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Impact of Combustion Air Oxygen Content and Moisture on DCN Using a CVCC Instrument

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Scott Berkhous
Thomas Herold
Pat Ritz
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What is Cetane Number and DCN?

- **Cetane Number** is a **measurement** of the combustion quality of a fuel during compression ignition (diesel engine)
  - Higher cetane number fuels ignite more quickly, resulting in more complete combustion of the fuel
- **Derived Cetane Number (DCN)** is based on the ignition delay **measurement** or the time differential between injection and one or more points along the combustion curve
  - Shorter ignition delays correlate to higher DCN values
- **Cetane Index** is **calculated** from density and boiling range

How is Cetane Number Determined?

- ASTM D613 – Standard Test Method for Cetane Number of Diesel Fuel
- Comparison of test fuel characteristics to reference fuel characteristics
- Defines the Cetane Number scale

CFR F-5

Why Did the Petroleum Refining Industry Desire a New Cetane Test?

- New demands for higher Cetane Numbers to reduce Emissions and gain Efficiency for Diesel Engines
  - Cetane Improver widely used to achieve high Cetane Numbers
- Cetane Index calculation is unusable for Cetane improved samples and Biodiesel
  - Cetane Number has to be measured
- Current Cetane Engines (ASTM D613)
  - Size - Cetane Engines are large – may require a separate room
  - Skill - Requires highly trained operators
  - Precision – large r and R

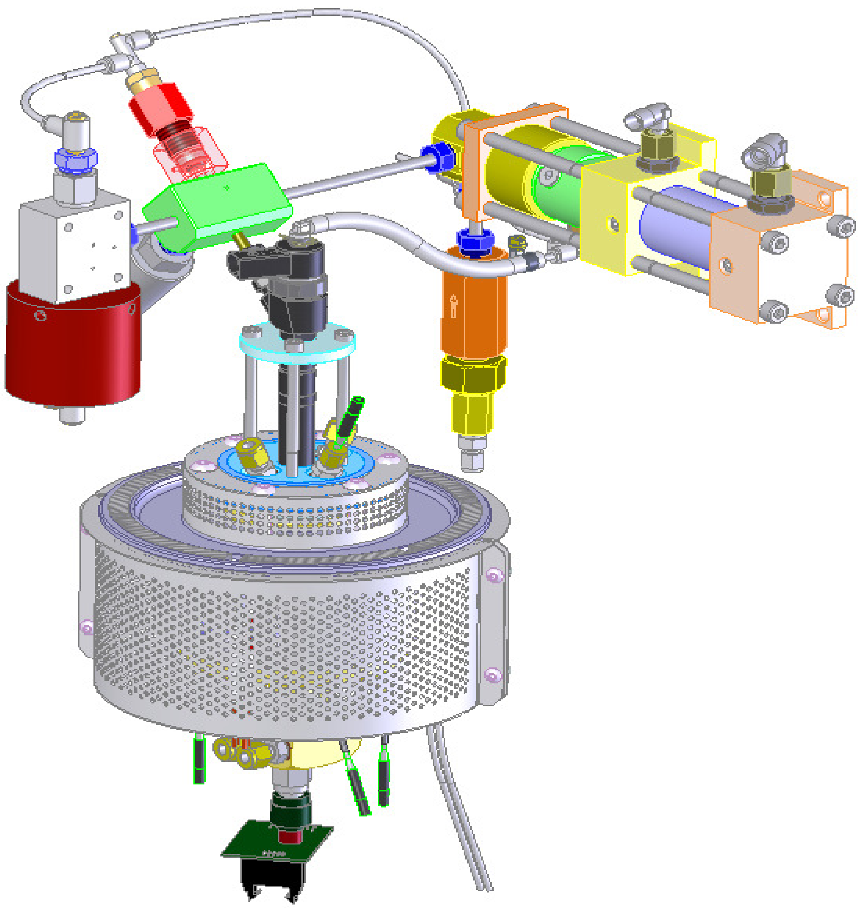
Cetane ID 510

- Easy to use One Button operation
- Fully automated Test & Calibration
- Bench top unit with small bench space requirement
- Measuring Range
  35 to 65 DCN

