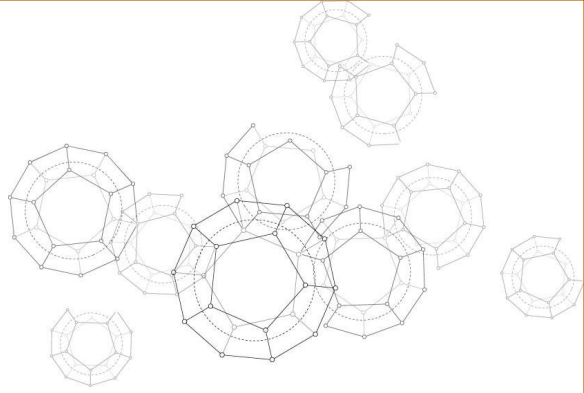

Improved Treatment Methodologies for Removing Low Concentrations of H_2S in South Texas Natural Gas Systems

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Introduction

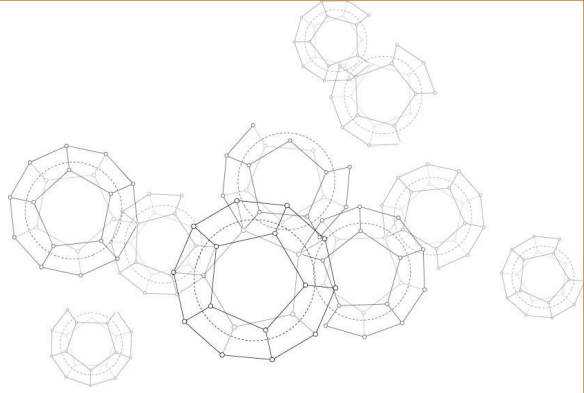
- Applies to any natural gas system
- Low H_2S concentrations <1000 ppm, often < 100 ppm
- Focus is on improving treating methodology using liquid scavengers
- Opportunity to build a system step-wise and evaluate
- Synergistic use of traditional treating methods
- A mass balance approach was used to evaluate the extent of reaction

Mass Balance

- Theoretical Capacity – Derived volume to mass (H_2S) ratio that the chemical scavenger can consume.
- Based on stoichiometric ratios derived from laboratory experimentation and mechanistic studies.
- Expressed:

  Liters liquid scavenger / Kg H_2S.

Mass Balance



- Actual Capacity: The process driven amount of H_2S removed per volume of liquid scavenger.

- Extent of Reaction: Ratio of Actual capacity versus Theoretical Capacity.

