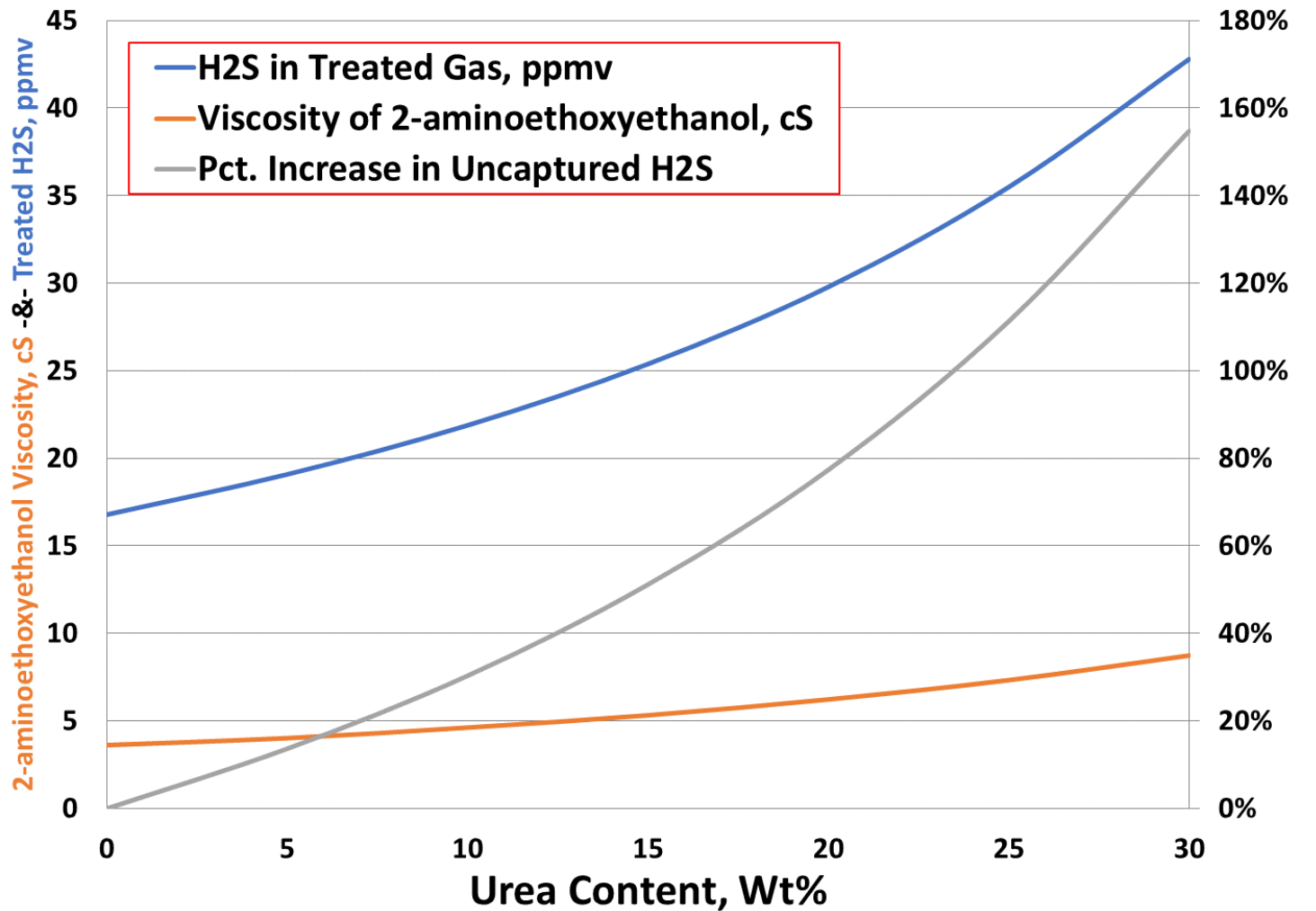


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UREA IMPACTS AMINE VISCOSITY AND ACID GAS TREATING

Amine solvents with higher viscosity exhibit:

- Higher amine losses
- Increased carry under of LPG from the contactors
- Reliability issues for pumps and higher operating temperatures in the regenerator.²



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1. Kohl, Arthur and Nielsen, Richard. (1997). *Gas Purification* (5th Ed, pp. 165, 225-226, 233, 239, 241). Gulf Publishing Company.



