

Identifying Authentic and Fraudulent Diesel Fuel by Fast GC Using Chemometrics

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Two ways to use chromatography

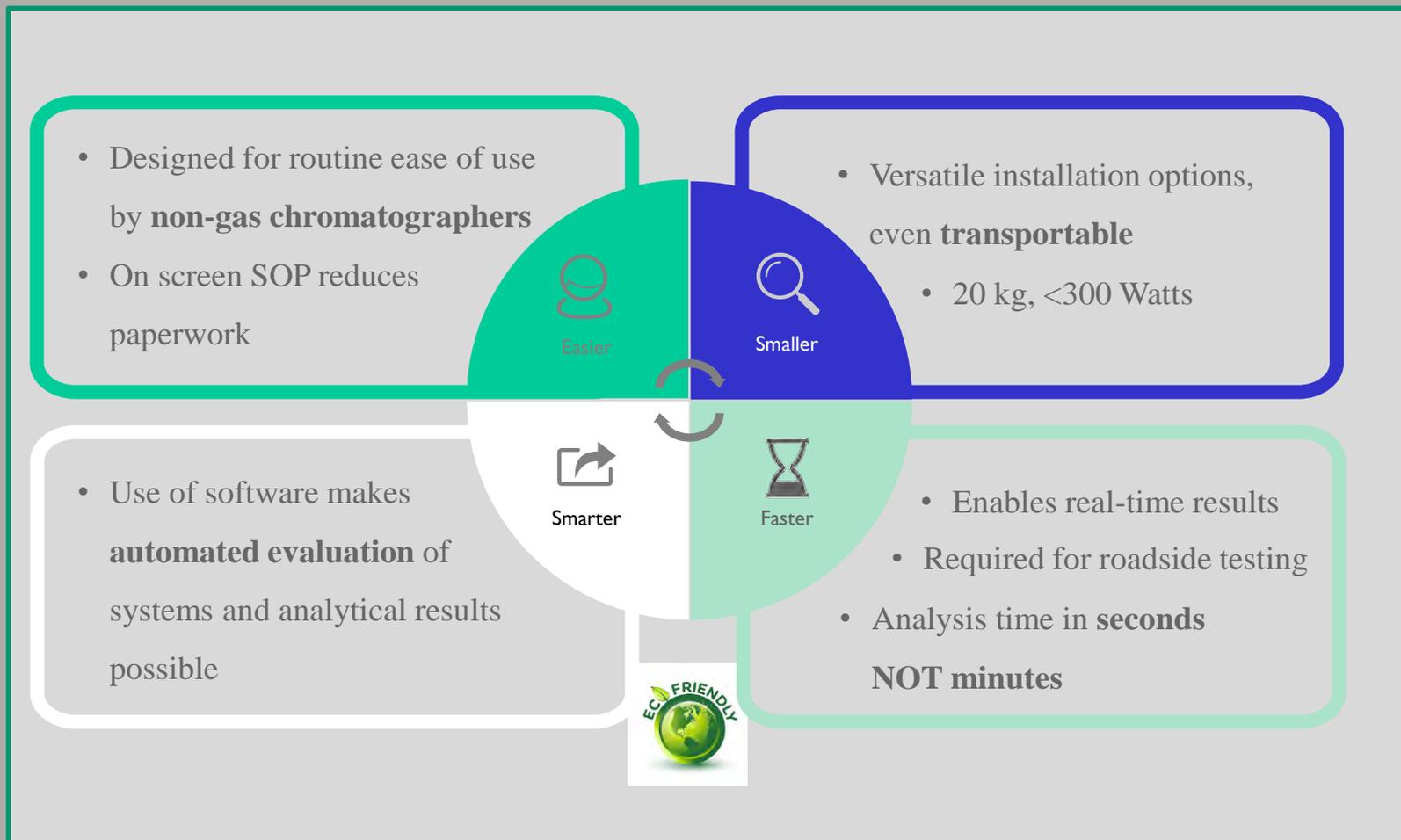
1. Quantitative Analysis

- Provide a means of accurately quantitating a small number of compounds
- Predicting a physical property or system parameter
- Unbundling a mixture

2. Qualitative Analysis

- Evaluate a pattern of components to determine if the mixture is within specifications

