Characterization of Compositional Effects on Dielectric Constant

Project 89

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ASCENT Project 89

Characterization of Compositional Effects on Dielectric Constant

University of Dayton Research Institute

PI: Steve Zabarnick

PM: Ana Gabrielian

Cost Share Partner: Global Bioenergies, Boeing, Shell, IHI, Neste, GE Aviation, NRC Canada, LanzaTech, and University of Dayton

Objective:

- Generate dielectric data on a range of conventional and synthetic fuels to help minimize uncertainties & speed SBC approvals

Project Benefits:

- Minimize uncertainties in aircraft fuel tank quantity gauging when aircraft are operated with SATFs and/or their blends
- Help speed future synthetic aviation fuel approvals through the ASTM D4054 process

Research Approach:

- Determine the typical range of dielectric values for conventional fuels
- Compare with approved SBC & SATF candidates
- Determine how compositional differences affects measured dielectric values

Major Accomplishments (to date):

- Stanhope-Seta JetDC instrument working
- Membership and participant in EI Dielectric Task Group
- Provided test fuels for ILS
- Beginning ILS testing

Future Work / Schedule:

- Finish ILS
- Work with Airbus & Boeing to determine testing to be performed
- Measure Dielectric and density for wide range of fuels/species and blends
- Final report

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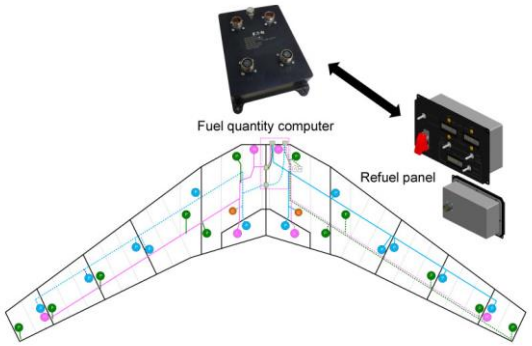
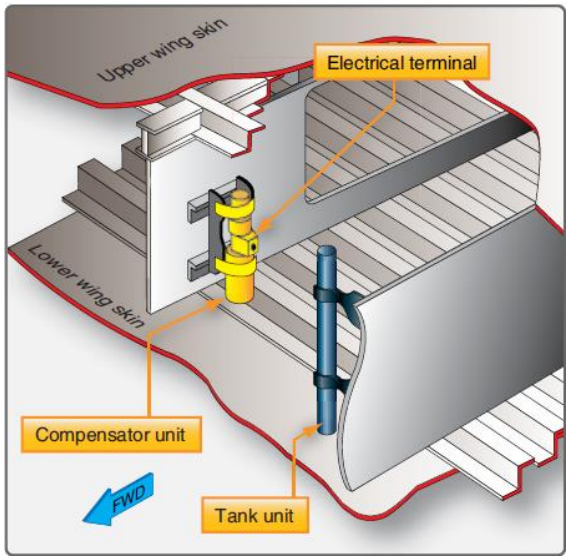
Fuel Quantity Indicating Systems

- Knowing fuel quantity essential for safety and efficiency
- Knowing the fuel quantity to better than 1% is desired, 2-3% is typical
- Accurate quantity requires care:
  - Tank geometry, cabling, sensor tolerances, deflection, stratification, attitude, fuel contaminants (e.g., water & microbial growth), dead volume, fuel characteristics (density, dielectric constant, temperature)
- Capacitance fuel tank gauges
  - Data from multiple sensors are used to calculate fuel mass (32 sensors in B737!)
  - Summation of data from multiple tanks
  - Computation method used varies (compensator/densitometer)

