H_2S in the Permian Basin

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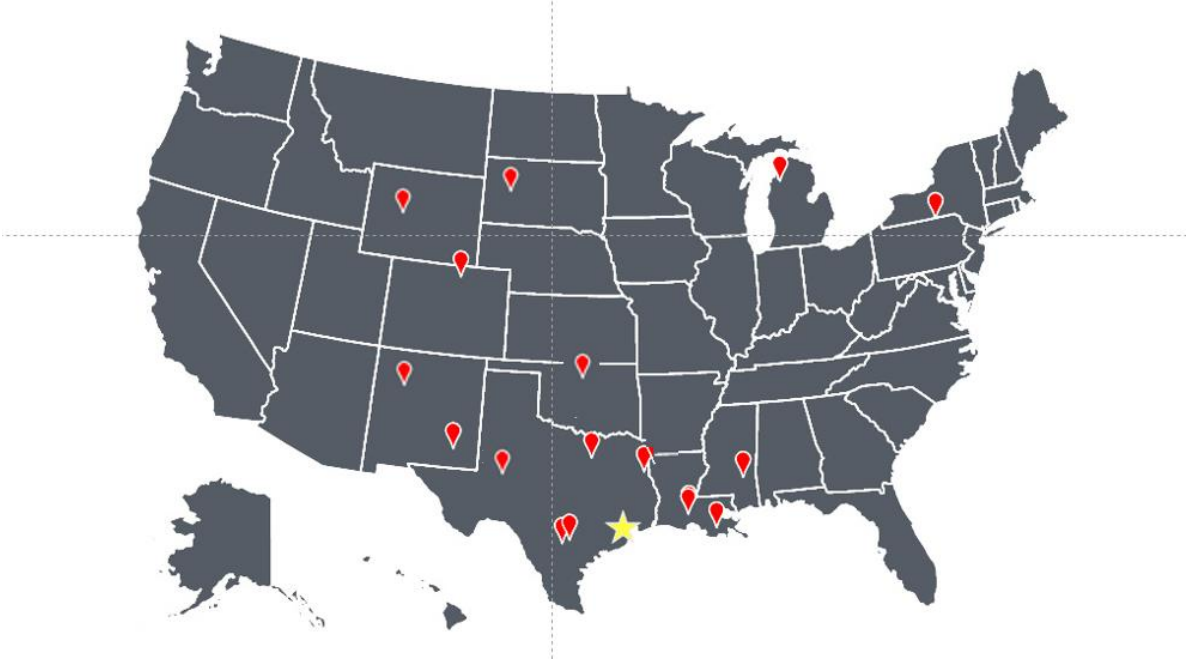
Management Owned,
Partnered with
Private Equity

500+ employees, including
300+ measurement techs,
100+ lab analysts, &
30+ data analysts

SPL US Locations

US Locations Map for all SPL Locations



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Industrial Hazards of Hydrogen Sulfide

- Dangerous and Deadly Gas
- PEL Limit
- Maximum Exposure Limit

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Summary of Test Method – ASTM D5705

- Measurement of Hydrogen Sulfide in Vapor Space above Residual Fuel Oil
- Quart Glass Bottle is filled 50% with Oil Sample
- Vapor Space is purged with Dry Nitrogen and Capped
- Bottle and Sample is heated and agitated
- Hydrogen Sulfide in the Vapor Space is Measured by Stain Tube

