
2025
UNVEILING THE MAGIC OF MIDSTREAM INNOVATION
GPA MIDSTREAM CONVENTION
Welcome!

Mitigation of H2S Spikes in Molecular Sieves Gas Drying

Arkema Molecular Sieves

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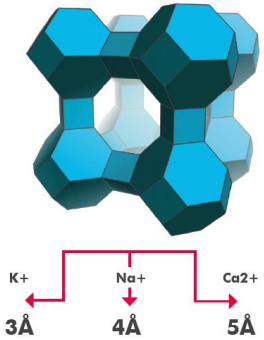
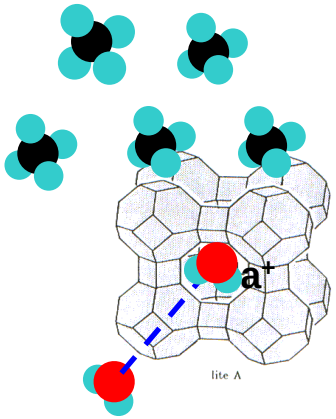
Introduction

- **Molecular sieves are used to dry gas to very low dew points (0.1 ppmv)**
- **Reliable, but not free of operational challenges (contamination, process limitations, process upsets)**
- **One of those challenges is H_2S spikes**
  - Off-spec gas
  - Disruption to downstream equipment
  - Metallurgy selection/corrosion
  - Dealumination of sieves
  - Safety concerns
- **H_2S spikes can be mitigated**
  - Operation
  - Design

What are Molecular Sieves?

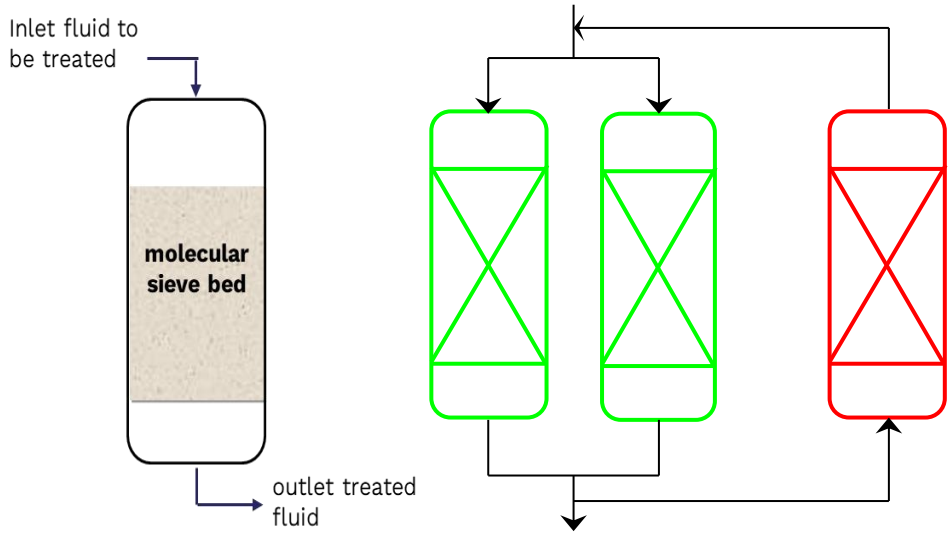
- **Zeolite based adsorbents**
  - Crystalline structure with pores/channels
  - Electronic Activity
  - Large Surface Area
- **Zeolite + binding clay → MS Beads/Pellets**
  - Type
  - Grade
  - Pore Size
  - Media Size
- **Separate impurities from fluid**