SOLVENT SEARCH

DOW'S LABORATORY PILOT PLANTS



Dow's in-house liquid treater pilot plant



Dow's in-house gas treating pilot plant

GAS TREATING PILOT PLANT RESULTS

UCARSOL™ LE 777 Solvent and 2-aminoethoxyethanol comparable for H₂S, CO₂, COS, and total mercaptan removal

Parameter	Units	Case #1		Case #2	
		2-aminoethoxyethanol	LE 777	2-aminoethoxyethanol	LE 777
L/G	cc/L	3.3	3.3	2.3	2.3
Rich H ₂ S	mol/mol	0.13	0.13	0.18	0.18
H ₂ S	% removal	99.95	99.93	99.94	99.90
CO ₂	% removal	96.28	97.32	97.84	97.80
COS	% removal	100	100	100	100
C ₁ SH	% removal	87.15	72.29	70.95	56.63
C ₂ SH	% removal	44.42	46.53	31.78	37.22
n-C ₃ SH	% removal	34.48	36.11	20.69	30.56
Total Mercaptan	% removal	54.29	52.54	40.75	41.79

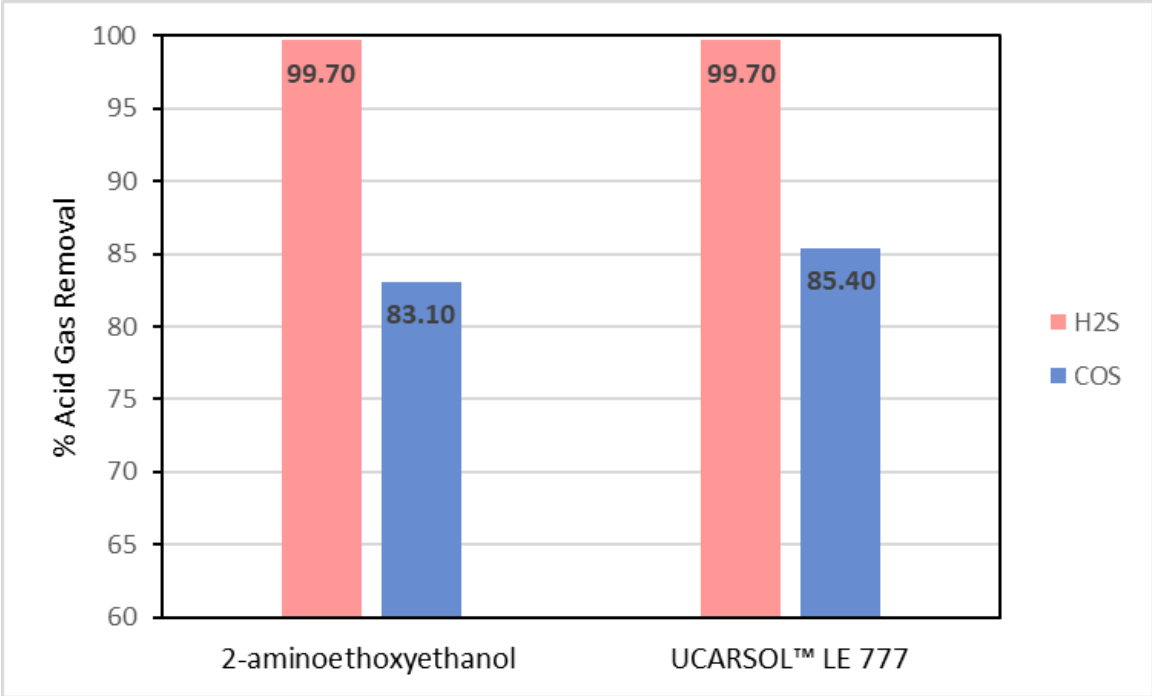
UCARSOL™ LE 777: greater removal capacity of higher molecular weight mercaptans