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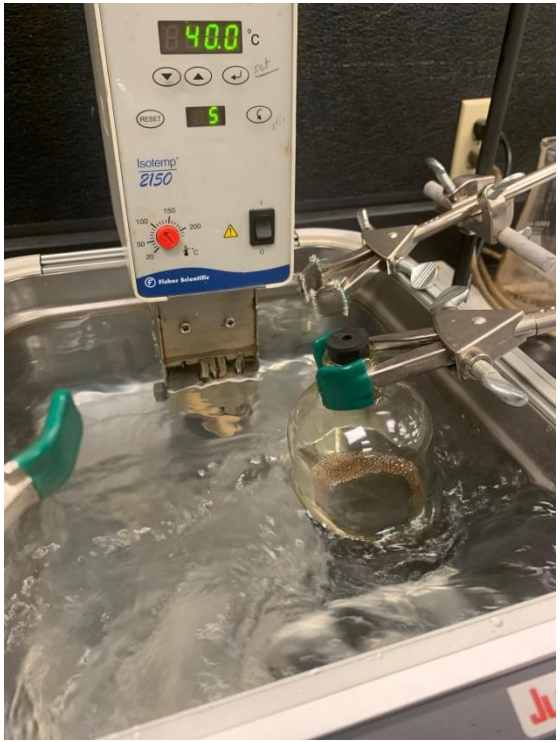
ASTM D5705



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ASTM D5705

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Summary of UOP 163

- Measurement of Hydrogen Sulfide in Liquid Hydrocarbons by Potentiometric Titration
- Liquid Oil Sample is weighed into an Alcohol Solvent
- Solution is titrated with AgNO3 to react with H2S to create AgS
- Hydrogen Sulfide content is calculated from amount of AgNO3 required

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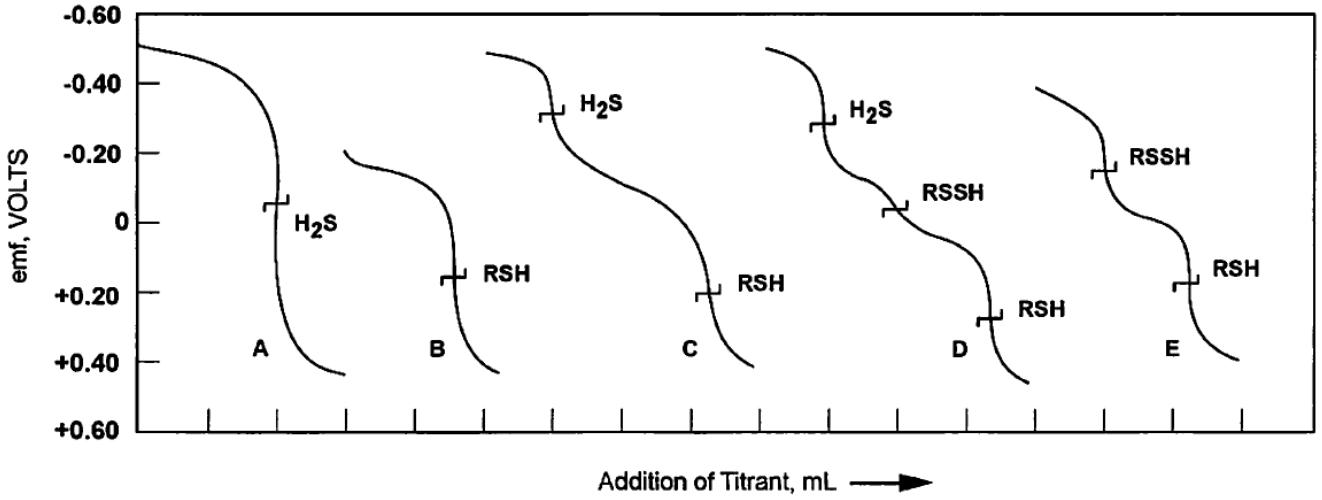
Picture of Typical Titration Curve



Figure

Potentiometric Titration Curves of Sulfur Species in Gasoline

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Challenges of ASTM D5705

- Method is written for Residual Fuel Oil
- Temperatures should be adjusted for differences in crude oil viscosity volatility
- Field test designed to create a 1:1 Vapor/Liquid ratio where H2S Vapor is Equilibrated
- Rapid Qualitative determination of the presence of H2S in the Vapor Space
- Results do not represent H2S Vapor Concentrations in Tanks or Transports
- Samples should be analyzed quickly, not more than once and precision is poor

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Challenges of ASTM D163

- Method is written for Liquid Petroleum Distillates
- Automatic Titration Analyzers are recommended to perform test
- Liquid Oil Sample is weighed and titrated under Atmospheric Conditions
- Operator must analyze H2S and Mercaptan separately when H2S is low
- No Precision Statement for H2S