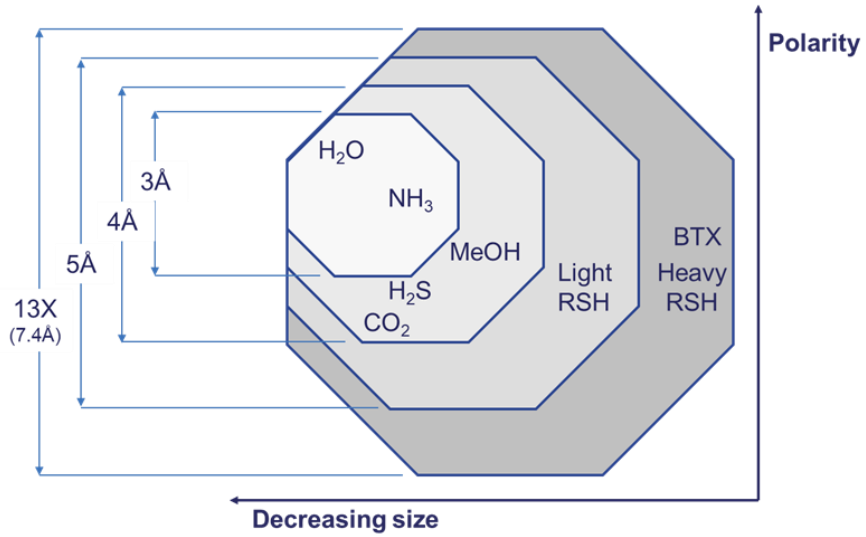
Industrial Adsorption

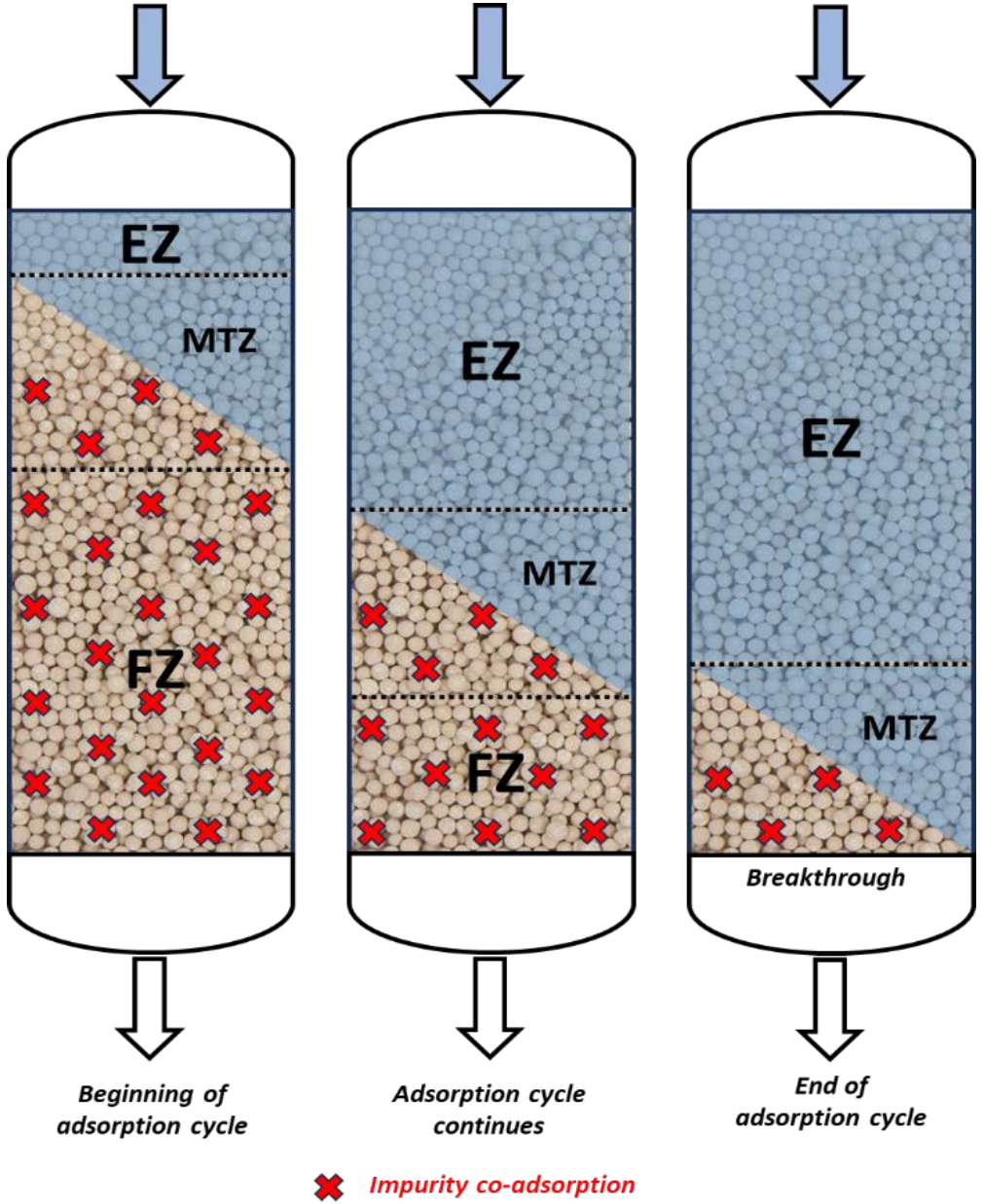
- **MS Beads/Pellets loaded into fixed beds (2+)**
- **Adsorption**
  - Capacity – equilibrium and dynamic capacity
  - Fixed or BT cycles
- **Regeneration (desorption)**
  - Slip stream/alternate gas
  - High temperature
  - Cooling step