Easier, Smaller, Smarter, Faster, Greener



Transportable, Fast, Simple, Capable GC



In the Hands of Fuel Inspectors

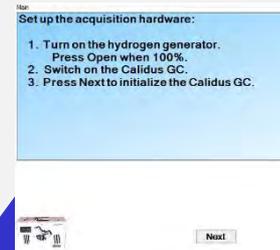
Program Launch

Dedicated user interface for analytical and data security



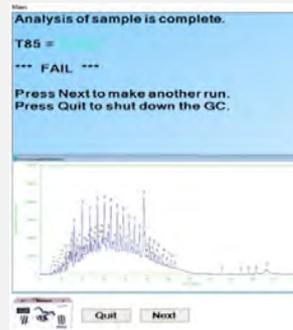
Step by Step Instructions

Reduces needs for printed SOP



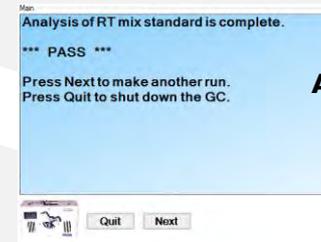
On Screen Results

Dependable results on screen in about 3 minutes



Automatic Daily Calibrations

Assures instrument is working within specifications every day

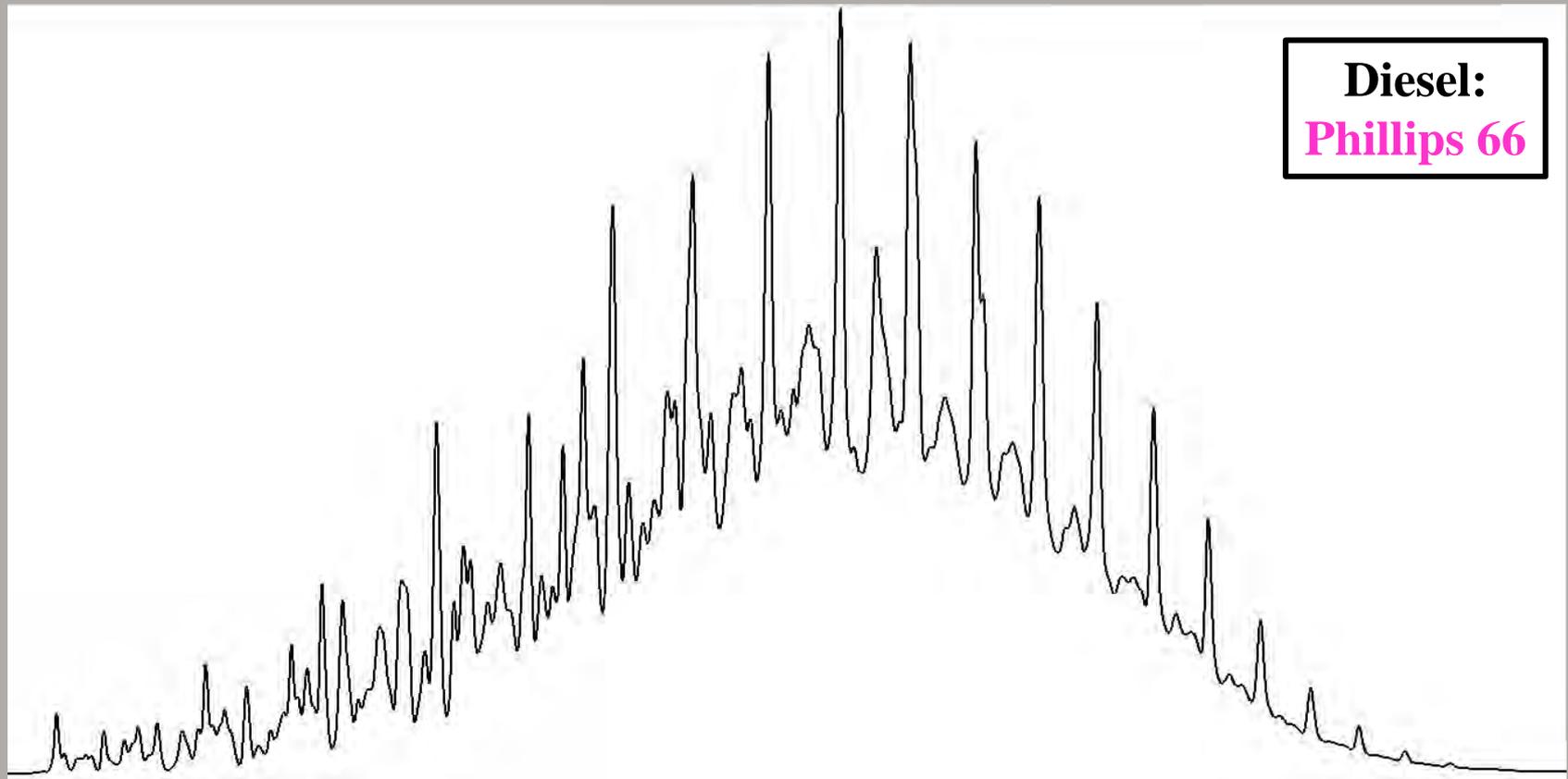


A Complete Solution

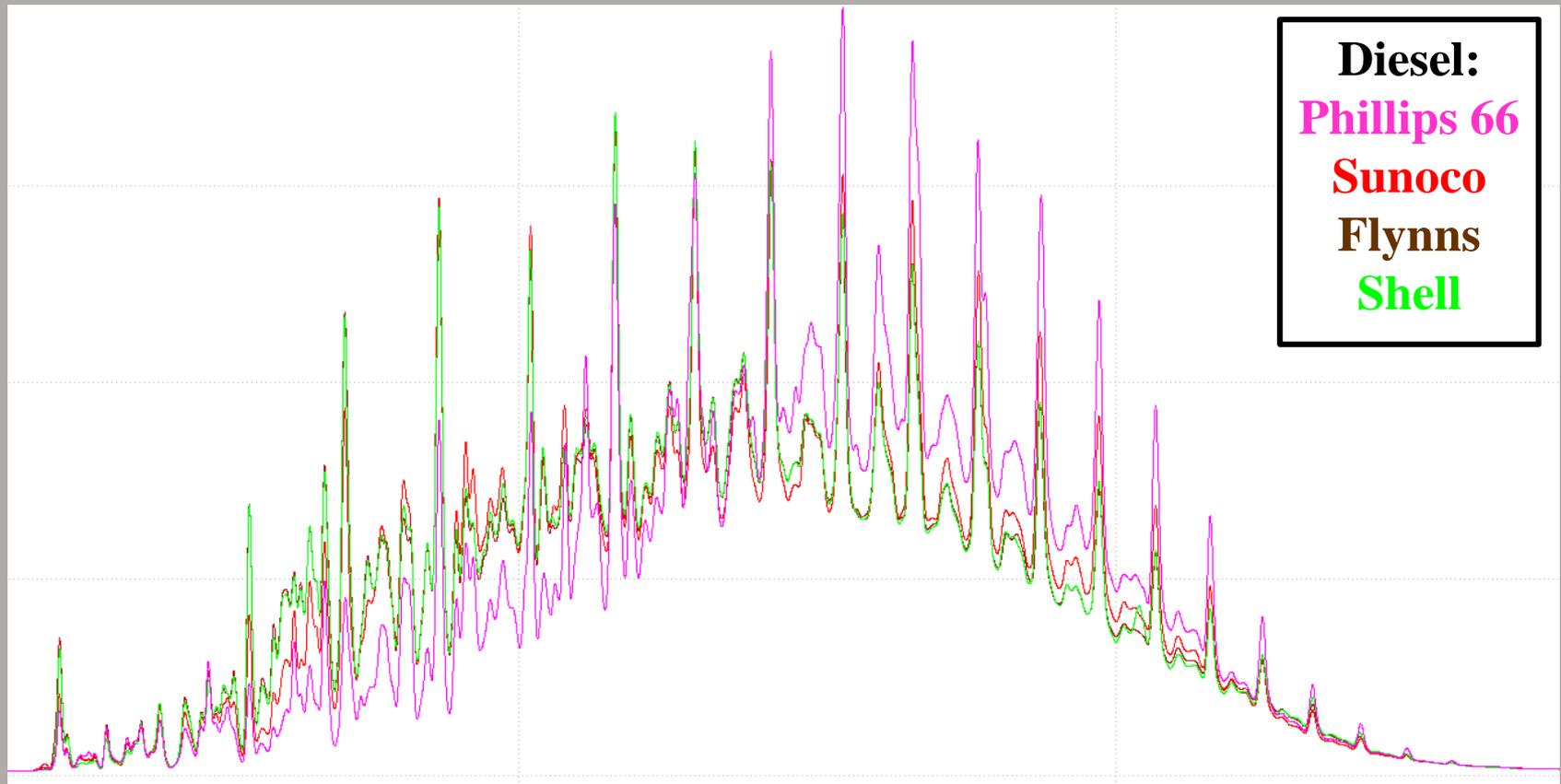
Data Input Fields

Field notes integrated with data file