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ASTM D5705 versus UOP 163

ASTM D5705	UOP 163
• Field Test	• Lab Test
• H2S in Vapor	• H2S in Liquid
• Precision	• Precision
• Qualitative Result	• Quantitative Result

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Interpretation and Comparison of Test Results

- ASTM D5705 yields a Qualitative Result of H2S Concentration in Vapor Phase
- ASTM D5705 result are reported as ppm volume of H2S in Vapor
- UOP 163 yields a Quantitative Result of H2S Concentration in Liquid Phase
- UOP 163 result are reported as ppm weight in Liquid
- Correlation of ppm volume to ppm liquid

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Physical Properties of Hydrogen Sulfide (60oF @ 14.696 psia)

• Molecular Weight	34.08 (Atomic Mass)
• Boiling Point	-76.5 oF
• Vapor Pressure	230 psia
• Liquid Specific Gravity	0.7989 (Water = 1.000)
• Gas Specific Gravity	1.1767 (Air = 1)
• Volumetric Ratio (Ideal Gas/Liquid)	554.7

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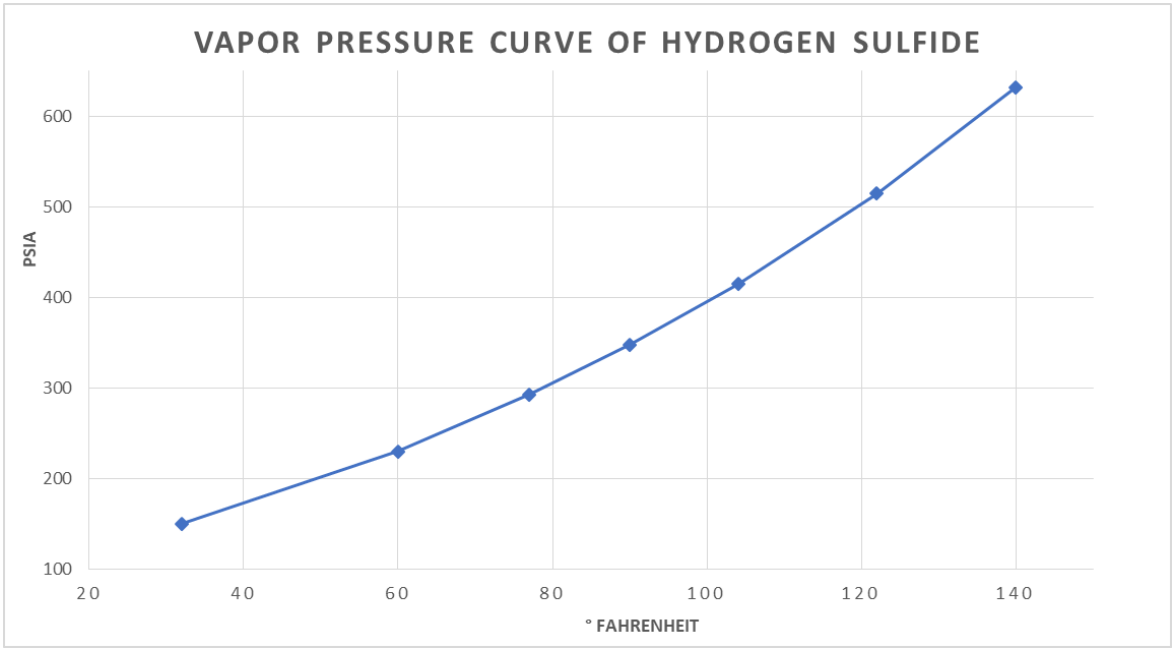
H2S Vapor Pressure Curve



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Recommendations for Hydrogen Sulfide Testing

- Understand the limitations of current methods
- Handle samples for H2S testing similar to other volatiles testing
- Work efforts to create create or improve precision statements for current H2S tests
- Identify goals to pursue and create better analyses for H2S

Thank You!

Questions and Answers