2-aminoethoxyethanol: exhibits a slight advantage in methyl mercaptan removal

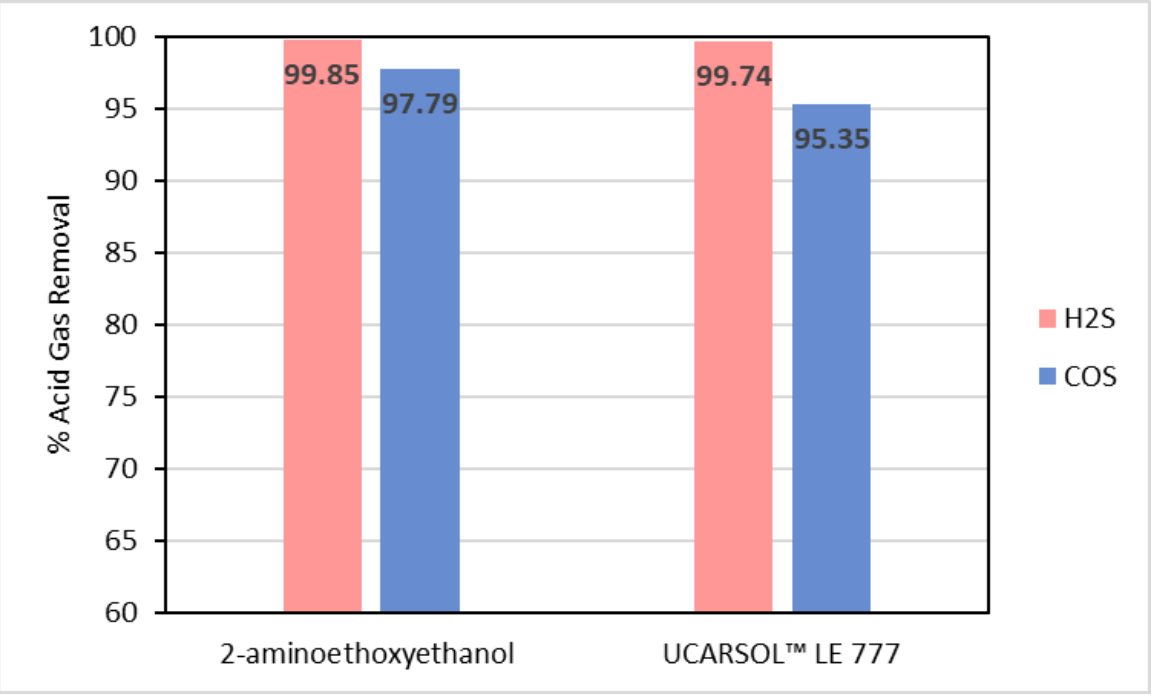
LIQUID TREATER PILOT PLANT RESULTS – COS STUDY

Both UCARSOL™ LE 777 Solvent and 2-aminoethoxyethanol achieve comparable H₂S and COS removal