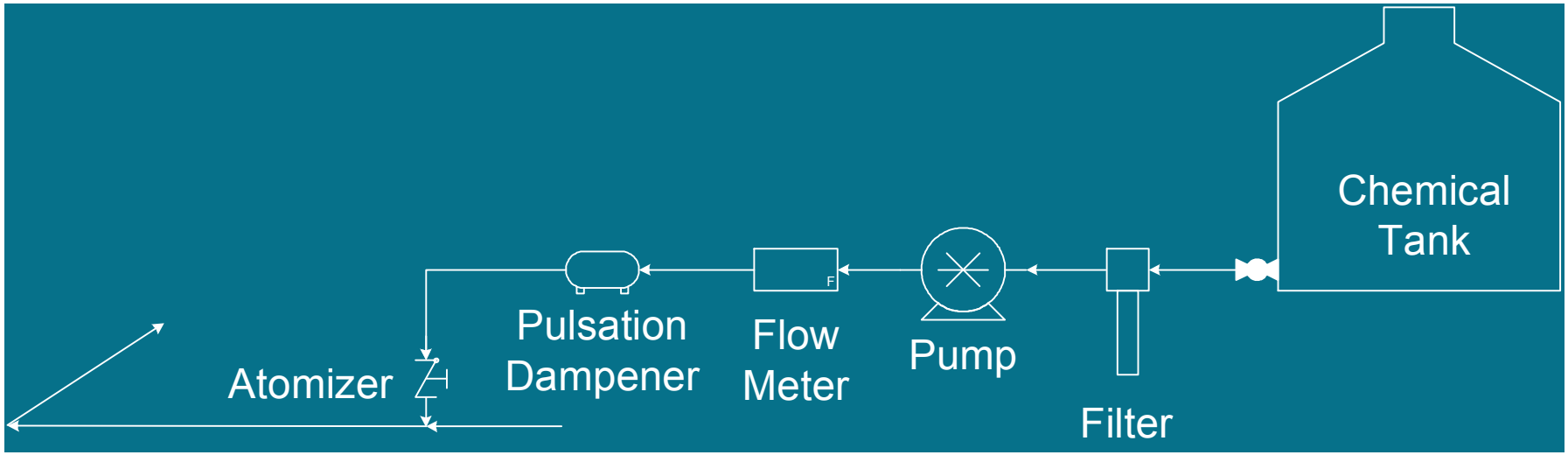
Mass Balance

Application Design	Typical Extent of Rxn
Single Point In-line Injection	30-60%
In-line Injection – with retention loop	40-75%
In-line Injection – with static mixer	40-65%
Contact Tower	50-60% Before Remediation

