Selective H_2S Removal

New promoter systems for amine solutions - A case study

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BASF *OASE*® Gas Treating Excellence
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Technologies & Applications

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OASE® GAS TREATING EXCELLENCE	purple	Natural Gas, LNG
OASE® GAS TREATING EXCELLENCE	white	Ammonia, Syngas
OASE® GAS TREATING EXCELLENCE	yellow	Sulfur Selective Treatment
OASE® GAS TREATING EXCELLENCE	green	Biogas
OASE® GAS TREATING EXCELLENCE	blue	Flue Gas

Content

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- Acidification of MDEA
  - Basis of Design
  - pH Profiles
- Case 1: Tailgas Treatment Unit
  - Working at the Edge
- Case 2: Natural Gas Treatment Unit (Sales Gas)
  - Summer / Winter Case
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Drivers for selective H_2S Removal

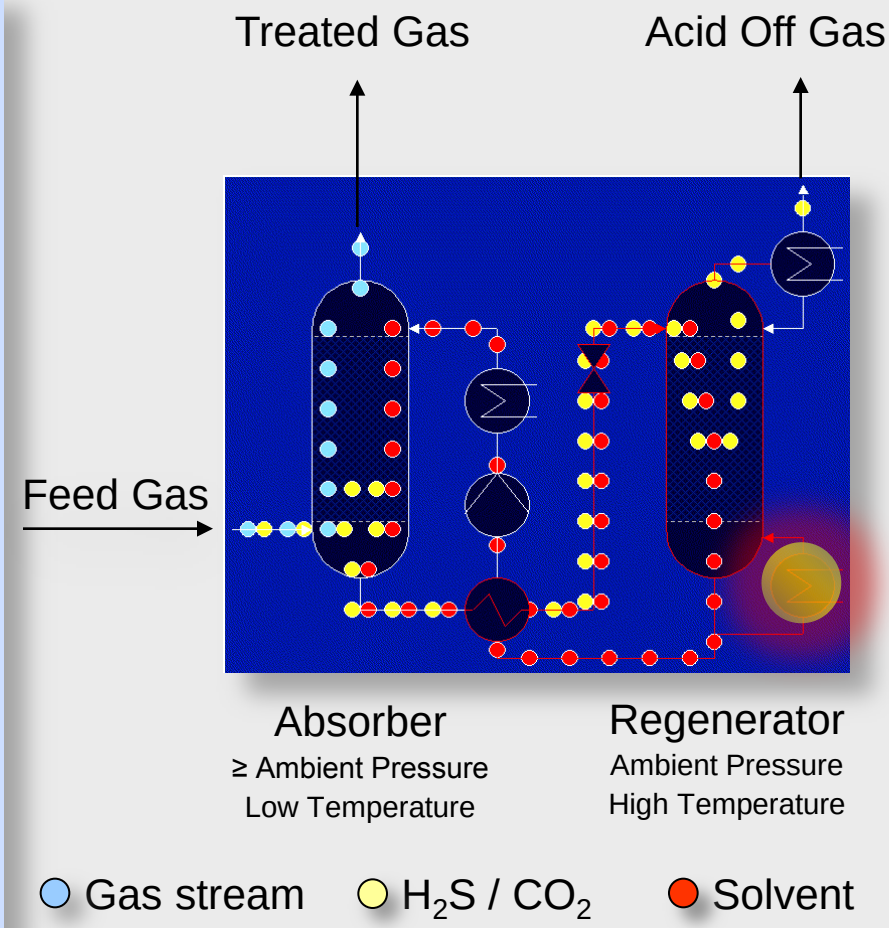
→ **H_2S / CO_2 Specifications in Treated Gas** (e.g. caloric value in sales gas)

→ **H_2S Concentration in Acid Off Gas** (=***A**cid **G**as **E**nrichment*, e.g CLAUS feed gas)

→ **Energy Considerations** (OPEX)

→ **Equipment Sizing** (CAPEX)