**2 mol% H₂S
100 ppm COS**



**7 mol% H₂S
400 ppm COS**

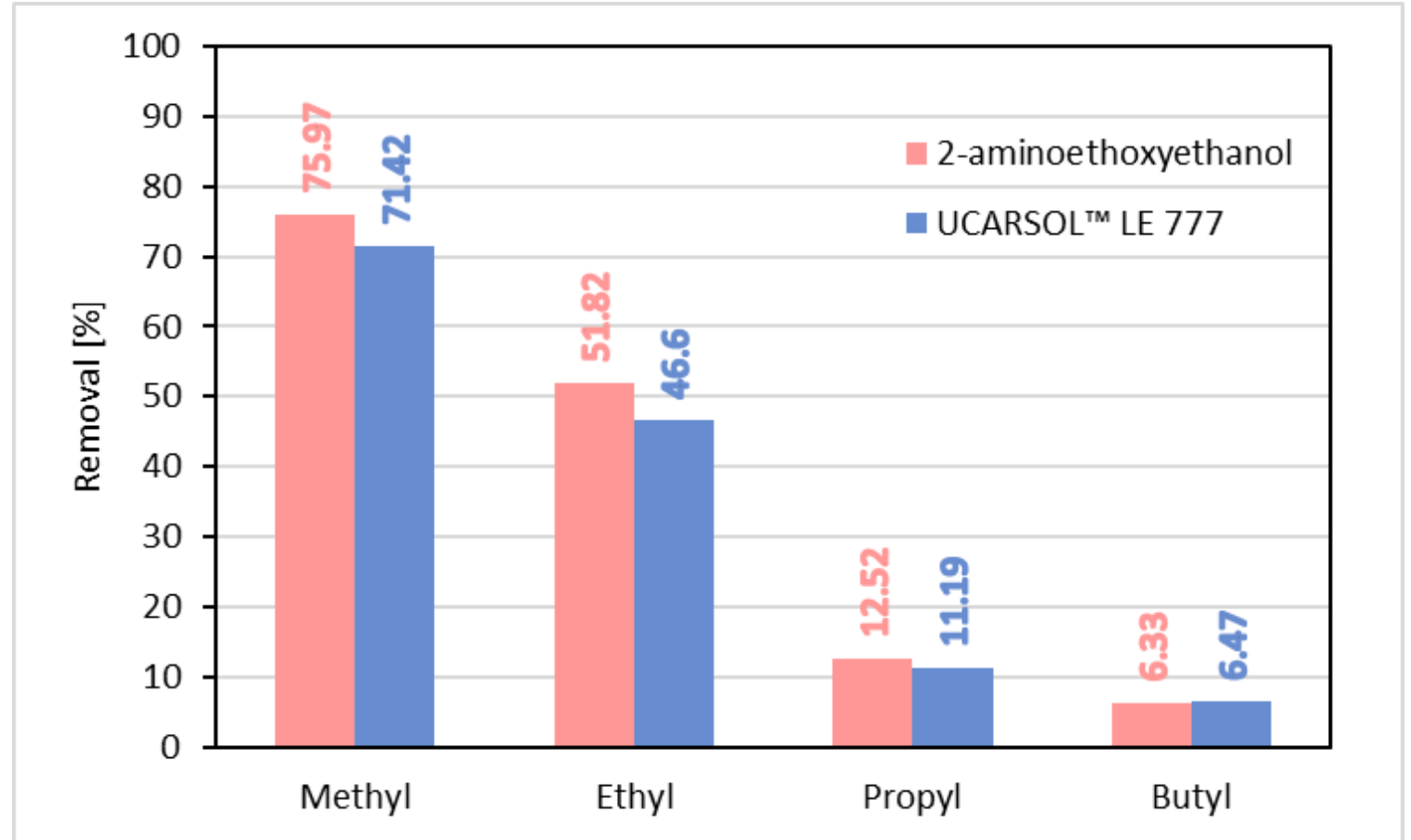


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LIQUID TREATER PILOT PLANT RESULTS – MERCAPTAN STUDY

UCARSOL™ LE 777 Solvent mercaptan removal capacity comparable to 2-aminoethoxyethanol

- Both solvents exhibit lower removal capacity for higher molecular weight mercaptans
- 2-aminoethoxyethanol demonstrated a slightly higher affinity for low molecular weight mercaptans