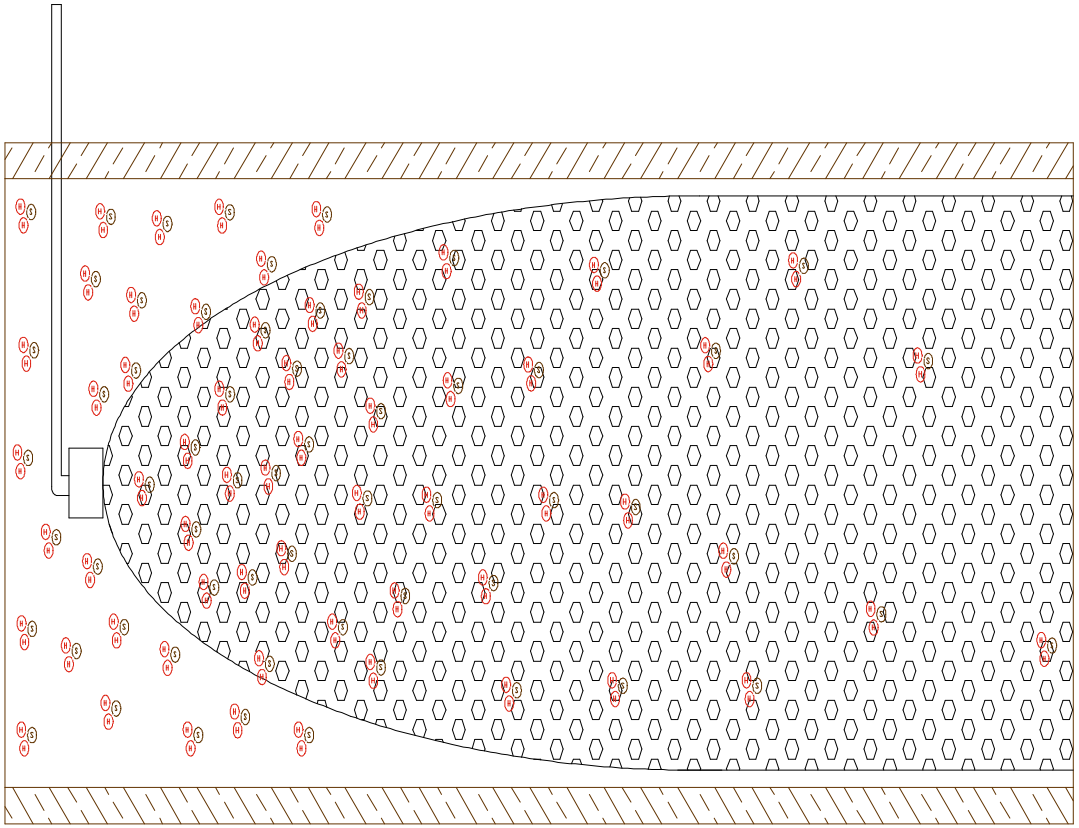
Single Point In-line Injection

Dependent Factors

- Flow Regime
- Velocity
- Retention Time
- Chemical Entrainment



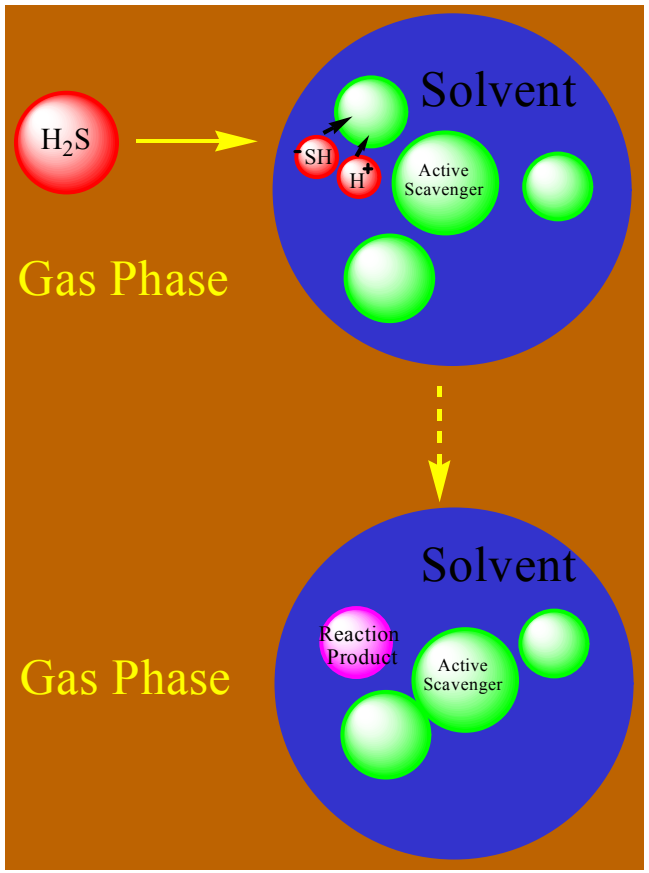
Chemical Entrainment



Dependent Factors