Adsorption Zones

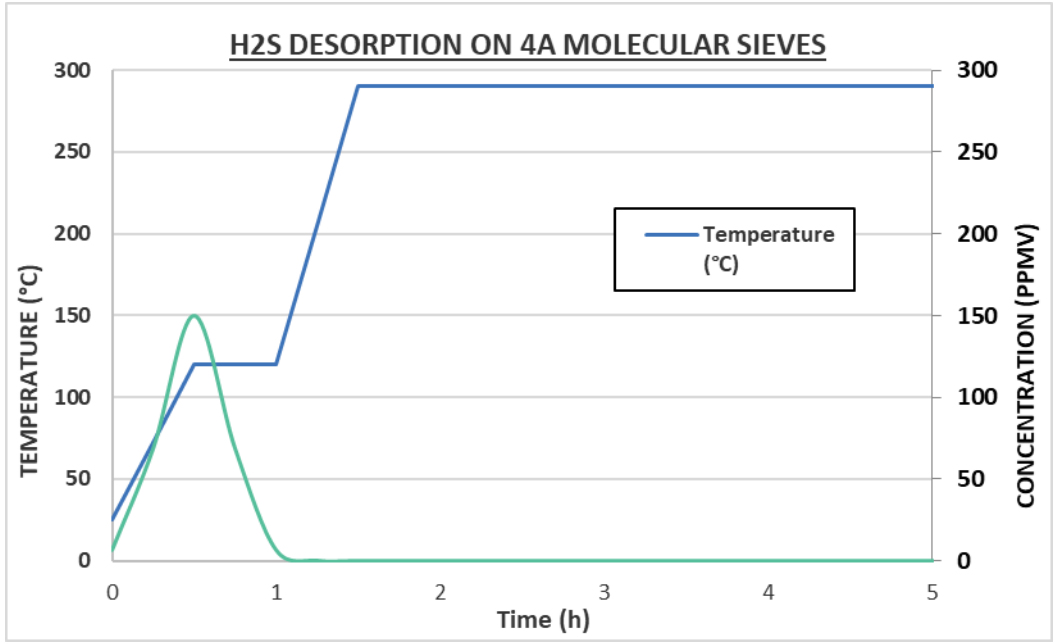
- **Adsorption Zones**
  - Equilibrium (EZ)– saturated with impurities
  - Mass Transfer (MTZ)– concentration gradient
  - Fresh (FZ) – unused portion of bed
- **Zone Evolution**
- **Water – smallest, most polar**





H2S Desorption Peak

- **Use of 4A molecular sieves**
  - Efficiency (capacity and regeneration)
  - H2S can co-adsorb in the MTZ & FZ
- **Desorption Peak**
  - H_2S desorbs more easily than water
  - Peak Occurs around 80 – 120°C (176 – 248°F)
  - 5 -10 ppmv H2S in feed → 100 – 150 ppmv peak