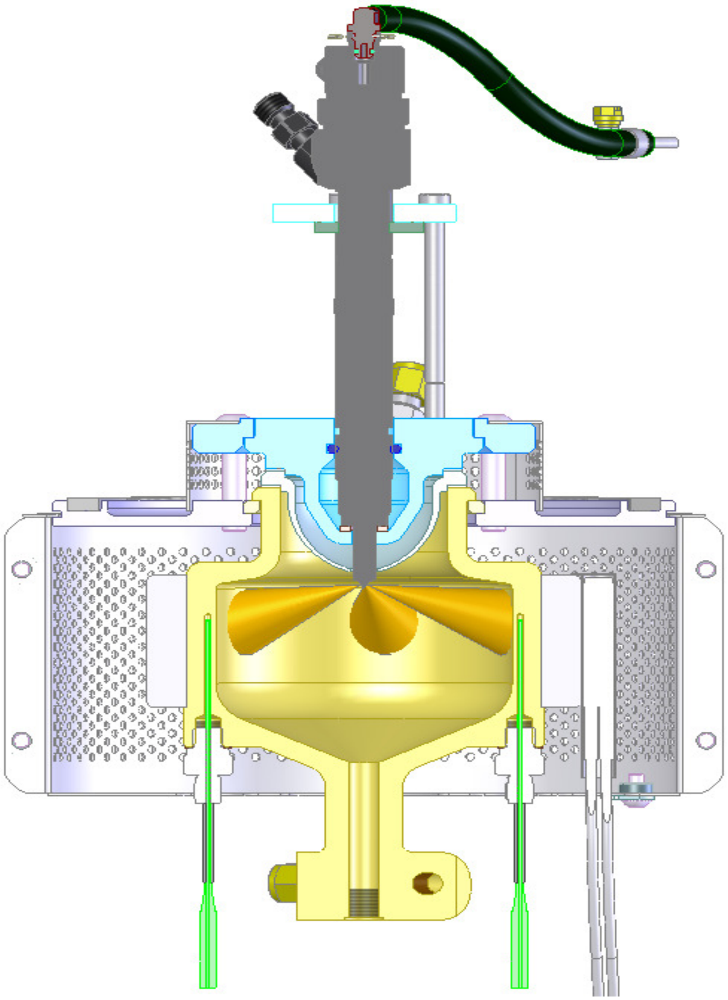
High Pressure Sample Section of the CID 510

- High Pressure Common Rail Fuel Injector
  - Modern diesel injector with six spray orifices
  - Produces a highly dispersed injection for better air / fuel mixing

- Electronic Injection Volume Control



Cetane ID 510 Combustion Chamber



- Electronically controlled High Pressure Injector generates finer droplet size
- Multiple nozzle orifices for better fuel evaporation and mixing with air
- Simulates real world injection systems of modern Diesel engines
- Wider combustion chamber to accommodate spray pattern
- Complete Combustion eliminates cleaning of injector and pressure sensor due to soot formation

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Affect of Charge Air Composition on Derived Cetane Number