1. Droplet Size
2. Velocity
3. Reaction Surface Area

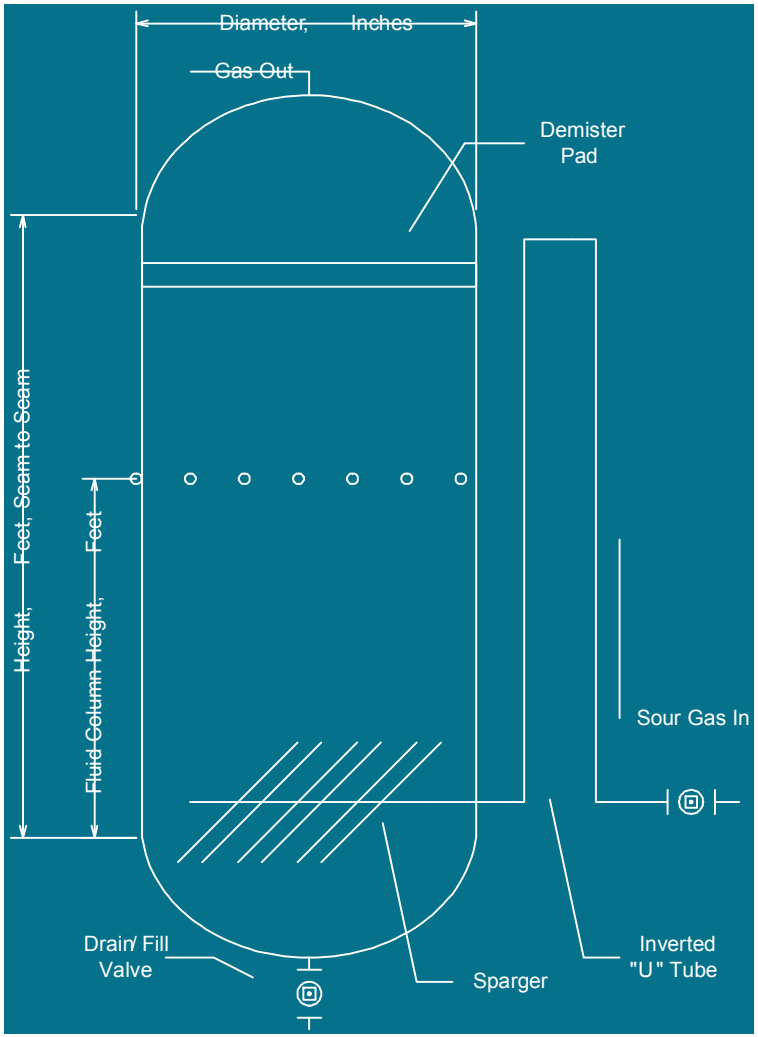
Transport Properties: In-Line Injection



Gas-Liquid Reaction

Mass transport driven by migration of H_2S to liquid-gas interface.