→ **Debottlenecking Measures**



MDEA
the standard amine for selective H_2S removal

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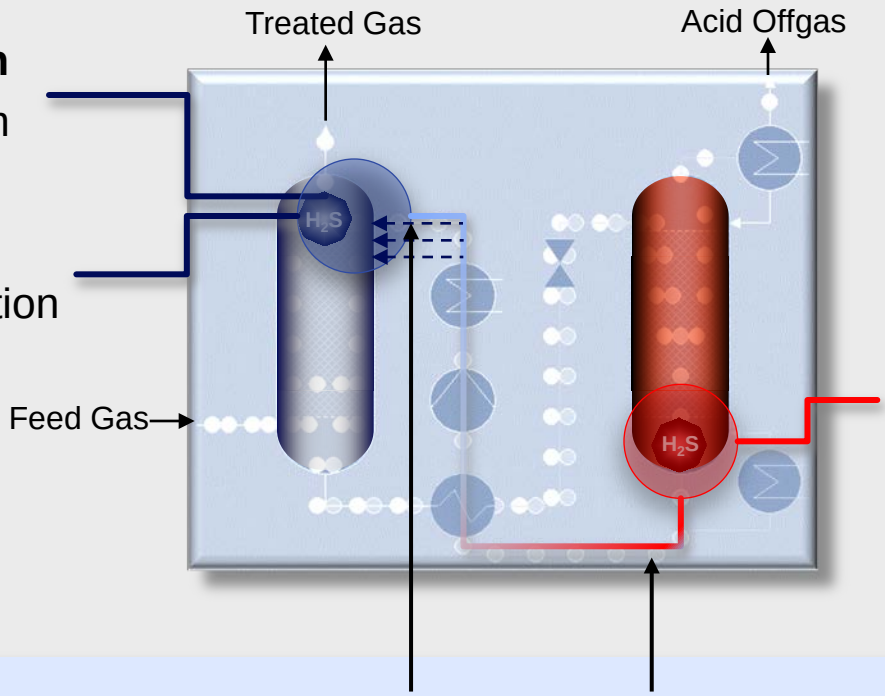
Characteristics

		H_2S Selectivity	Kinetics (low p.p.)	Binding Energy	Corrosion Issues
		Low	Fast	High	High
Monoethanolamine **MEA**	Primery Amines				
Aminodiethylhlycol **ADEG** (= DGA)	Primery Amines				
Diethanolamine **DEOA**	Secondary Amines				
Diisopropoanolamin **DIPOA**	Secondary Amines				
Methyldiethanolamine **MDEA**	Tertiary Amines				
		High	Slow	Low	Low