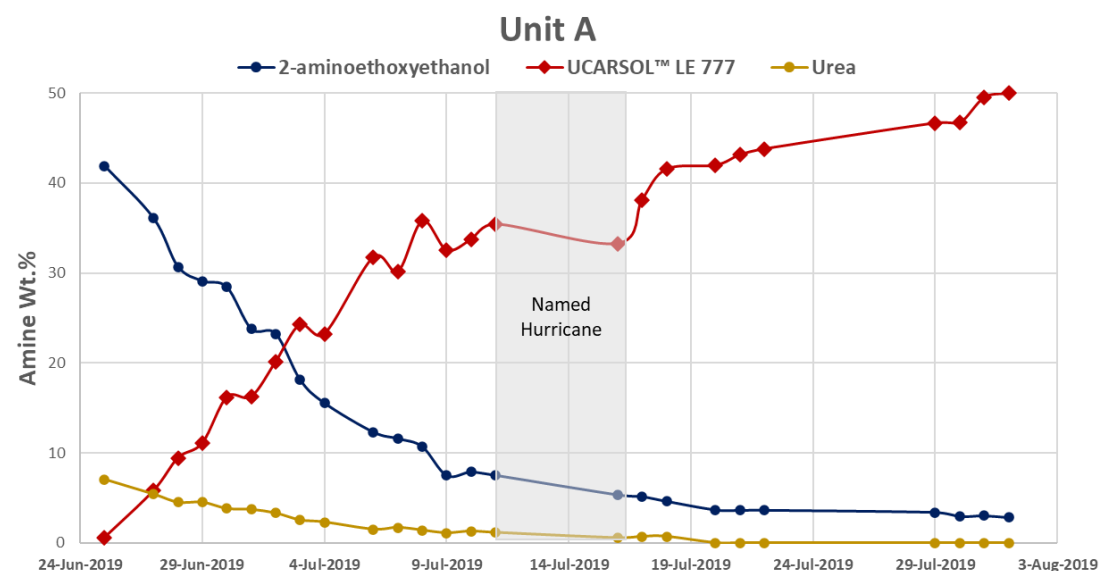
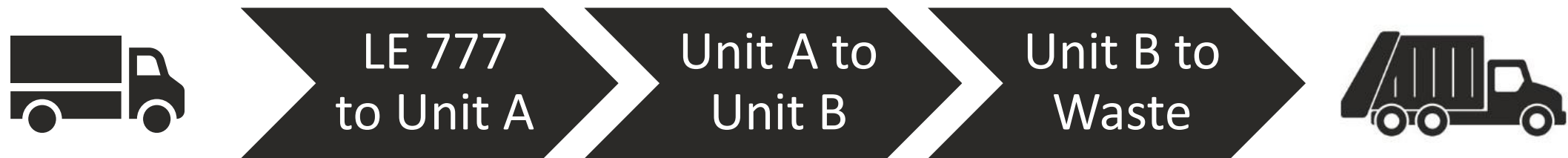


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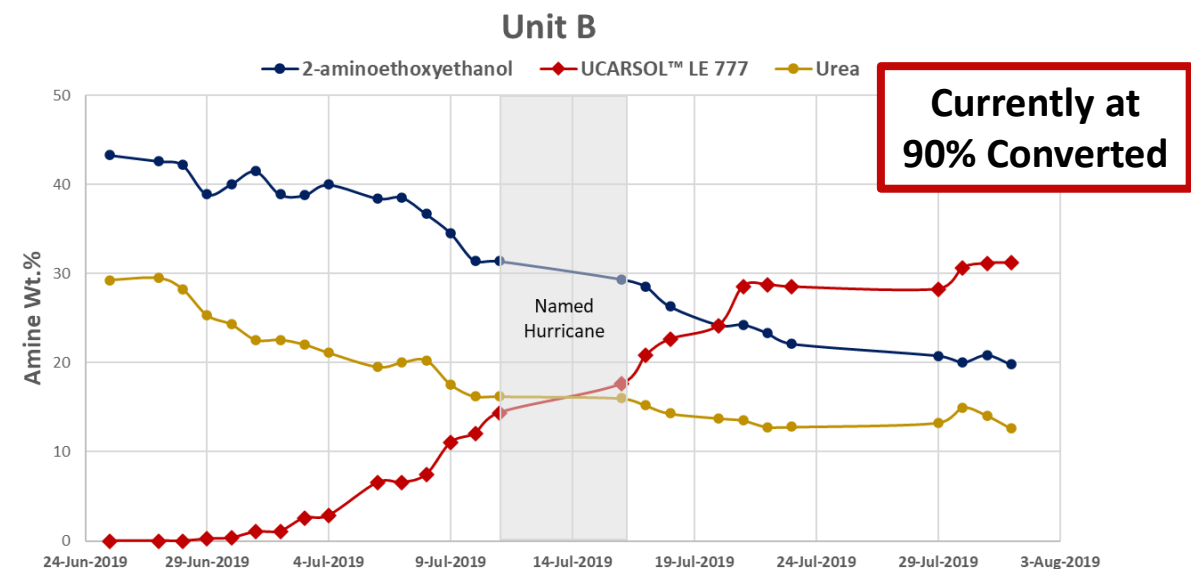