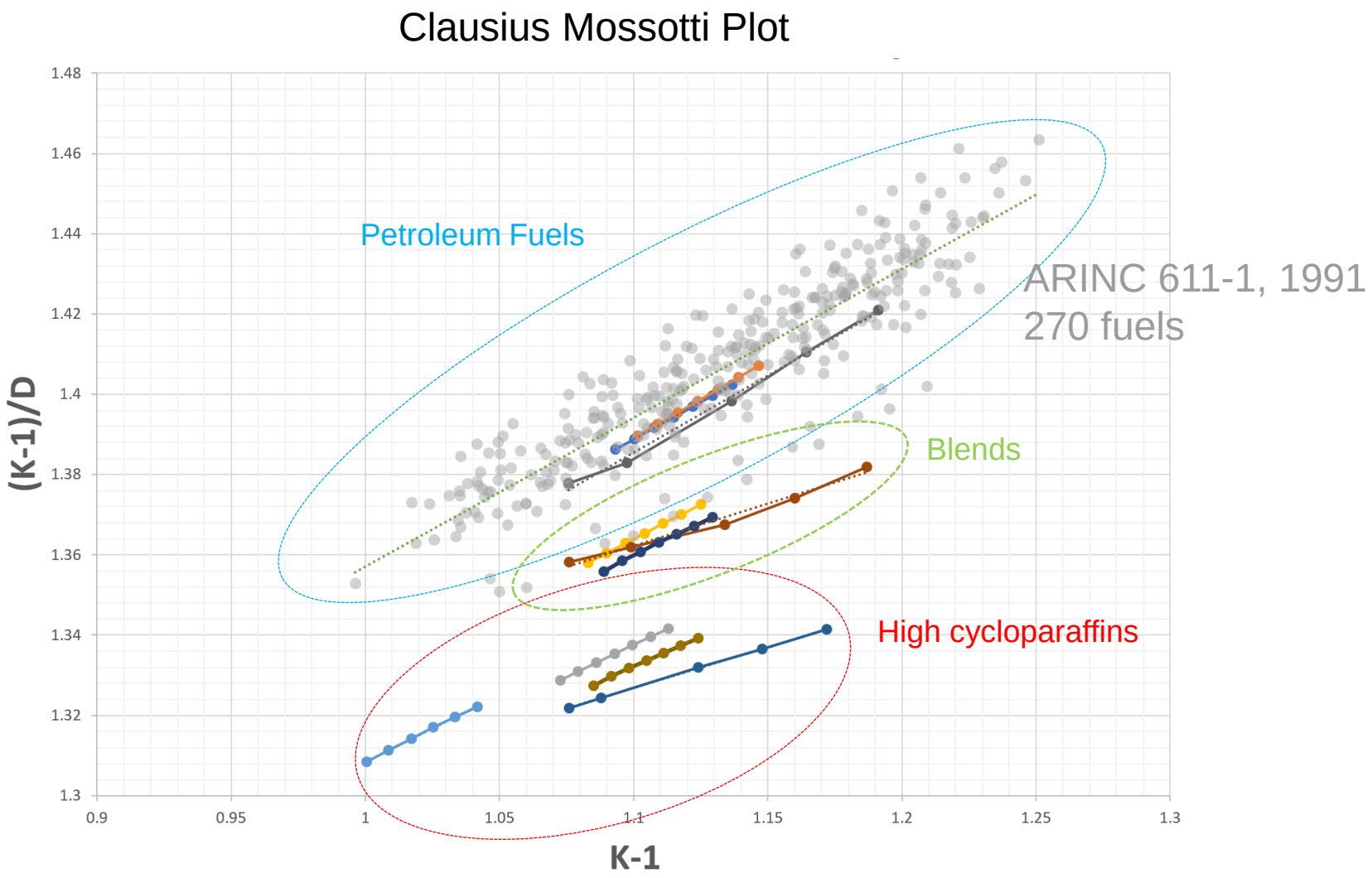




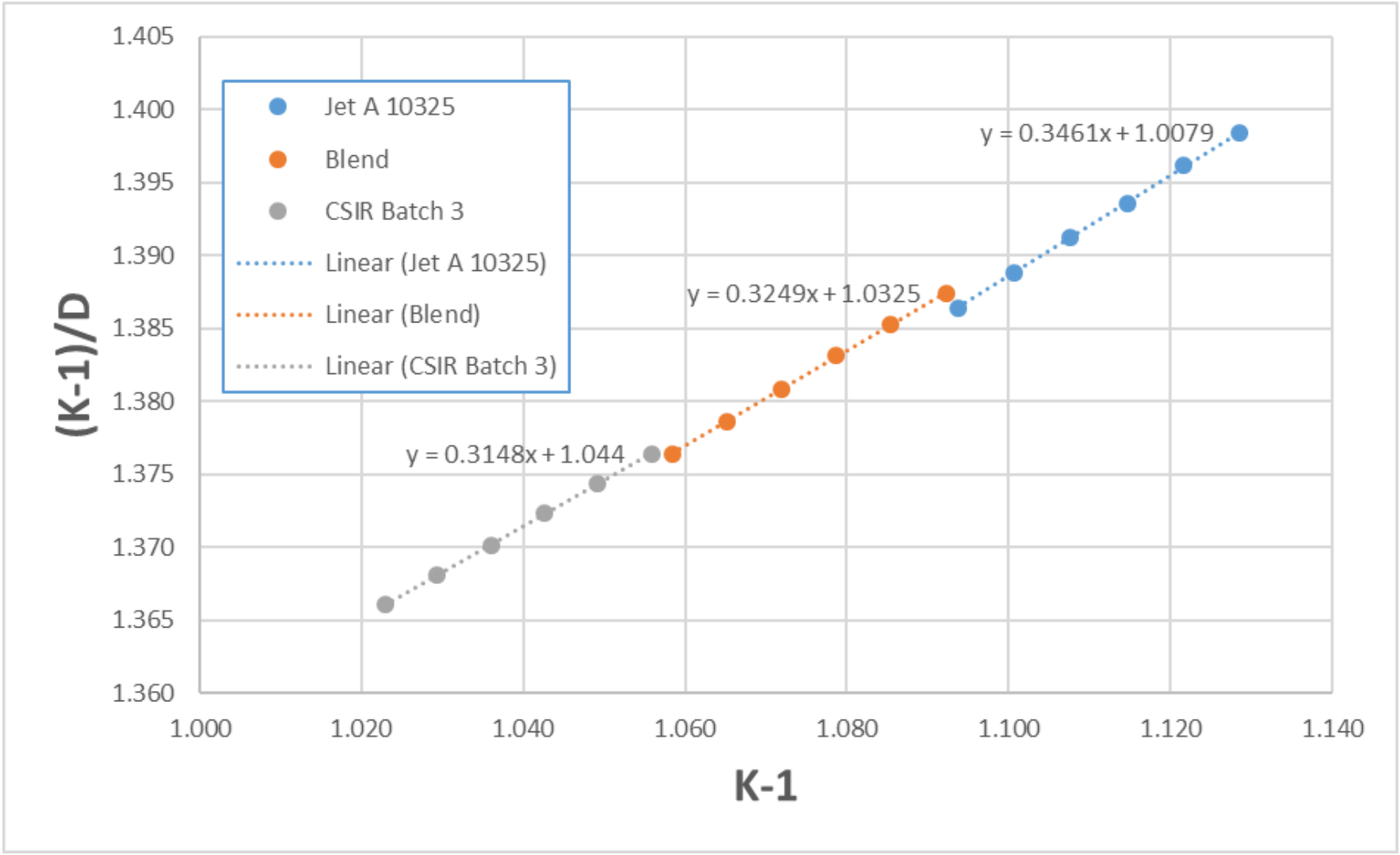
Dielectric Constant

- Used for fuel tank gauging – capacitance gauges, concentric tubes
  - Assumes known relationship between dielectric & density – "Clausius Mossotti relationship"
  - Airframe OEMs concerned that candidate SAF behavior may be too different
- Current method ASTM D924 not designed for jet fuel
  - Aircraft technology is different – e.g., frequency
- UK Energy Institute developing new method
  - Stanhope-Seta instrument – EI Spec
  - ILS – 8 labs, 15 fuels with varying density properties
  - Supported by airframe OEMs, i.e., Airbus & Boeing
- New Project P89 – extend ILS
  - Measure wide range of samples & temperatures
  - Effect of species classes – e.g., cycloparaffin level
  - Comparison of new instrument with ASTM D924

Dielectric Behavior vs Density/Temperature



Initial Results



Acknowledgments

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