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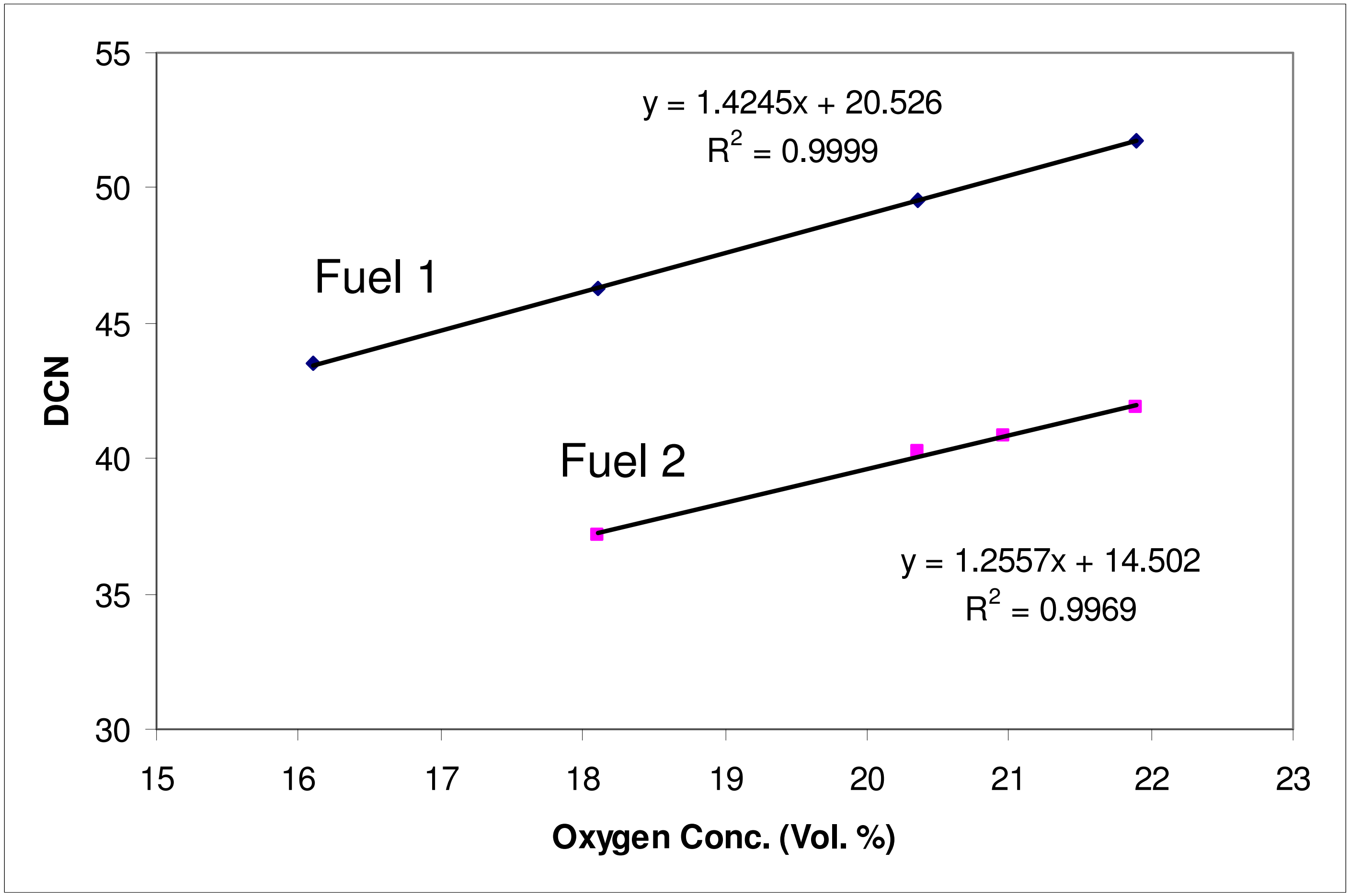
Charge Air Compositions - Oxygen