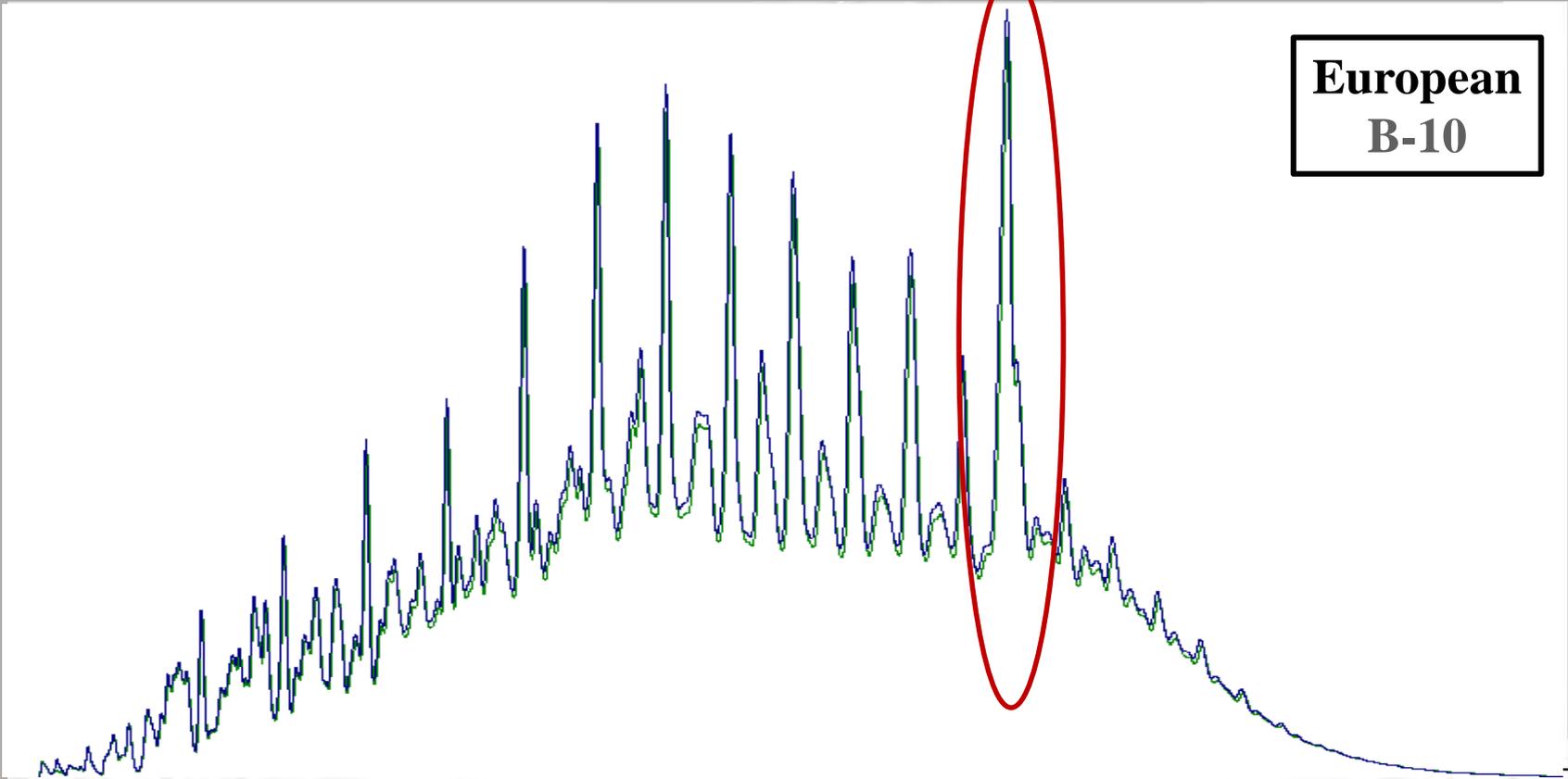
Refinery Diesel Fuels on D7798



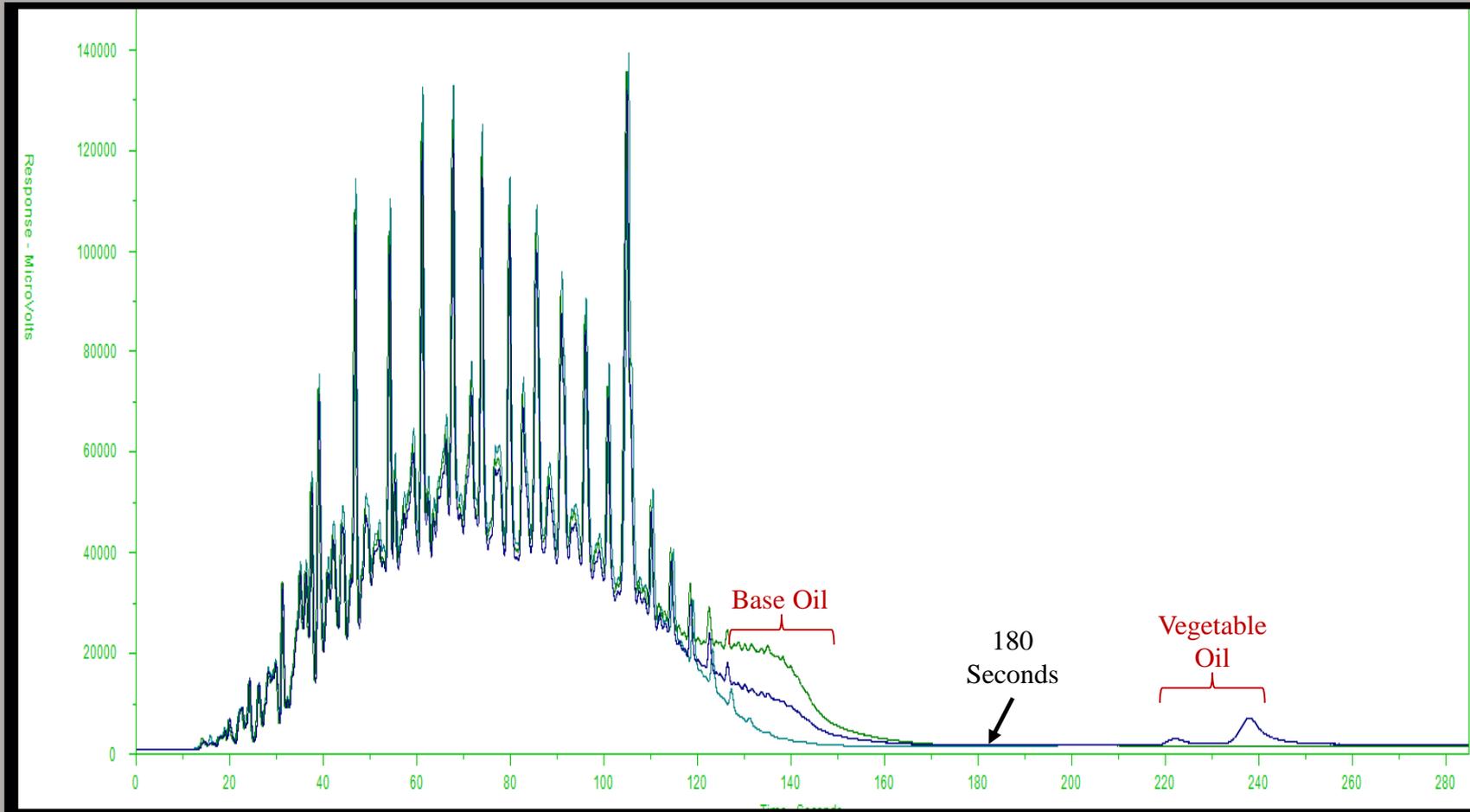
Refinery Diesel Fuels on D7798