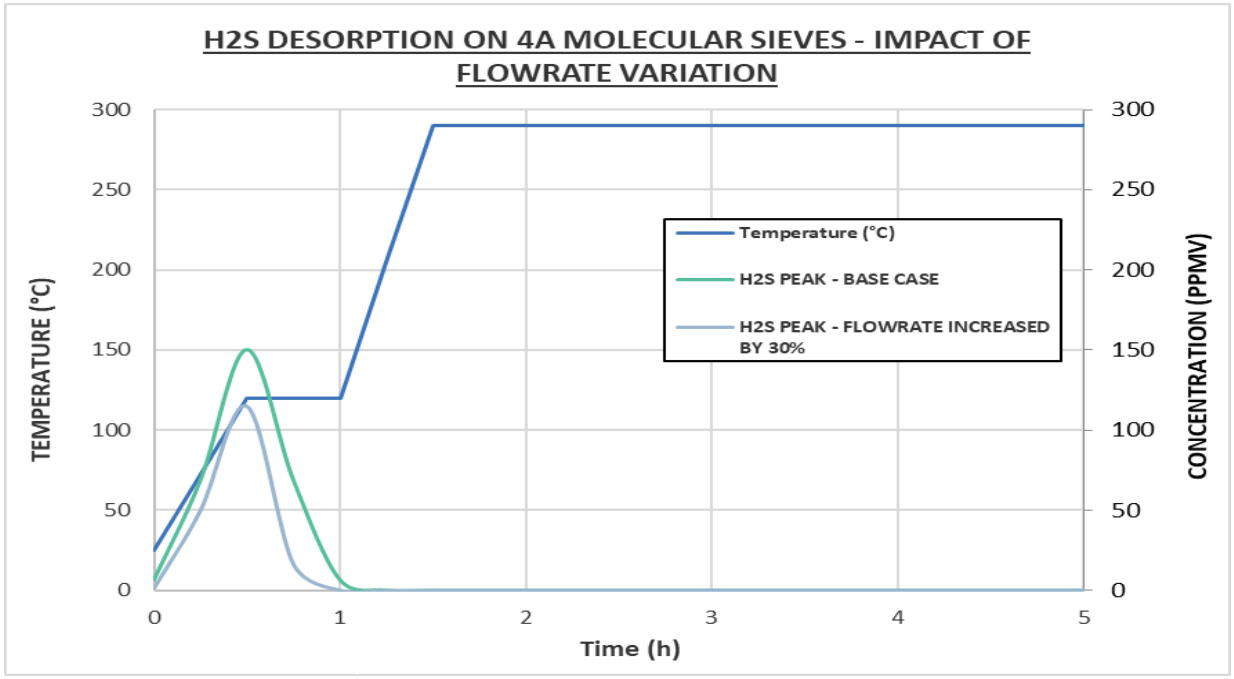


H2S Spike Mitigation in Operation

Regeneration Modifications

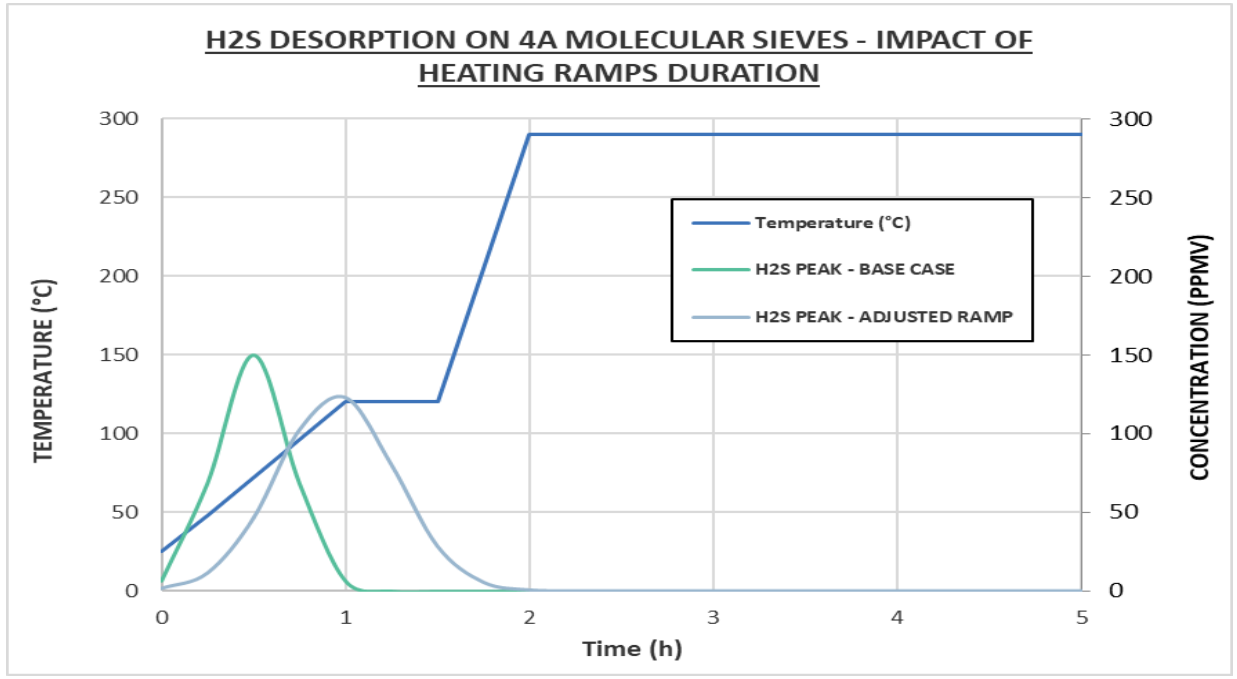
Increased regeneration flow

- Increased Regen Gas Consumption (~30%)
- Dilutes H_2S peak from 150 to 115 ppmv



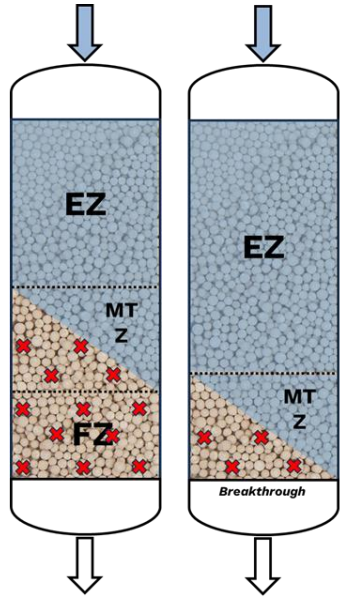
Slower temperature ramp

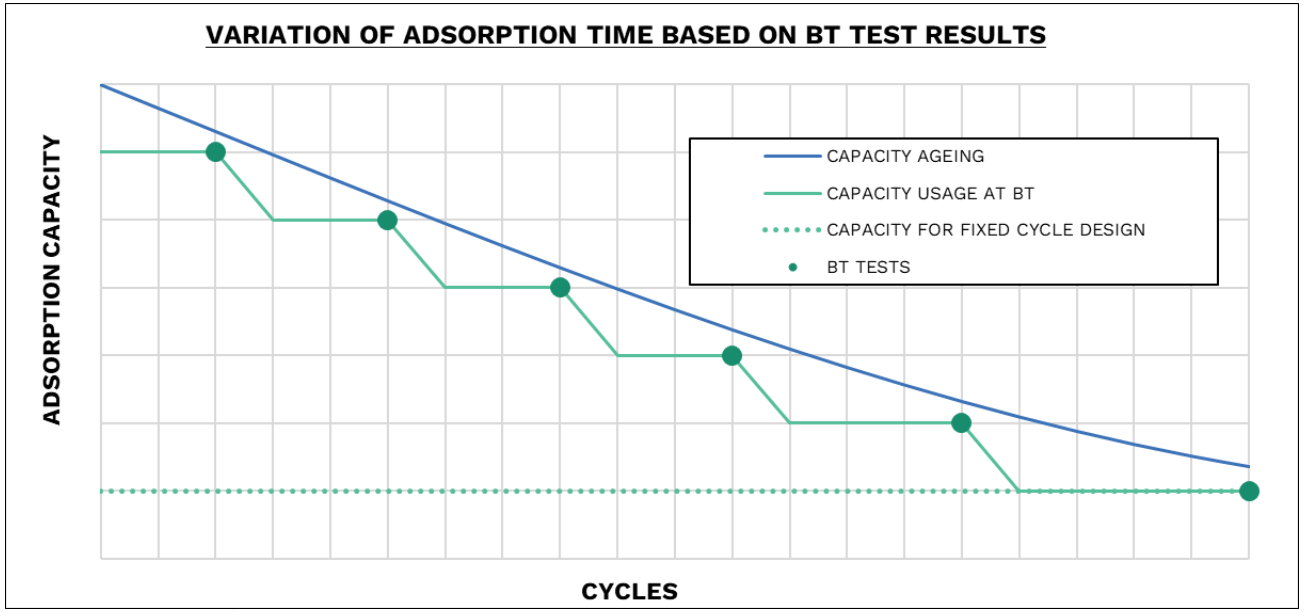
- Reduce temperature ramp from 90 to 120 min
- Gradually desorbs H_2S – reducing peak from 150 to 123 ppmv