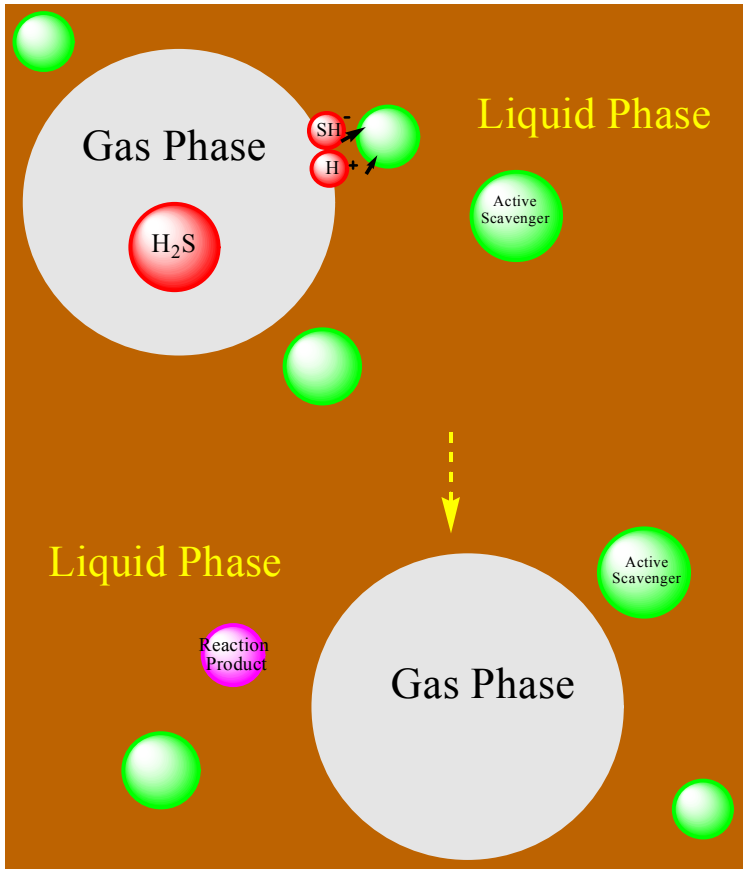
Contact “Bubble” Tower



Dependent Factors

- Retention Time
- Reactive Surface Area
- Remediation before spent

Transport Properties: Contact "Bubble" Tower



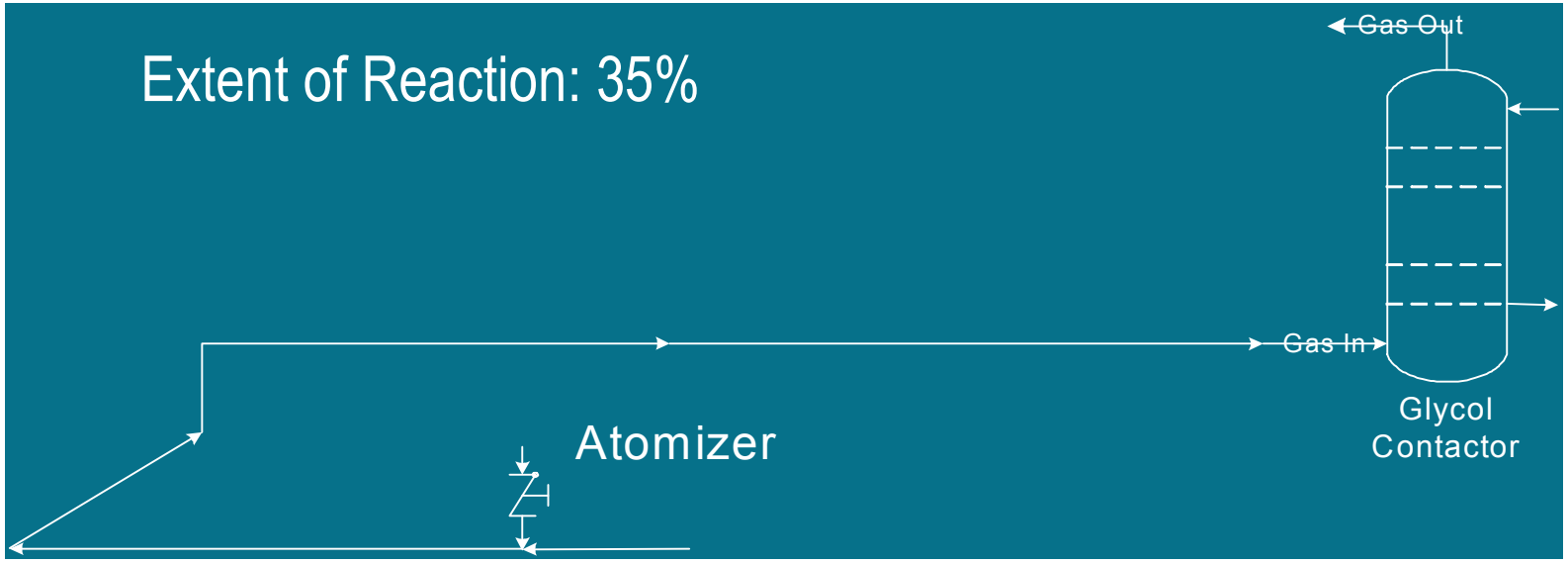
Gas-Liquid Reaction

Mass transport driven by the migration of H_2S to the liquid-gas interface.