Biodiesel Added

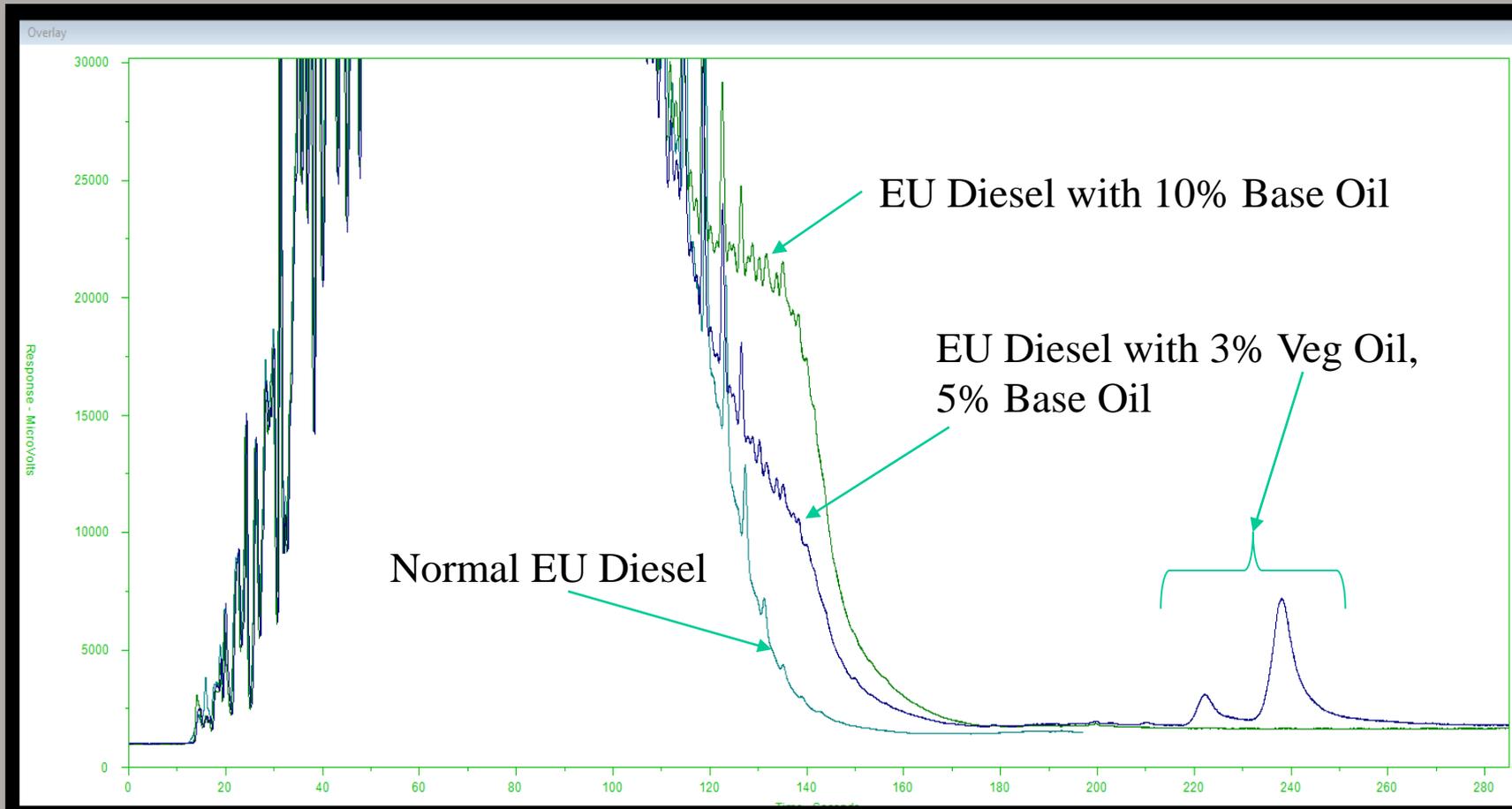


Processing on a Fully Transportable System

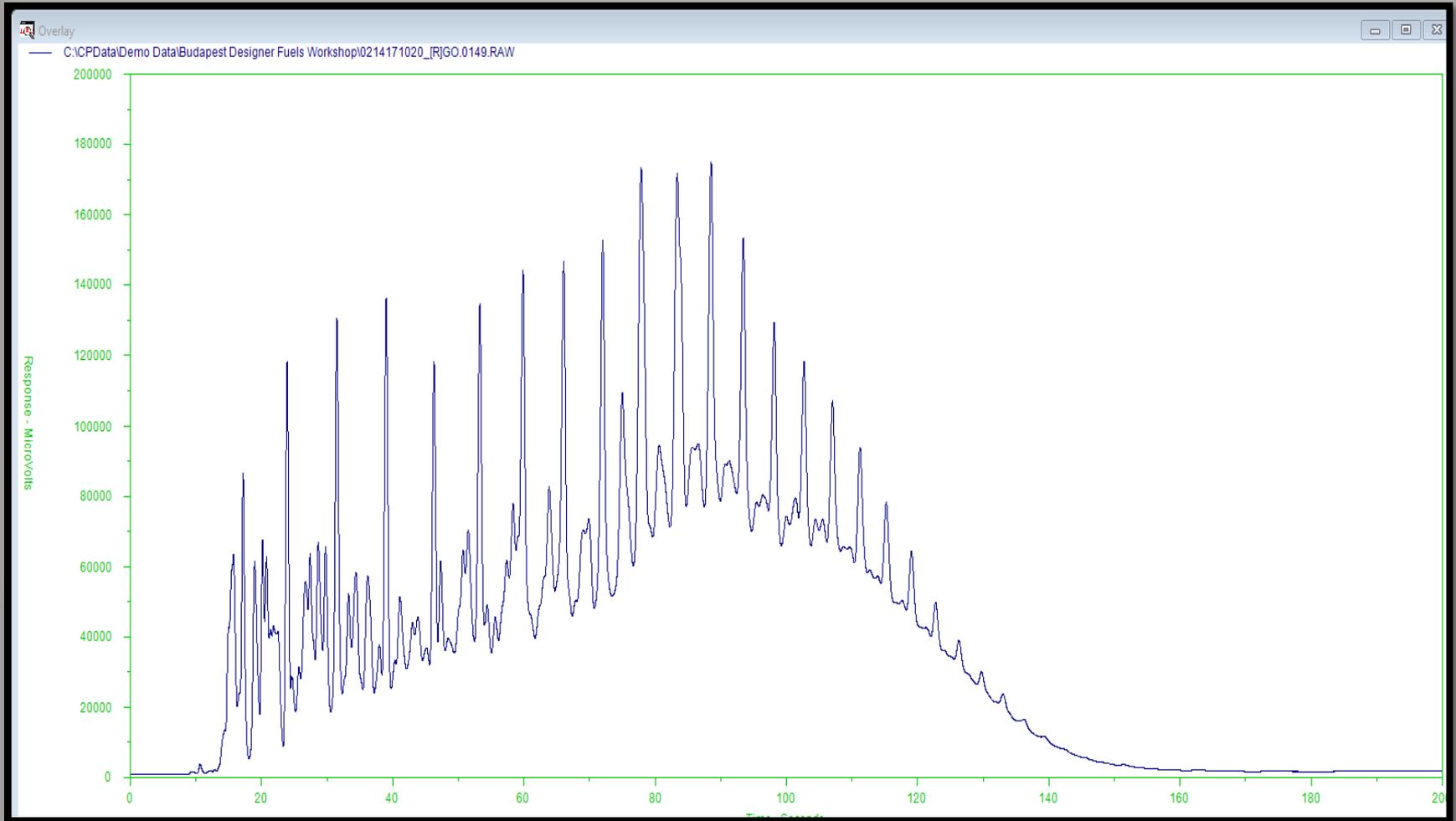


EU Biodiesel, 10% Base Oil