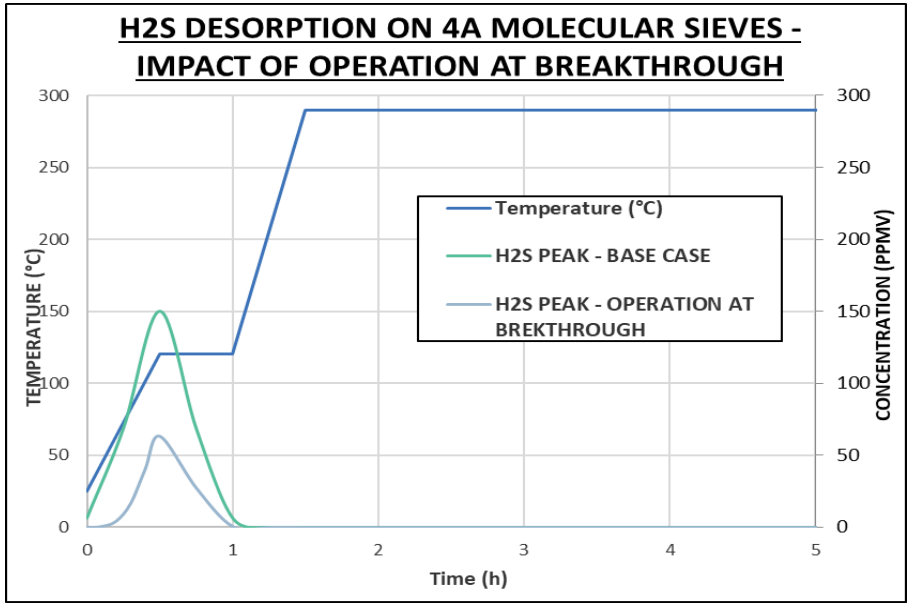


Operation to Breakthrough

- **Adsorption time varies based on water loading + aging**
  - Adsorption stopped when moisture is detected at the bed outlet
  - Or based on BT testing, the adsorption time can be periodically adjusted
- **FZ eliminated → reduced H2S spikes → 150 ppmv to ~60 ppmv**