ON-THE-RUN CONVERSION FROM 2-AMINOETHOXYETHANOL TO UCARSOL™ LE 777 SOLVENT

STRATEGY FOR SOLVENT CONVERSION



Amine conversion for Unit A

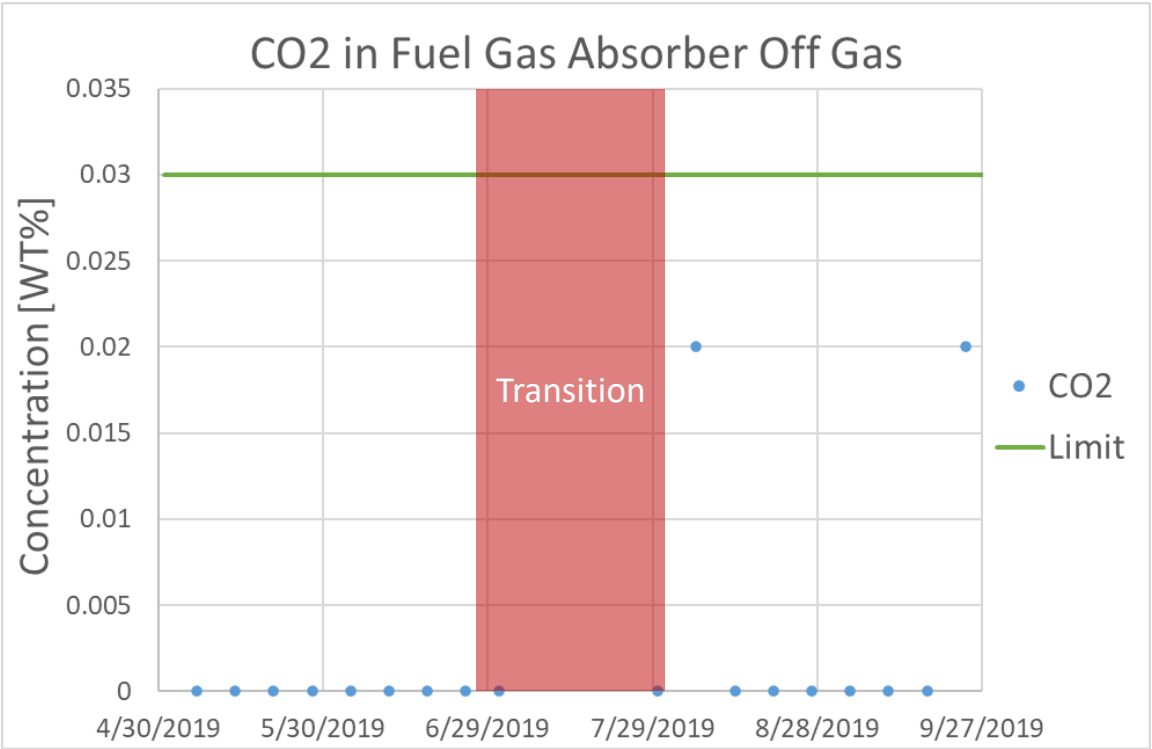
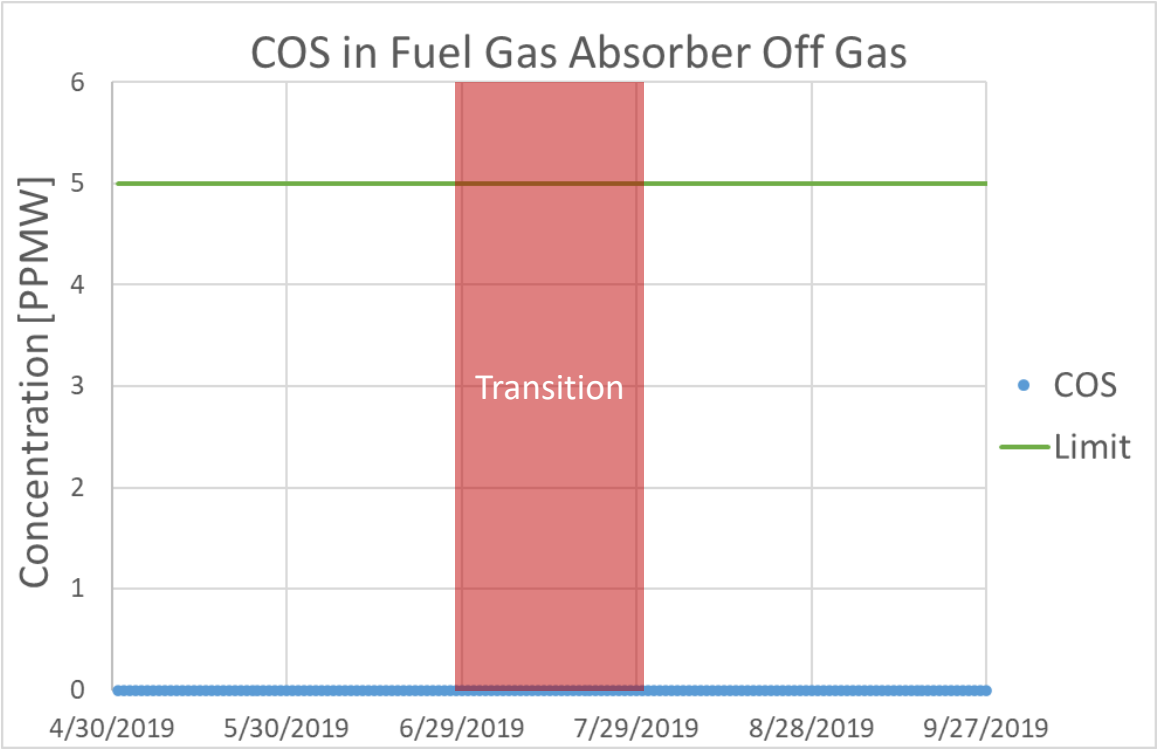