Acidification of MDEA / Basis of Design

H_2S Specification
→ H_2S Equilibrium

H_2S Selectivity
→ CO_2 Coabsorption



H_2S Lean Loading
→ Acidification

$HS^- + MDEAH^+ \leftrightarrow H_2S + MDEA$

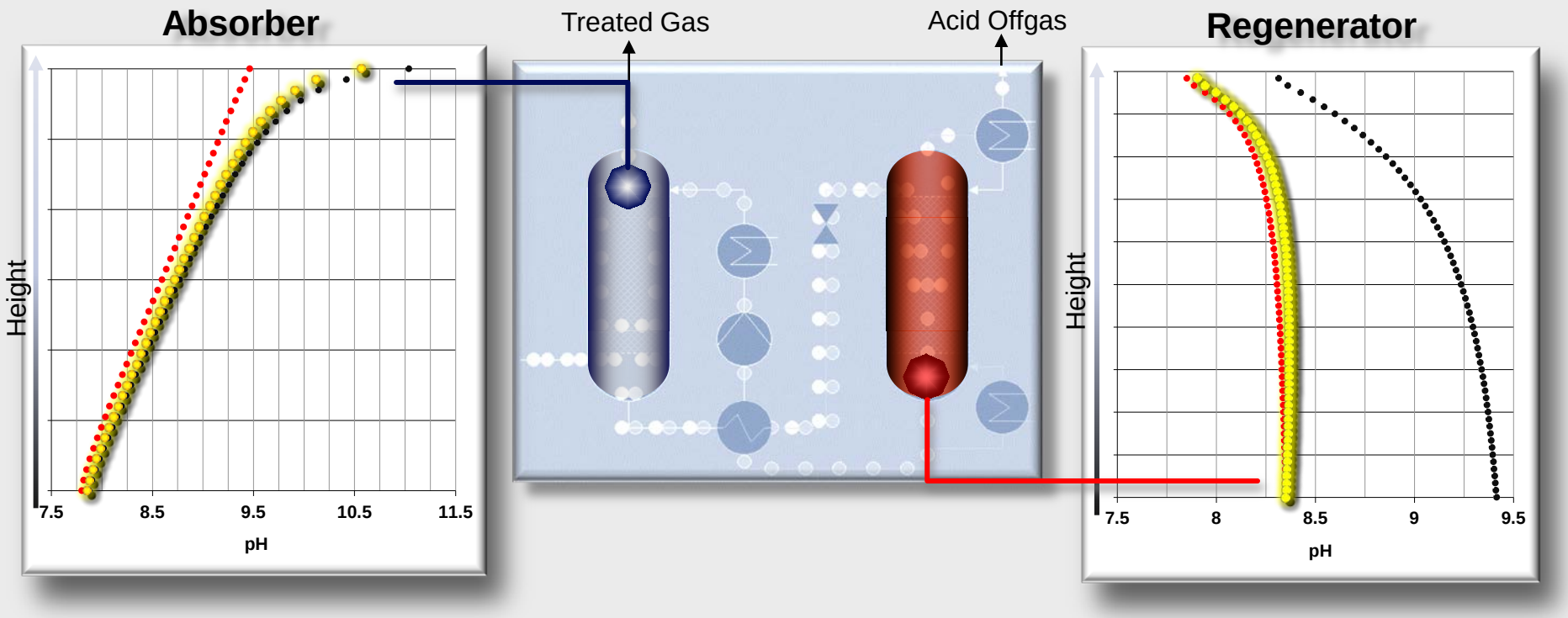
$HCO_3^- + MDEAH^+ \leftrightarrow CO_2 + MDEA + H_2O$

negative impact on equilibrium load
increased sensitivity at severe conditions
limited flexibility in multiple absorber systems

rules energy demand
rules H_2S lean loading
“driving force” for H_2S specification

Acidification

Acidification / pH Profiles



MDEA | Acidified MDEA | Advanced Solvent

Case 1: Tailgas Treatment Unit working at the edge

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Feedgas

H_2S 1.2 % / CO_2 44 - 51 % / p ~16 psi, ~1.1 bara

Design Spec.

< 250 vppm H_2S

Design Spec.	**1st Revised Spec.**	**2nd Revised Spec.**	**?**
< 250 vppm H_2S	**< 100 vppm H_2S**	**< 50 vppm H_2S**	
MDEA Design Duty	Acidified MDEA Reduced Duty	Acidified MDEA Design Duty	Advanced Solvent slightly reduced duty