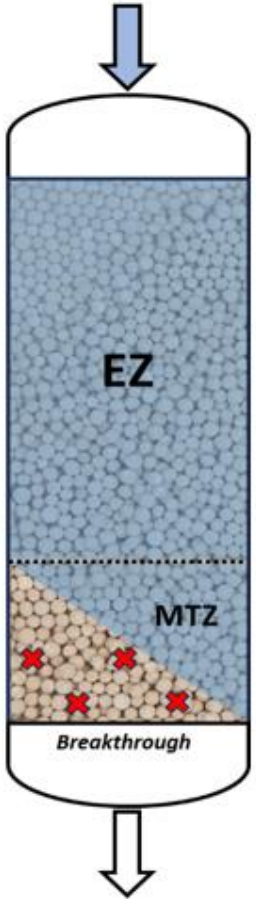


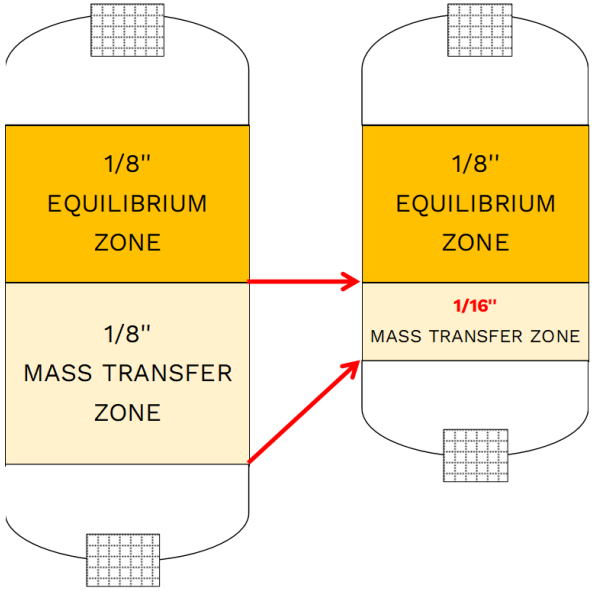


H2S Spike Mitigation in Design

MTZ Reduction

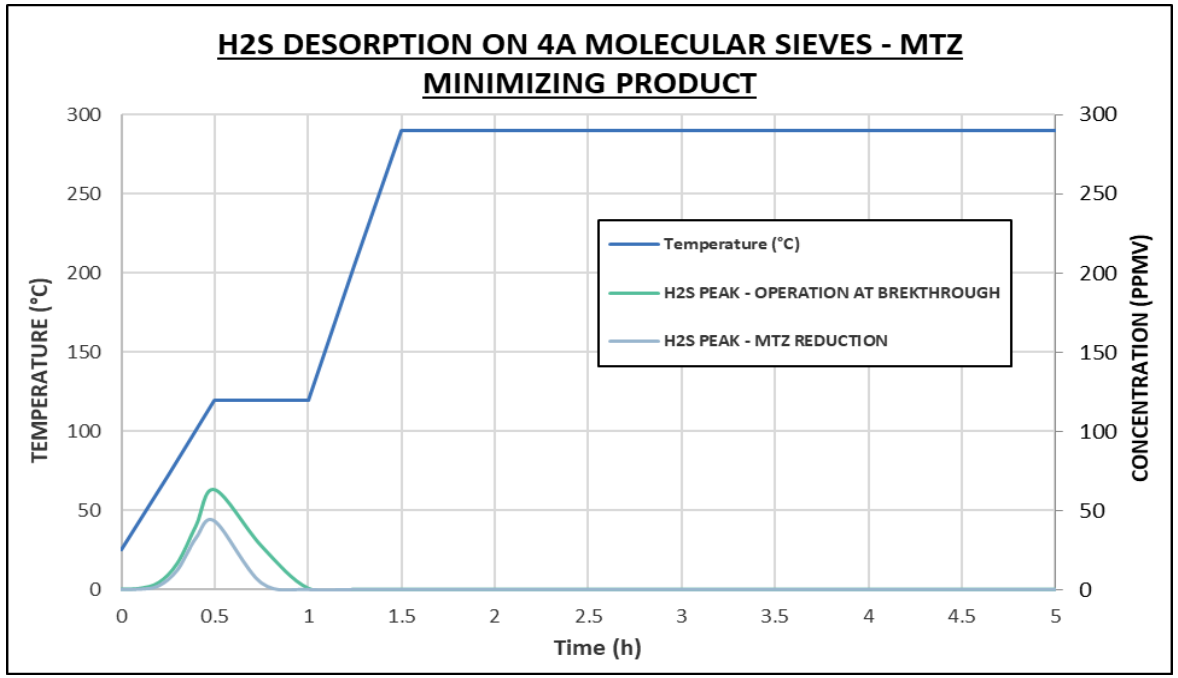
Molecular Sieves Size – large vs small





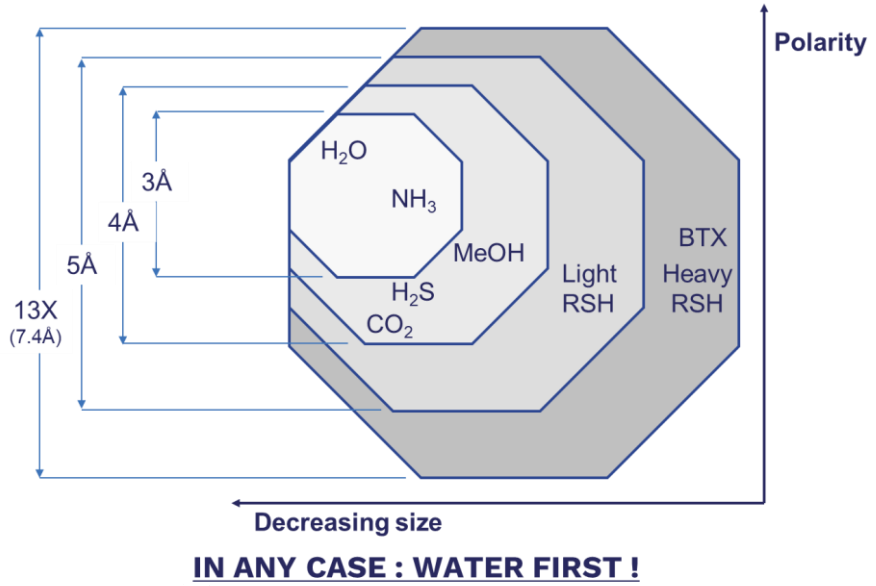
Optimized Product/Specialty Grade

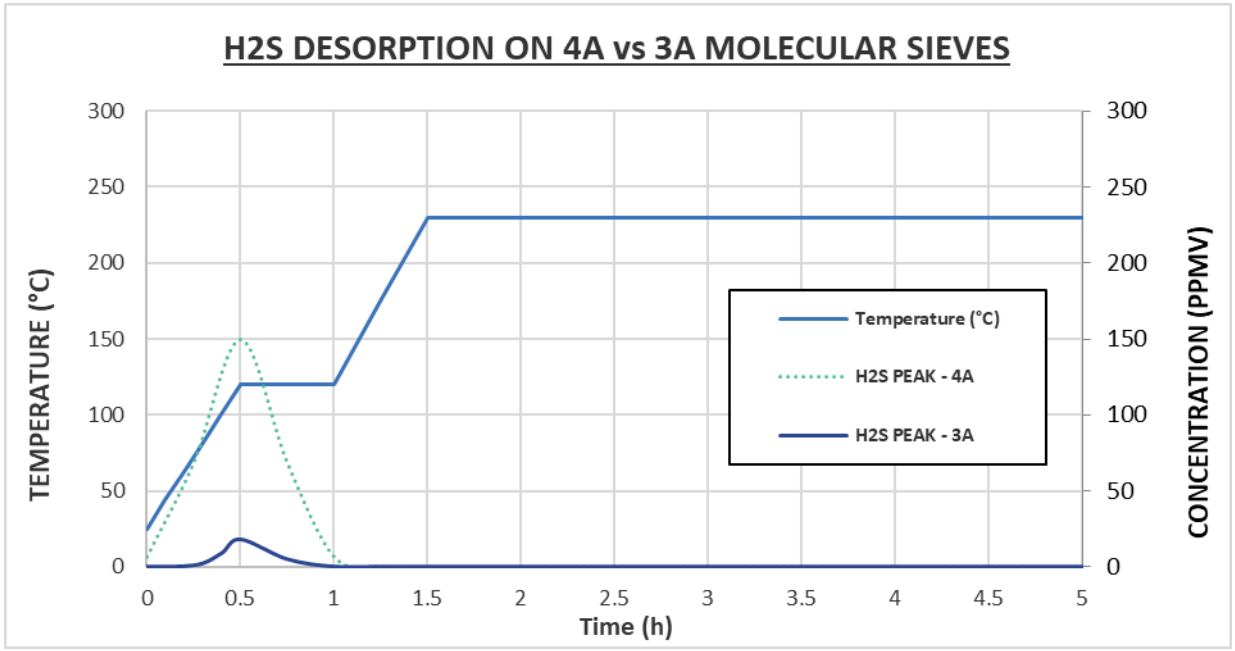
- Selection of correct clay binder
