Influence of Additives and Impurities on the Dielectric Properties of Jet Fuel

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Introduction

- The dielectric constant of jet fuel is critical in modern aircraft for fuel volume gauging
- Fluid composition impacts the dielectric constant response

Objective

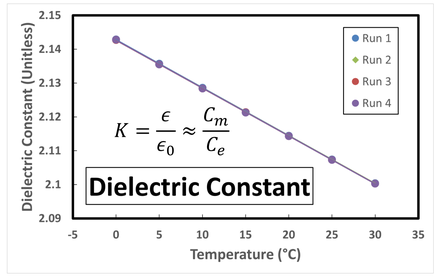
- Investigate the impact of three jet fuel additives on dielectric constant
  - Fuel System Icing Inhibitor (FSII). Max: 0.15V%
  - Corrosion Inhibitor/Lubricity Improver (CI/LI). Max: 23 mg/L
  - Static Dissipater Additive (SDA). Max: 5 mg/L

Methodology

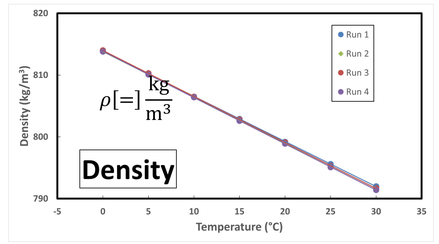
- Measurements were performed using the newly developed Stanhope-Seta JetDC (IP 638)
- Replicates dielectric constant data for fuel gauging systems.

Results

Development of the Clausius-Mossotti Graph

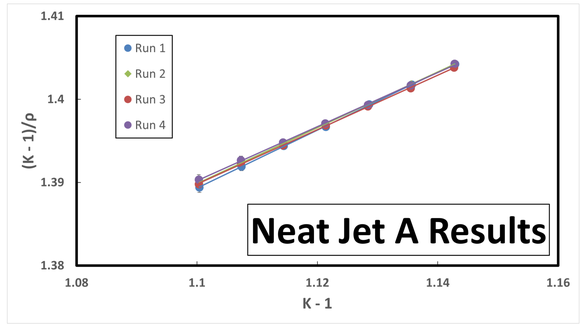


Dielectric constant decreases linearly with increasing temperature.

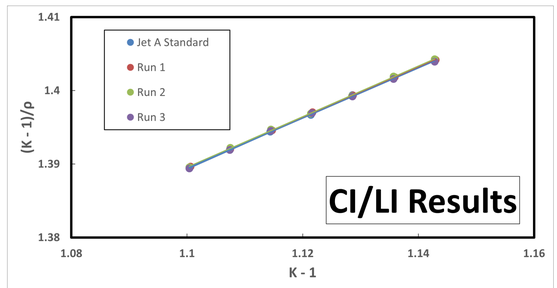


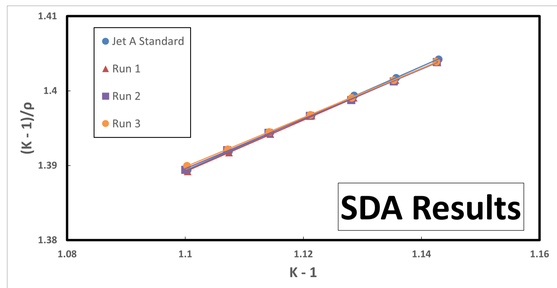
Density decreases linearly with increasing temperature.

$$\frac{K-1}{\rho} = \boldsymbol{b}(K-1) + a$$

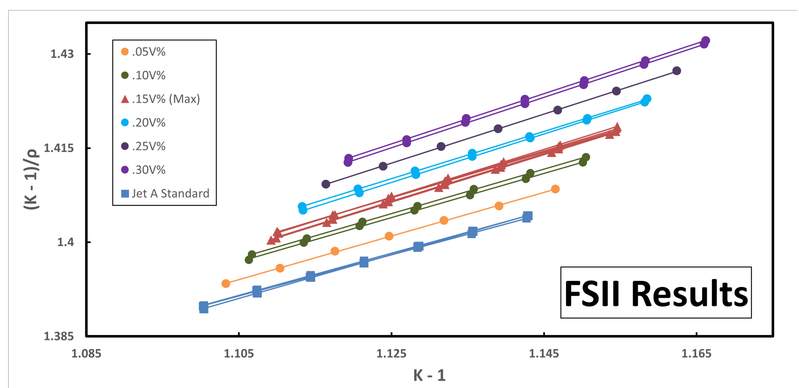


Combining the dielectric constant and density plots gives the Clausius-Mossotti plot. It is linear because both variables vary linearly.

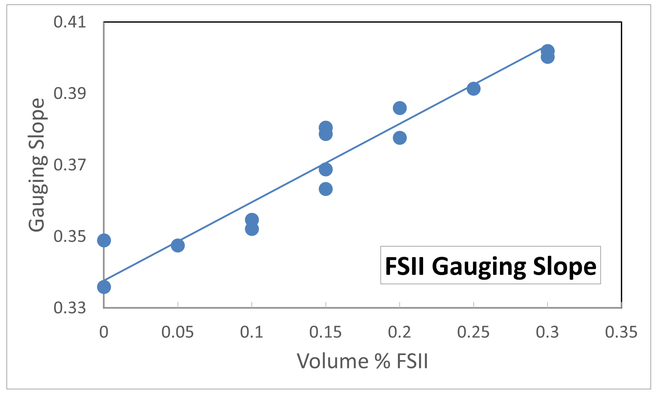




CI/LI and SDA showed no meaningful impact on the gauging slope.



*FSII measurably impacted the gauging slope across all concentrations and all temperatures tested. Gauging slope **b** linearly varies from 0.3475 to 0.4019.*



Conclusions

- FSII additive was shown to impact the dielectric constant and gauging slope
- A linear trend was observed between both the dielectric constant and calculated gauging slope versus volume amount of FSII in fuel
- Density was not affected by any of the three additives tested

Next Steps

- Explore the impact of dissolved water on dielectric constant
  - Use Karl Fischer titration to measure water content
  - Determine functional correlation (if any)