Adaptation of circulation rate required

Case 1: Tailgas Treatment Unit working at the edge

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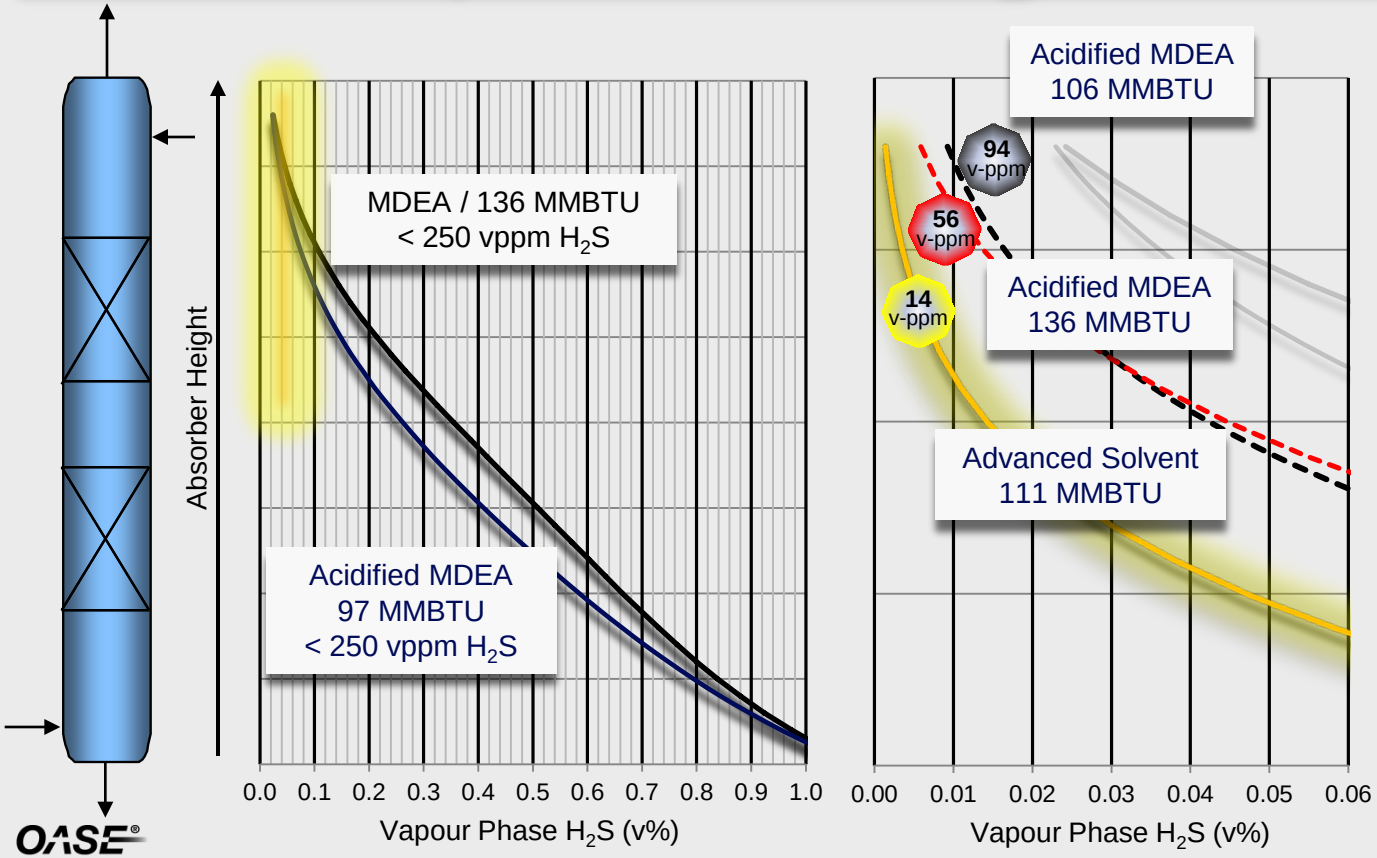
< 250 vppm H_2S

1st Revised Spec.
< 100 vppm H_2S

2nd Revised Spec.
< 50 vppm H_2S

?



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Case 1: Tailgas Treatment Unit working at the edge

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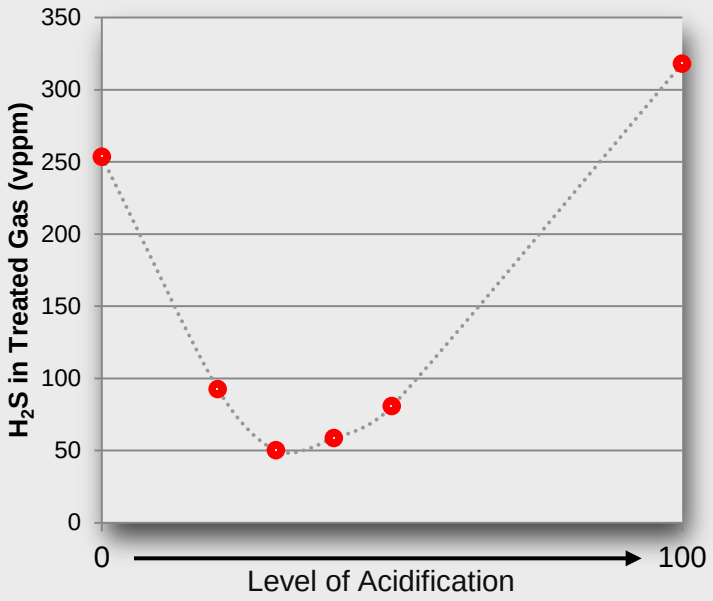