Field Application Case Study

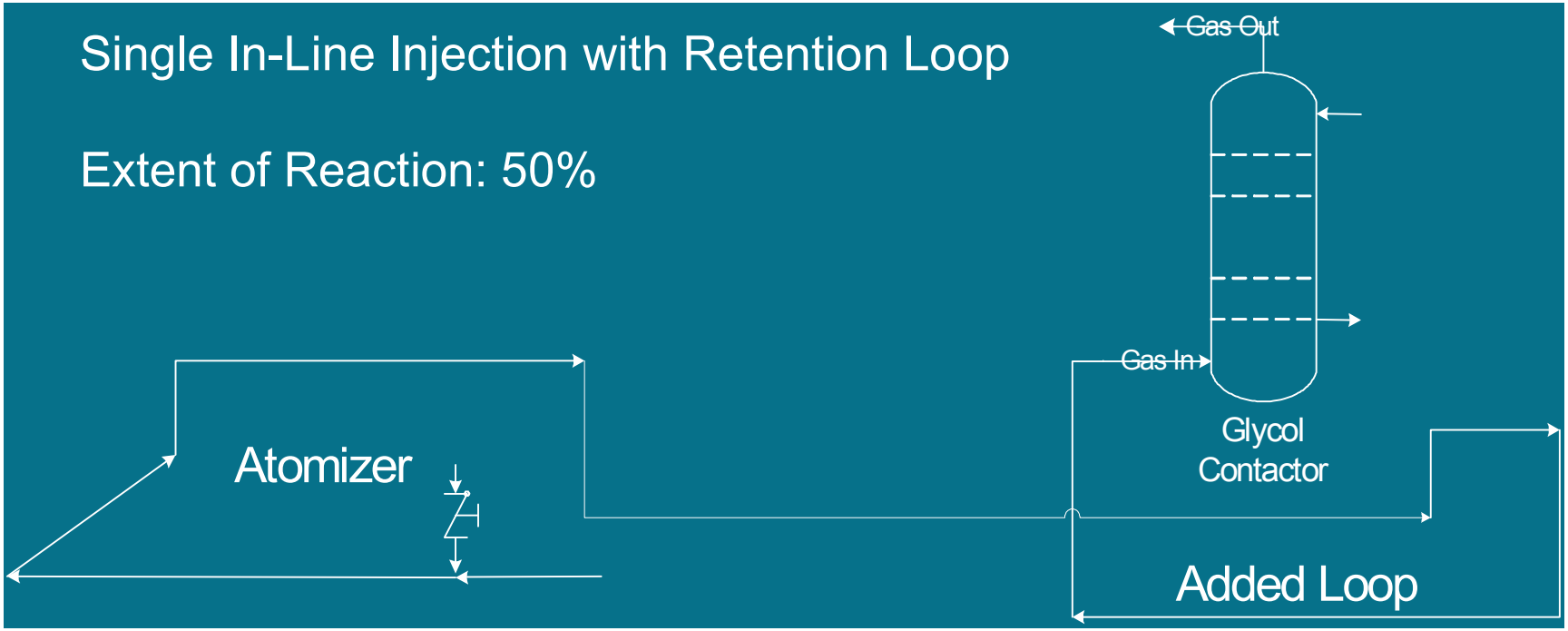
Single Point In-Line Injection

- 35 MMSCFD
- Gas Velocity: 8-10 ft/s
- Retention Time:10-15 sec
- Dewpoint: 10-12 lb H_2O/mmcf
- H_2S Inlet : 12-15 ppmv



Field Application Case Study

- 35 MMSCFD
- Gas Velocity: 20-25 ft/s
- Retention Time:16-20 sec
- H_2S Inlet : 12-15 ppmv

