Colorimetry of Biodiesel Blends for Possible Quick Concentration Detection

B. Brian He
Joe Thompson

Biological & Agricultural Engineering
University of Idaho

The Need

- Quick determination of the blend of biodiesel in diesel fuel is a critical need in the biodiesel industry

- Such a method is beneficial to
  - Engine manufacturers
  - Consumers
  - Biodiesel producers
Fuel Blend Detection

- In alcohol-gasoline blend detection, optical and dielectric effect methods are used

- **Optical methods**
  - Simple & easy to use
  - Quick
  - Too sensitive to contaminants

- **Dielectric methods**
  - More accurate
  - More complicated

Biodiesel Blend Sensors

- Biodiesel Blend Detection Using a Fuel Composition Sensor *(Tat & Van Gerpen, 2001)*

![Figure 7. Methyl Soy Ester Blends with No. 2 and No. 1 Diesel Fuel.](image)
**Purpose of This Study**

- To test the feasibility of quick determination of blend of biodiesel in diesel fuel using colorimetry method

**Method**

- Biodiesel of Mustard Methyl Esters (MEE) was used as the working media
- Cuvettes of metacrylate from Fisher was used for samples (*disposable standard 10x10mm*)
- Beckman DU520 spectrophotometer was used for the colorimetry measurements
Preliminary Results

- Scan spectrum of biodiesel at 190-1100 nm

- Scan spectrum of diesel at 190-1100 nm
Preliminary Results

- Scan spectra of biodiesel and #2 diesel

![Graph showing scan spectra of biodiesel and diesel](image_url)

**Preliminary Results**

**Scan Spectra of Biodiesel and Diesel**

![Graph showing scan spectra of biodiesel and diesel](image_url)
Preliminary Results

Biodiesel Optical Spectra

Absorbance against DI-water
Preliminary Results

480 nm

\[ y = 0.0049x + 0.0755 \]

\[ R^2 = 0.9998 \]

0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40

0 10 20 30 40 50 60

Optical ABS at 480 nm

Biodiesel Blends (%)

Preliminary Results

450 nm

\[ y = 0.0052x + 0.2256 \]

\[ R^2 = 0.9996 \]

0.00 0.10 0.20 0.30 0.40 0.50 0.60

0 10 20 30 40 50 60

Optical ABS at 450 nm

Biodiesel Blends (%)

\[ y = 0.0052x + 0.2256 \]

\[ R^2 = 0.9996 \]
Preliminary Results

\[
\begin{align*}
y &= 0.0034x + 0.4572 \\
R^2 &= 0.9991 \\
y &= 0.0052x + 0.2256 \\
R^2 &= 0.9996 \\
y &= 0.0049x + 0.0755 \\
R^2 &= 0.9998
\end{align*}
\]

Summary

- Biodiesel has characteristic optical absorbance peaks at 426, 450, and 480 nm
- Dielectric methods
  - More accurate
  - More complicated
- ABS at 450nm be the representative index
  - \( \Delta \text{ABS} = 0.410 \) at 426 nm
  - \( \Delta \text{ABS} = 0.603 \) at 450 nm
  - \( \Delta \text{ABS} = 0.562 \) at 480 nm
Summary

- Colorimetry method is feasible for MEE biodiesel blend detection
- More tests need to be done on
  - Different feedstock, e.g., rape, mustard, canola, soybean, etc.
  - Methyl esters of the same feedstock of different sources
  - Sensitivities to impurity, e.g., water, glycerol, etc.
  - ???