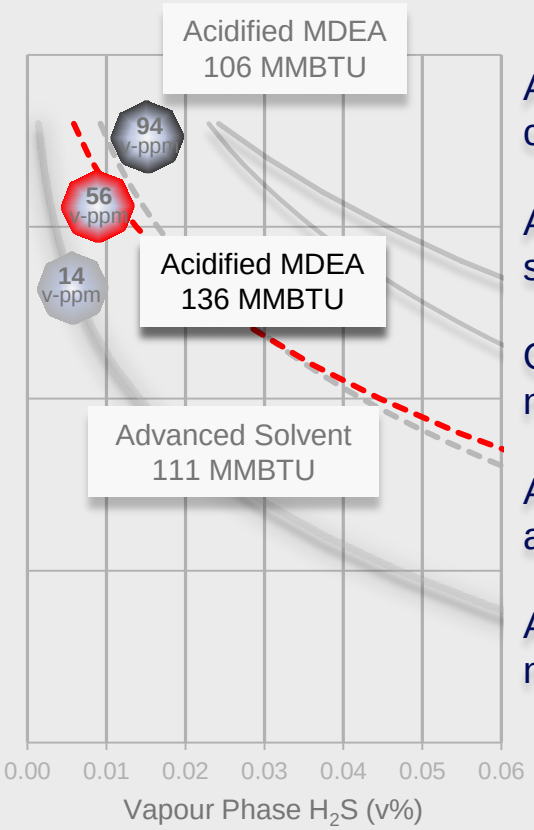

Acidification effective to a certain limit

Acidification may lead to high sensitivity on H_2S specification

Over-Acidification has a strong negative impact

Acidification requires adjustment of circulation rate

Advanced solvent overcomes negative impact on equilibrium

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Case 2: Natural Gas Treatment Unit winter/summer case

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Natural Gas	Feedgas	Treated Gas Spec.
	H_2S 4.0 % / CO_2 10.2 % / p ~609 psi	<5 vppm H_2S / <2v-% CO_2

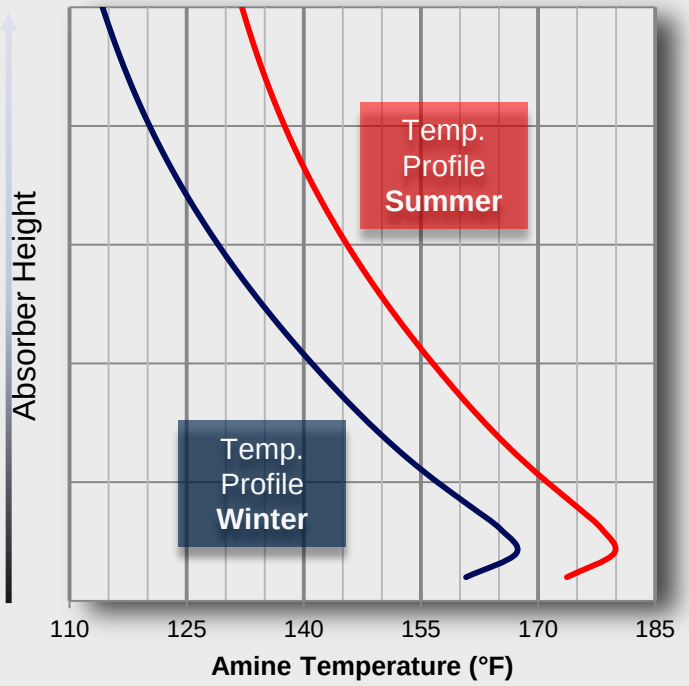
Winter Case

Lean Temperature	113°F (45°C)
Circulation Rate	799 USgpm (182 m^3/h)
Treated Gas Spec.	H_2S 4 vppm / CO_2 1.9 v%