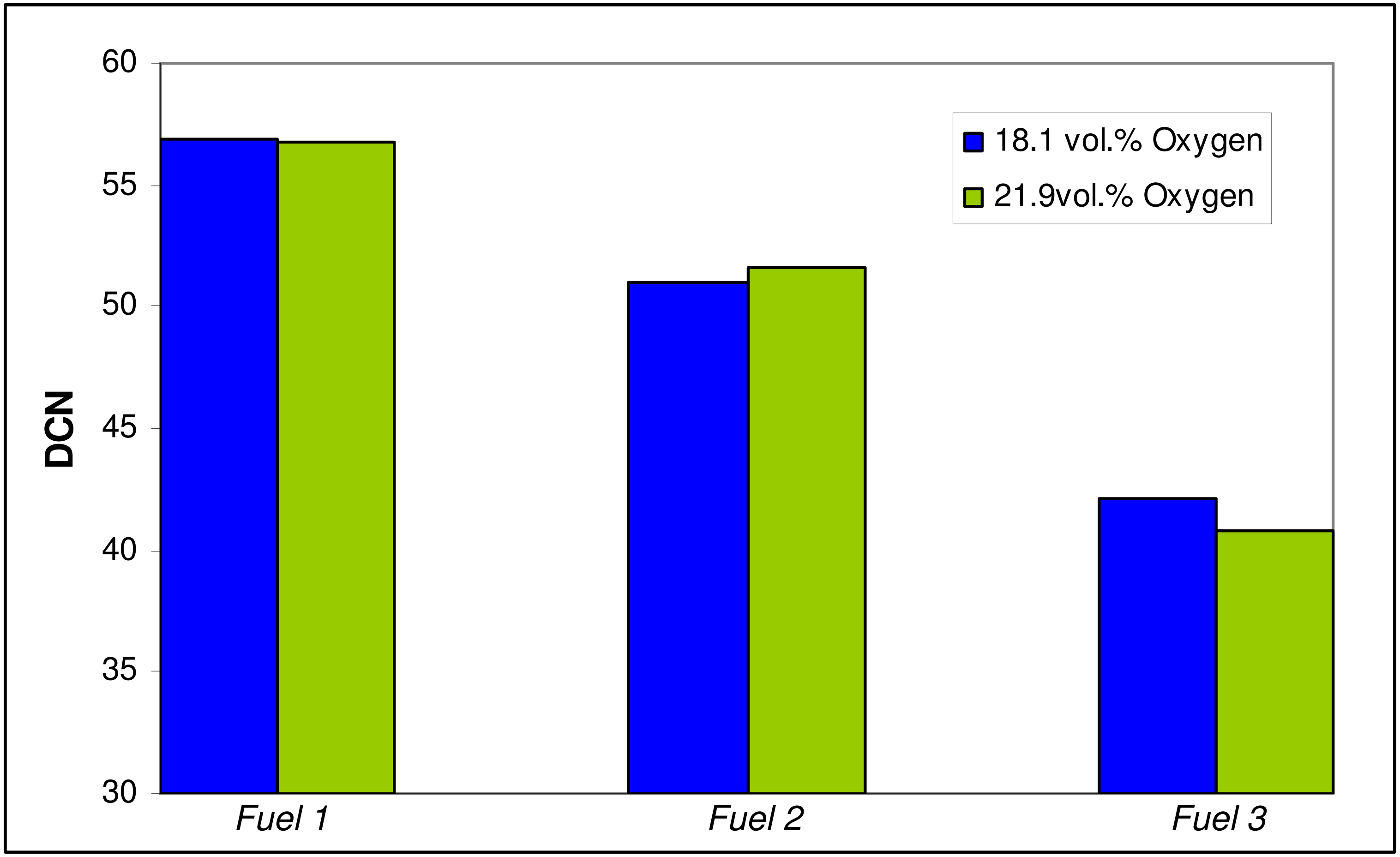
- Requested Oxygen concentrations between 16% and 22%
- Requested compressed air to be dry

Air Cylinder	Nitrogen (vol.%)	Oxygen (vol. % ± 2%)	Water (ppm, ± 5%)
A	83.90	16.10	Request Dry
B	81.90	18.10	Request Dry
C	79.64	20.36	Request Dry
D	79.03	20.97	Request Dry
E	78.10	21.90	Request Dry

Affect of the Oxygen Concentration of the Charge Air on the Derived Cetane Number



Calibration and Analysis at a Constant Oxygen Concentration



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Affect of Water in the Sample on the Derived Cetane Number