- Optimized/Controlled manufacturing → improved adsorption kinetics
- MTZ reduced by 30% → H_2S peak of 44 ppmv



3A Molecular Sieves

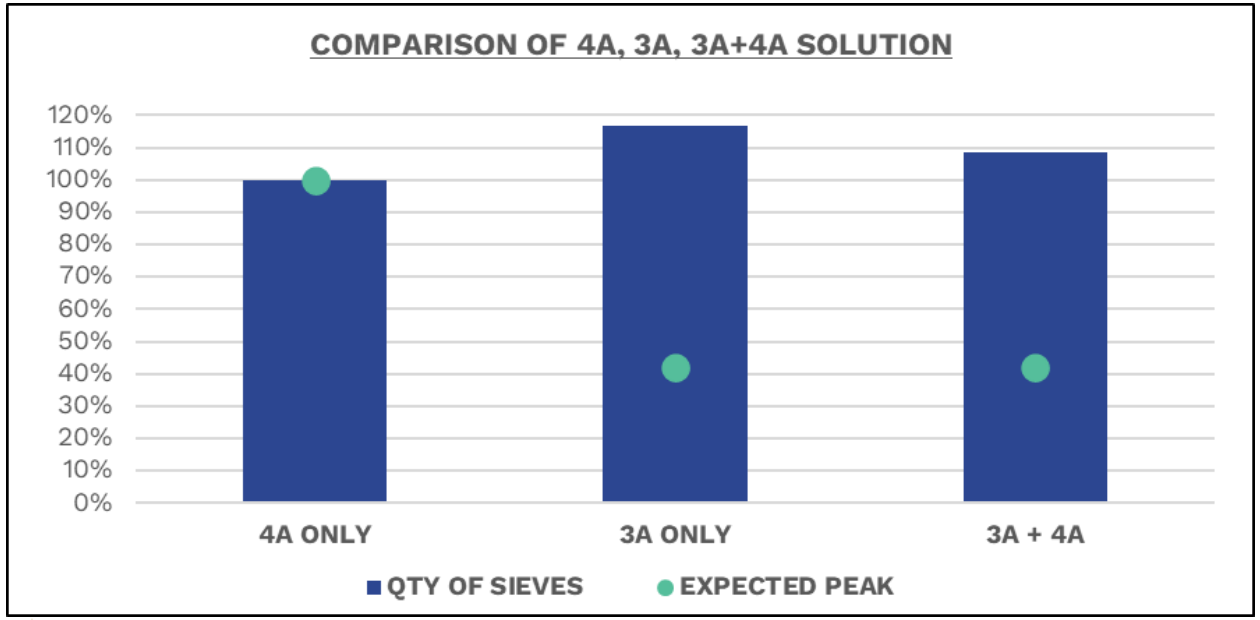
- Selective adsorption – minimizing co-adsorption of H_2S
- Standard or advanced grades with tightly controlled pore size
- Significant peak reduction vs 4A → H_2S Peak of 18 ppmv
- Reduced capacity vs 4A sieves