Summer Case

Lean Temperature	132°F (55°C)
Circulation Rate	905 USgpm (206 m^3/h)
Treated Gas Spec.	H_2S **8** vppm / CO_2 2.0 v%

Absorber Temperature Profile →



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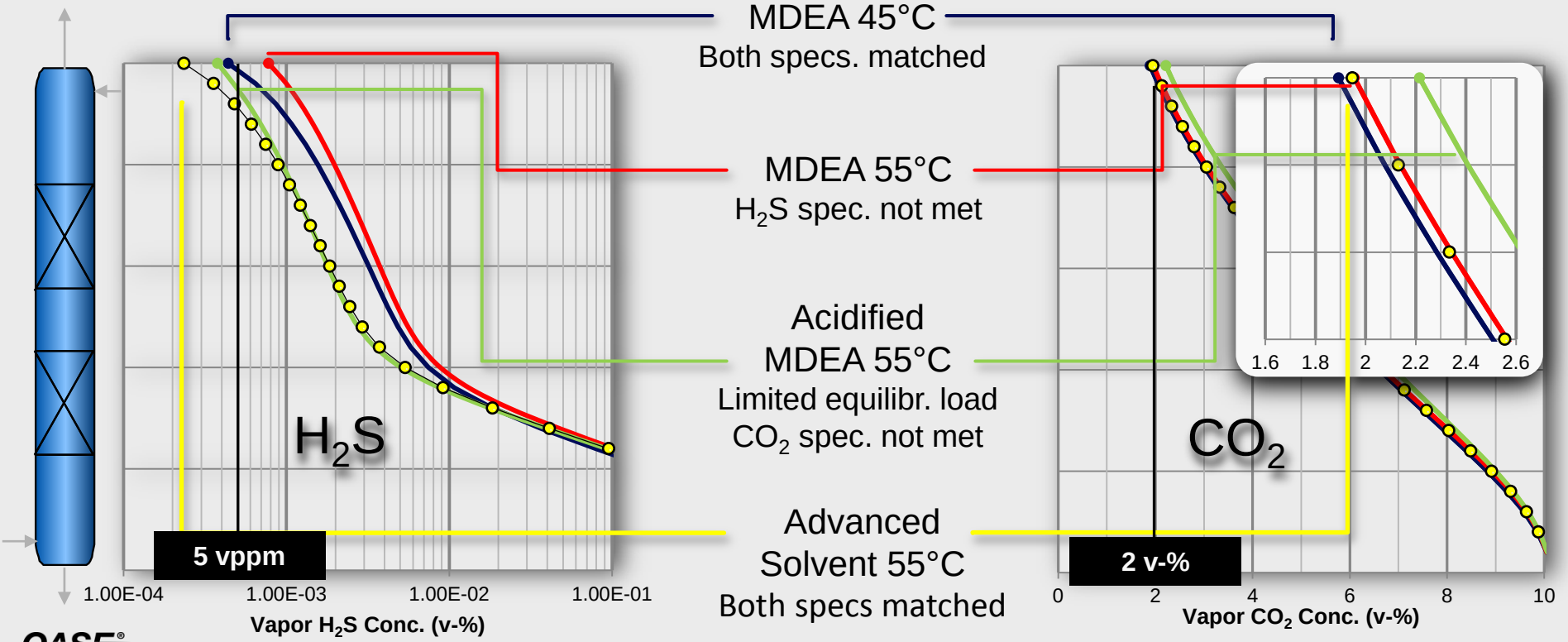
Case 2: Natural Gas Treatment Unit winter/summer case

Summer Case:

Countermeasures → higher Circ. Rate ✗ → higher Reboiler Duty ✗ → Acidification



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Summary

- **Tailgas Treatment:** tighter H_2S specifications required in future
- **Natural Gas:** adjustable CO_2 slip required for sales gas appl.
- **Matching specification** more severe at high amine temperature and low pressure
- **“Acidification”** is a common solution for selective H_2S removal
- **Acidified** amine systems are sensitive at severe conditions
- **Advanced solvent technology** overcomes constraints

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Many Thanks for your Attention

Questions?

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