Amine conversion for Unit B

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STRATEGY FOR SOLVENT CONVERSION

No off-specification events in any of the absorbers circulating with these regenerators!



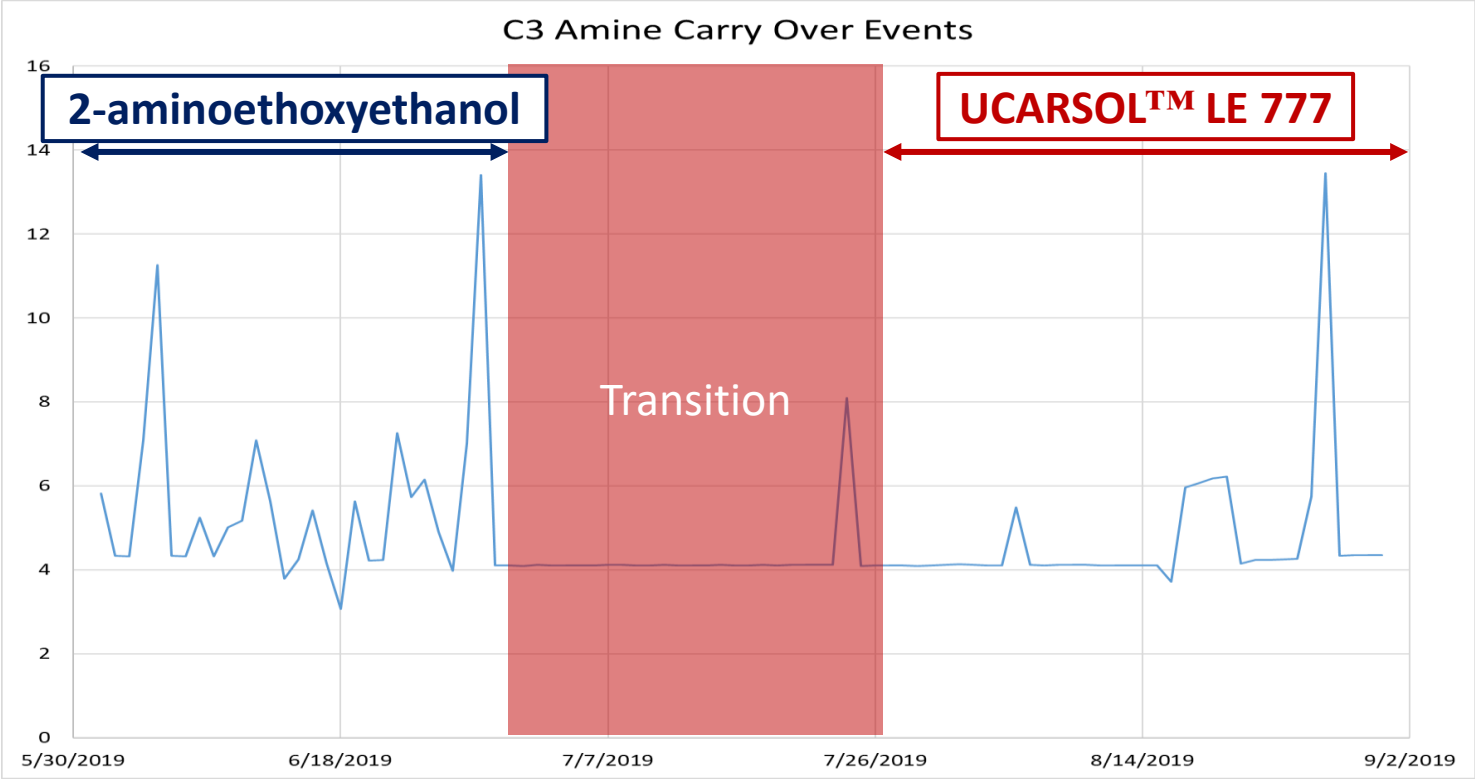
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OPERATIONAL IMPROVEMENTS