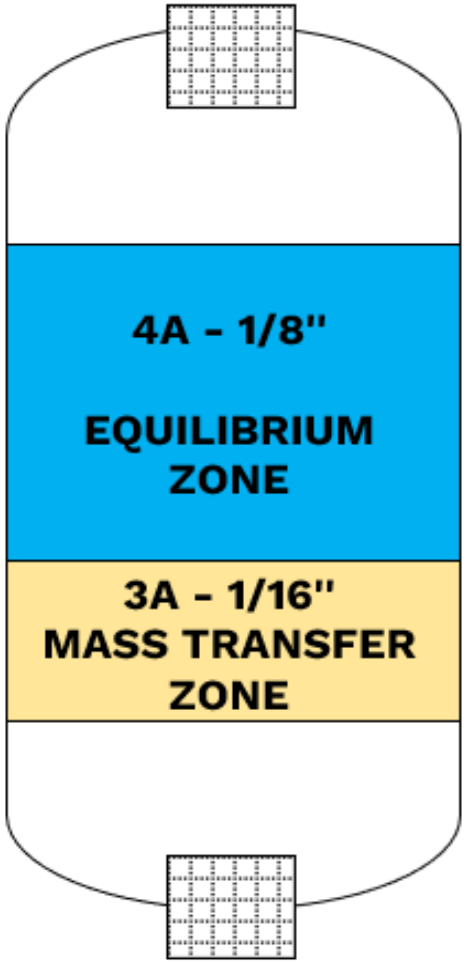




Optimized Design Solution

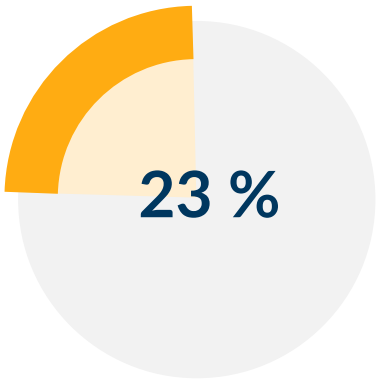
- Improved 4A + 3A
- Maximizes adsorption capacity while minimizing H_2S peak
- Design EZ with 4A and MTZ with 3A
- Results in 10% less MS needed than in the 3A solution



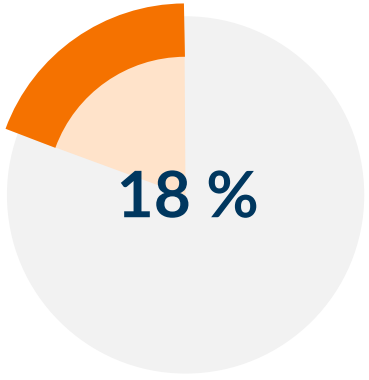


Conclusion

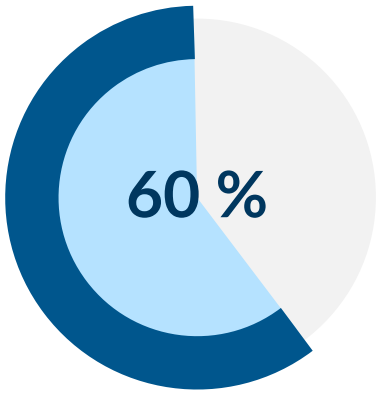
- H_2S peaks pose risks/issues for plants if not managed
- H_2S peaks can be managed in the operational and design phase
- Improvements in H_2S peaks observed in the Case Study



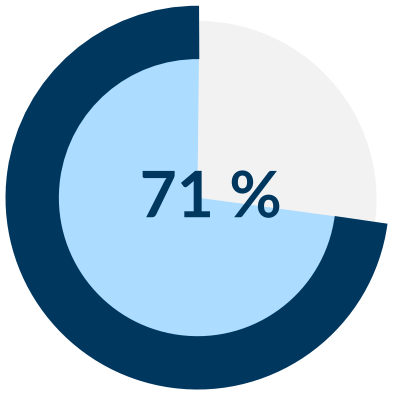
Regen Flow



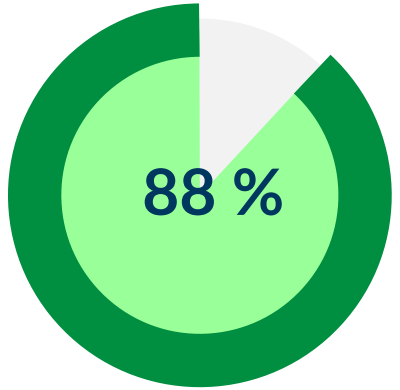
Heat Ramps



BT



MTZ Reduction



3A Sieves

Thank you!