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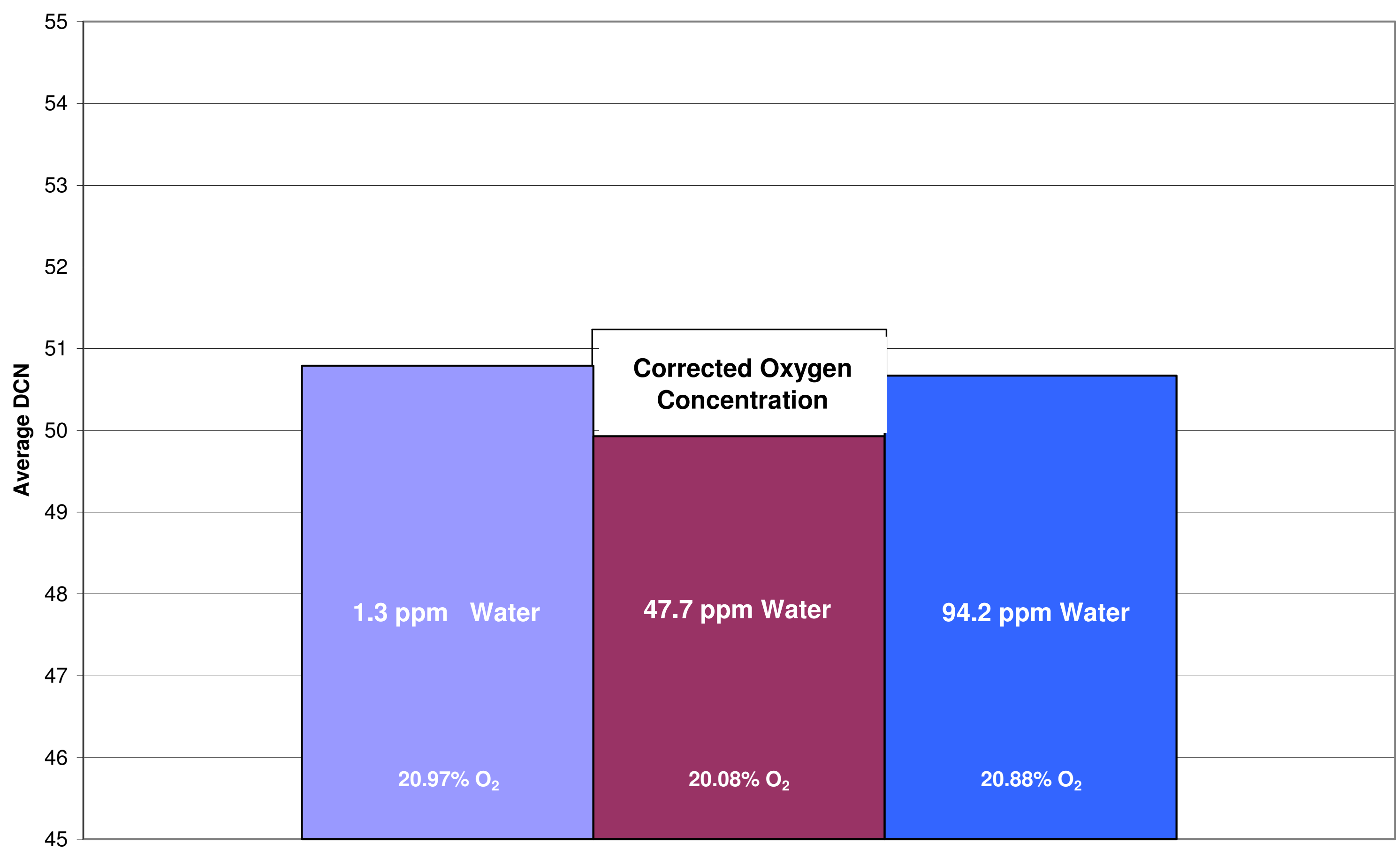
Charge Air Compositions - Water

- Requested Oxygen concentration of 20%
- Requested water concentrations of 0 ppm, 50 ppm, 100 ppm
- Above 100 ppm not practical due to saturation of pressurized air