REDUCED AMINE LOSSES AND THIRD-PARTY RECLAMATIONS

Improved Liquified Petroleum Gas Absorber Operation



**50% reduction in
total system amine
solvent losses**

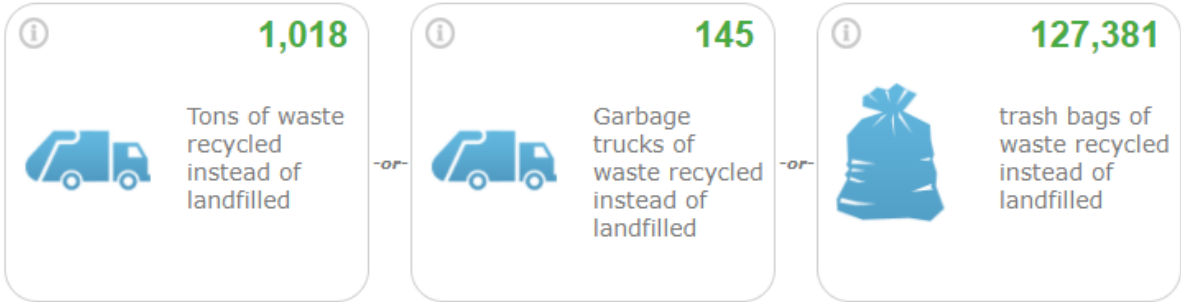
Plus \$700K in annual cost savings from reduced third-party reclamations

REALIZED ENERGY SAVINGS

Reduced reboiler duty for
amine regenerators
+
Thermal reclaimers shutdown

Parameter	Units	Value
Net Energy Reduction	B BTU/yr	56.5
Percent Reduction	%	8.3%
Emissions Reduction Equivalent	tons of CO ₂	3300

Greenhouse gas emissions avoided by



Carbon sequestered by



Greenhouse gas equivalencies for the realized energy savings³

2. U.S. Environmental Protection Agency (EPA). (July 8, 2021) *Energy and the Environment: Greenhouse Gas Equivalencies Calculator*. <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>.

REFERENCES

1. Kohl, Arthur and Nielsen, Richard. (1997). *Gas Purification* (5th Ed, pp. 165, 225-226, 233). Gulf Publishing Company.
2. U.S. Environmental Protection Agency (EPA). (July 8, 2021) *Energy and the Environment: Greenhouse Gas Equivalencies Calculator*.
<https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>.

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