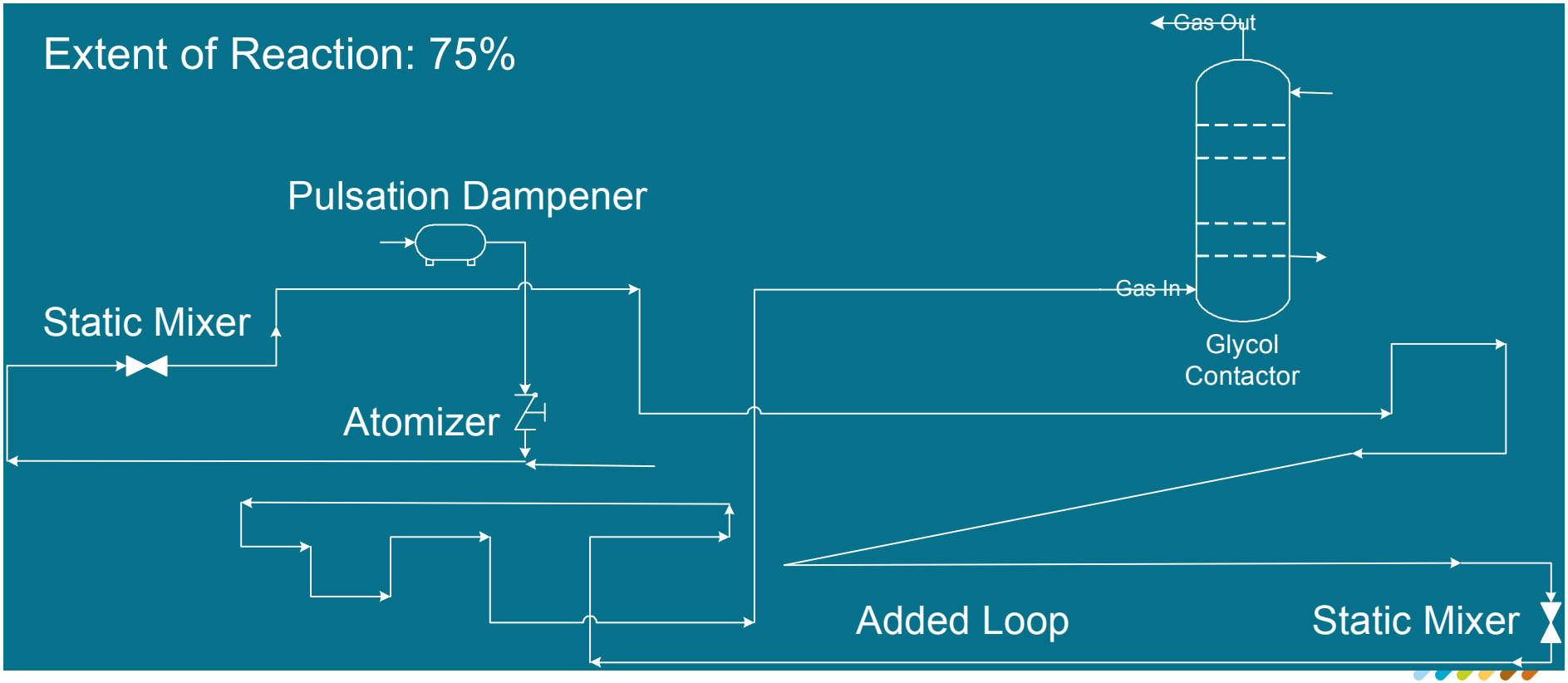


Field Application Case Study

Additional Modifications :