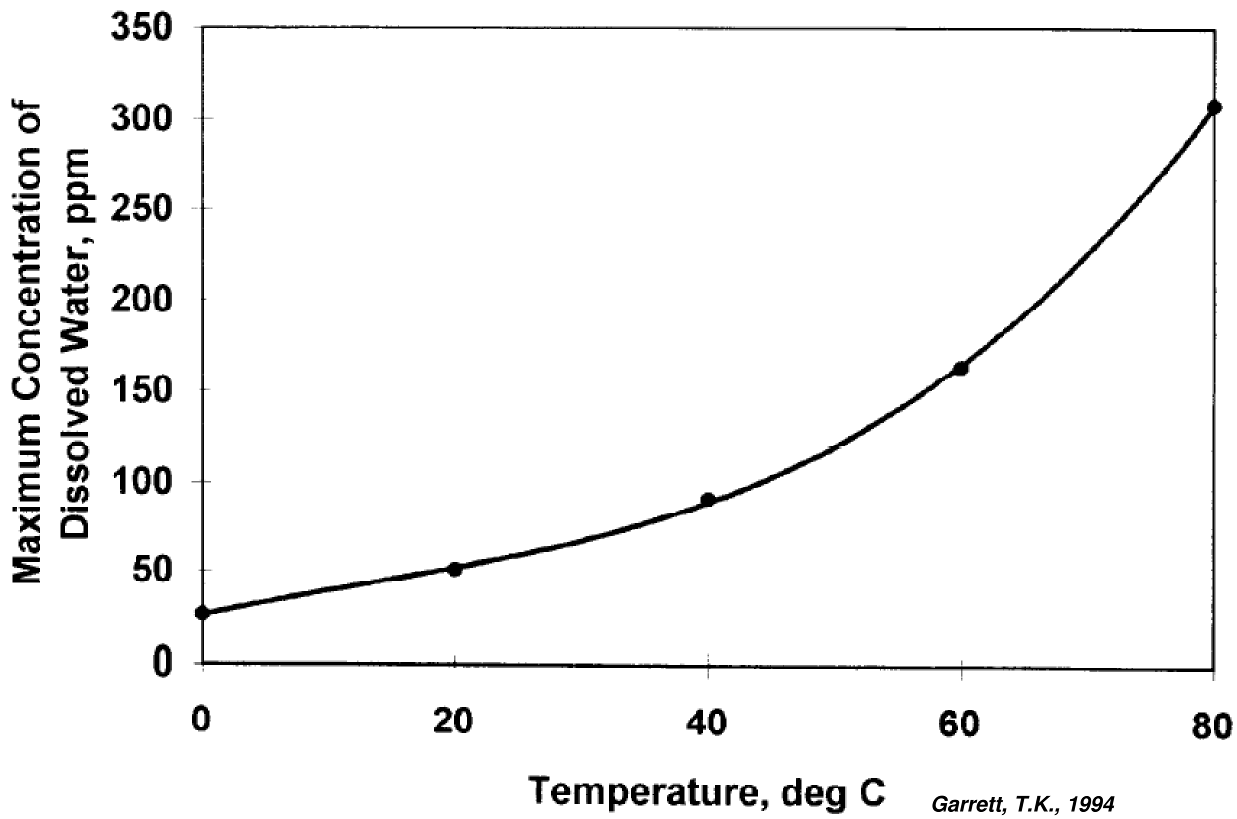
Air Cylinder	Nitrogen (vol.%)	Oxygen (vol. %, ± 2%)	Water (ppm, ± 5%)
A	79.03	20.97	1.3
B	79.92	20.08	47.7
C	79.12	20.88	94.2