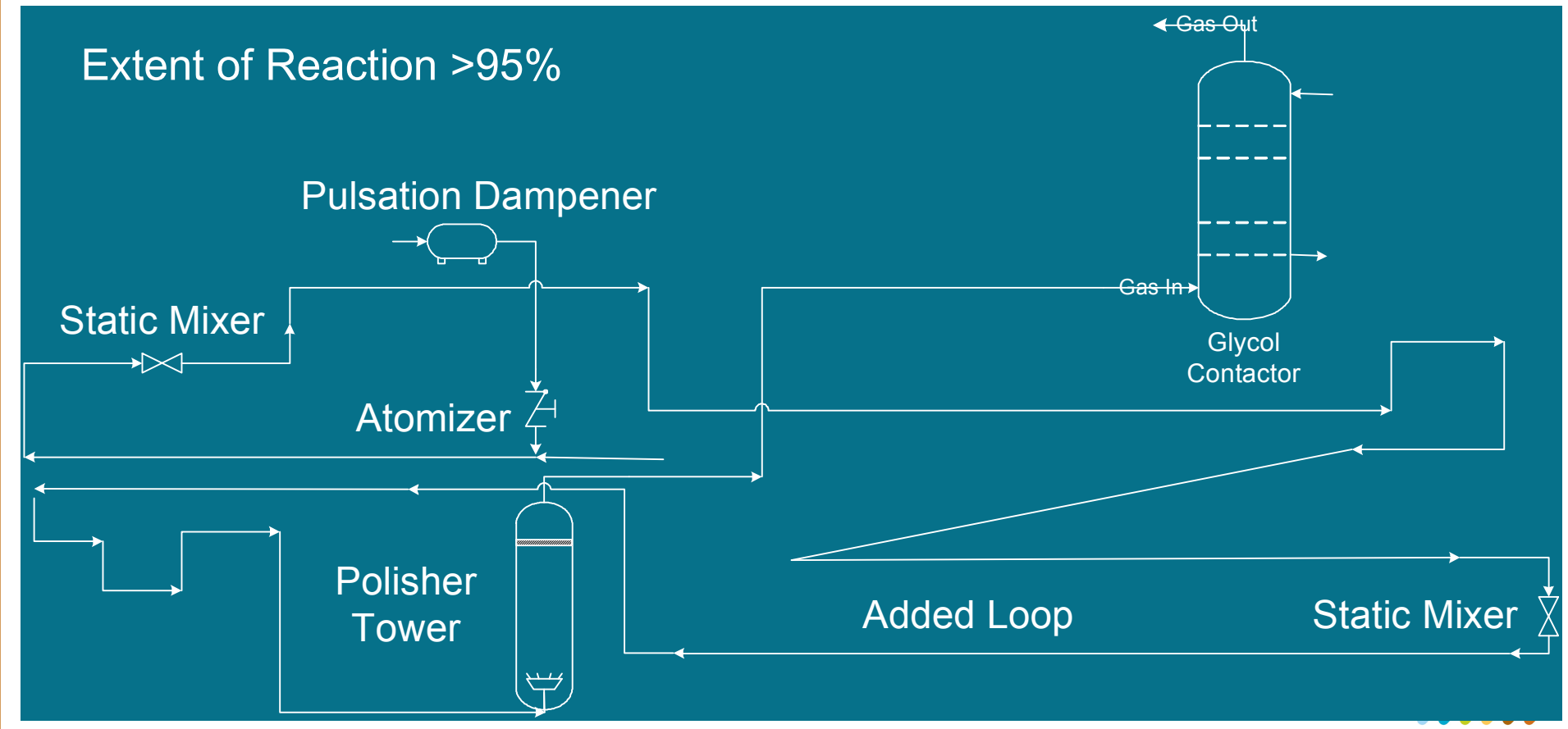
- **Retention Loop (Double) Length**
- **Pulsation Dampener**
- **2 Static Mixers**

- **35 MMSCFD**
- **Gas Velocity: 20-25 ft/s**
- **Retention Time: 35-40 sec**
- **H_2S Inlet : 12-15 ppmv**

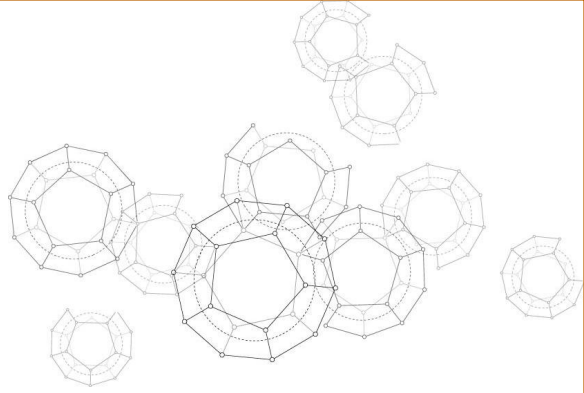


Field Application Case Study

Single In-line Injection With 2 Static Mixers, Retention Loop and Polishing Tower



Conclusions



- Extent of Reaction is enhanced and improved significantly by a synergistic configuration of traditional treating methods
- Improved system design – “the whole is greater than its parts”
- Dramatic decrease in treating costs using a liquid H_2S scavenger technology