Affect of Moisture in the Charge Air on the Derived Cetane Number Determination

Evaluation of Combustion Air Moisture on DCN

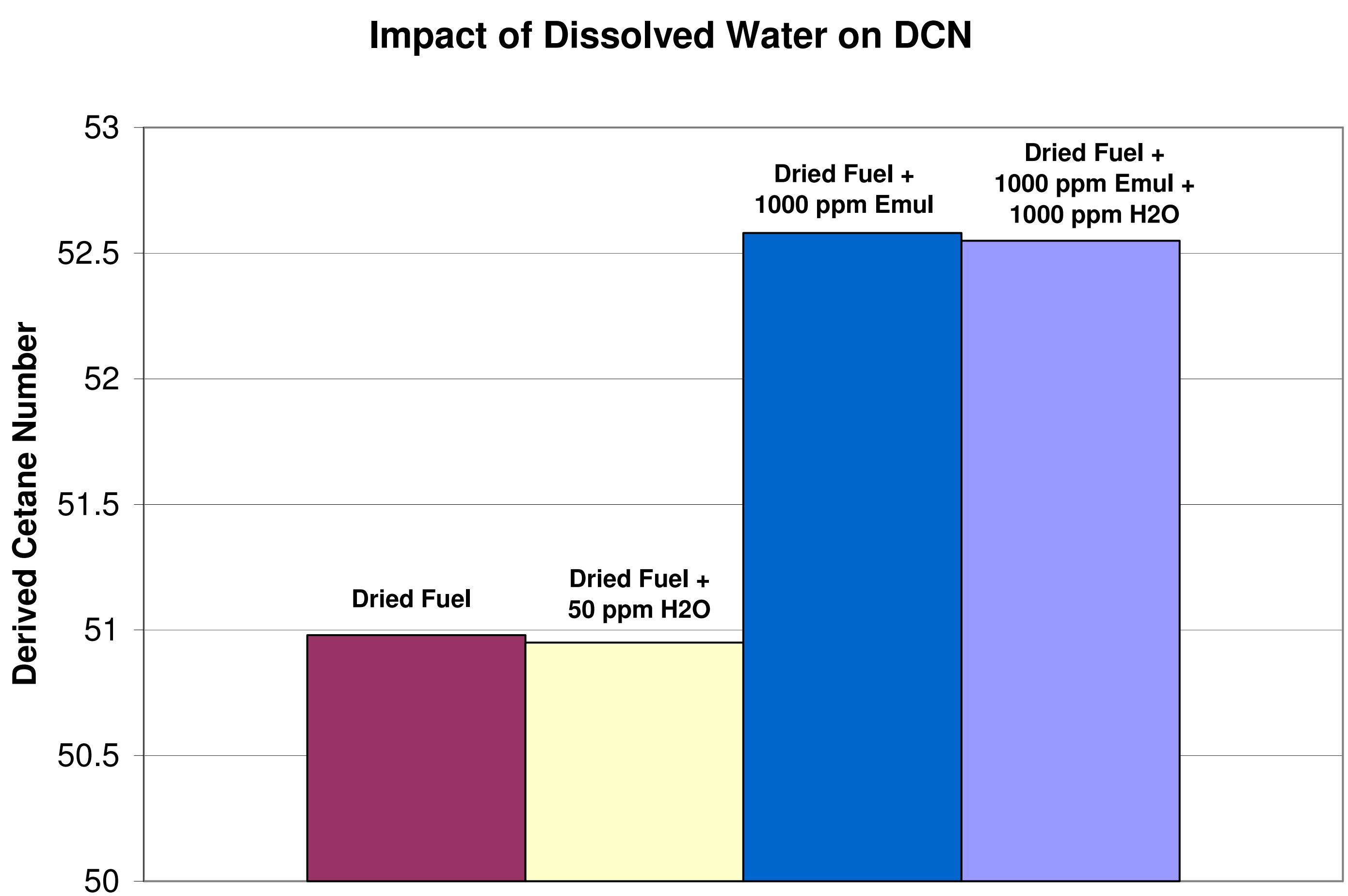


Solubility of Water in Diesel Fuel



Garrett, T.K., 1994

Derived Cetane Number Using a Sample Containing Various Amounts of Water



Conclusions

- Water in the charge air does not impact the DCN result at concentrations up to approximately 100 ppm
- Water in the test fuel sample, which included the calibration fluid, does not affect the determination of DCN at concentrations up to 1000 ppm
- The oxygen concentration of the charge air has a profound effect on the DCN result
- The oxygen concentration does not affect the determination of DCN as long as the oxygen concentration used for the calibration of the instrument is identical to the oxygen concentration used for the DCN determination

Thank you!

- Questions?
- Discussion