Added and 5% Base Oil 3% Veg Oil

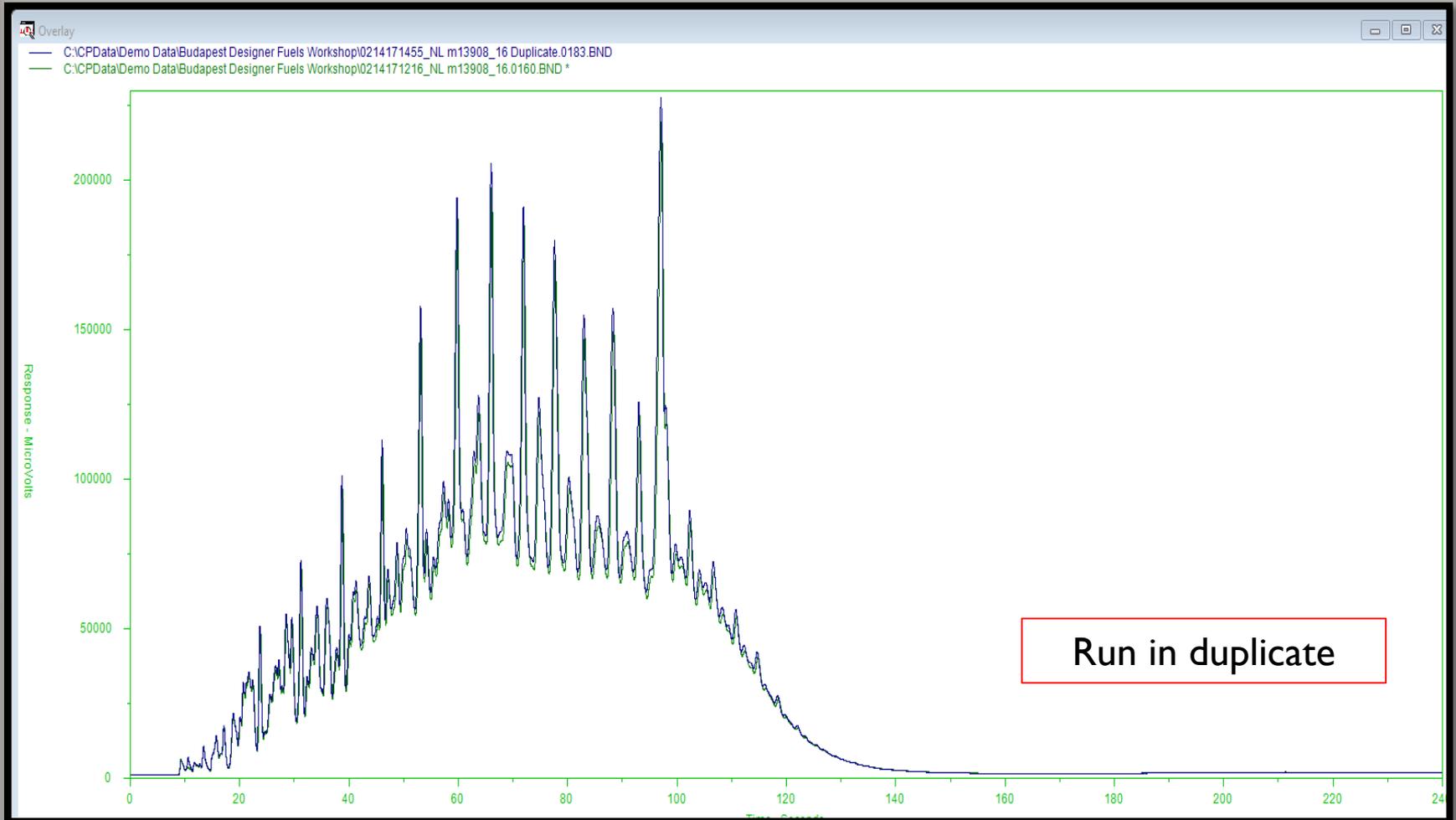
Same as Previous, Y-Axis Expanded



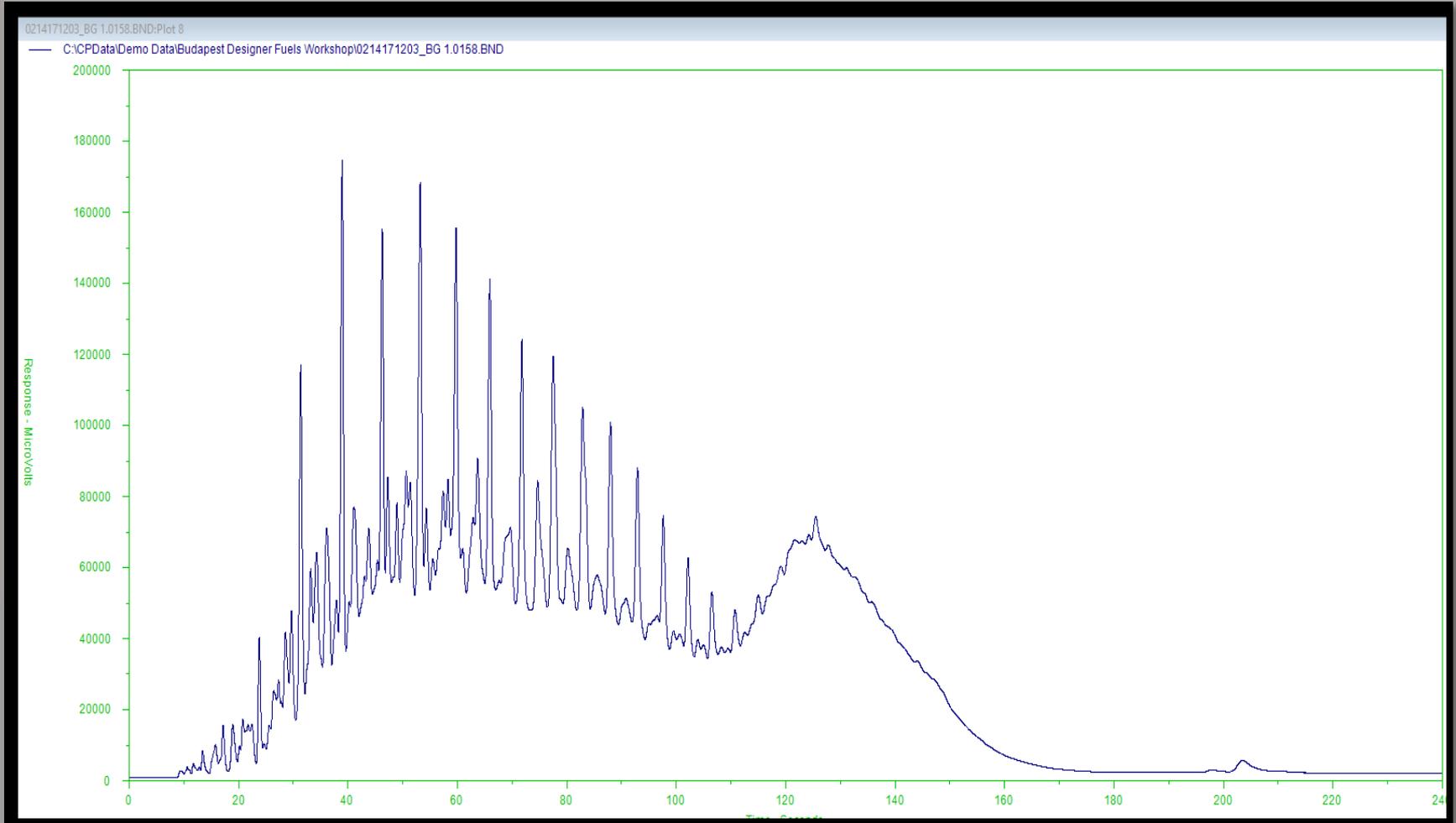
Reference Gas Oil



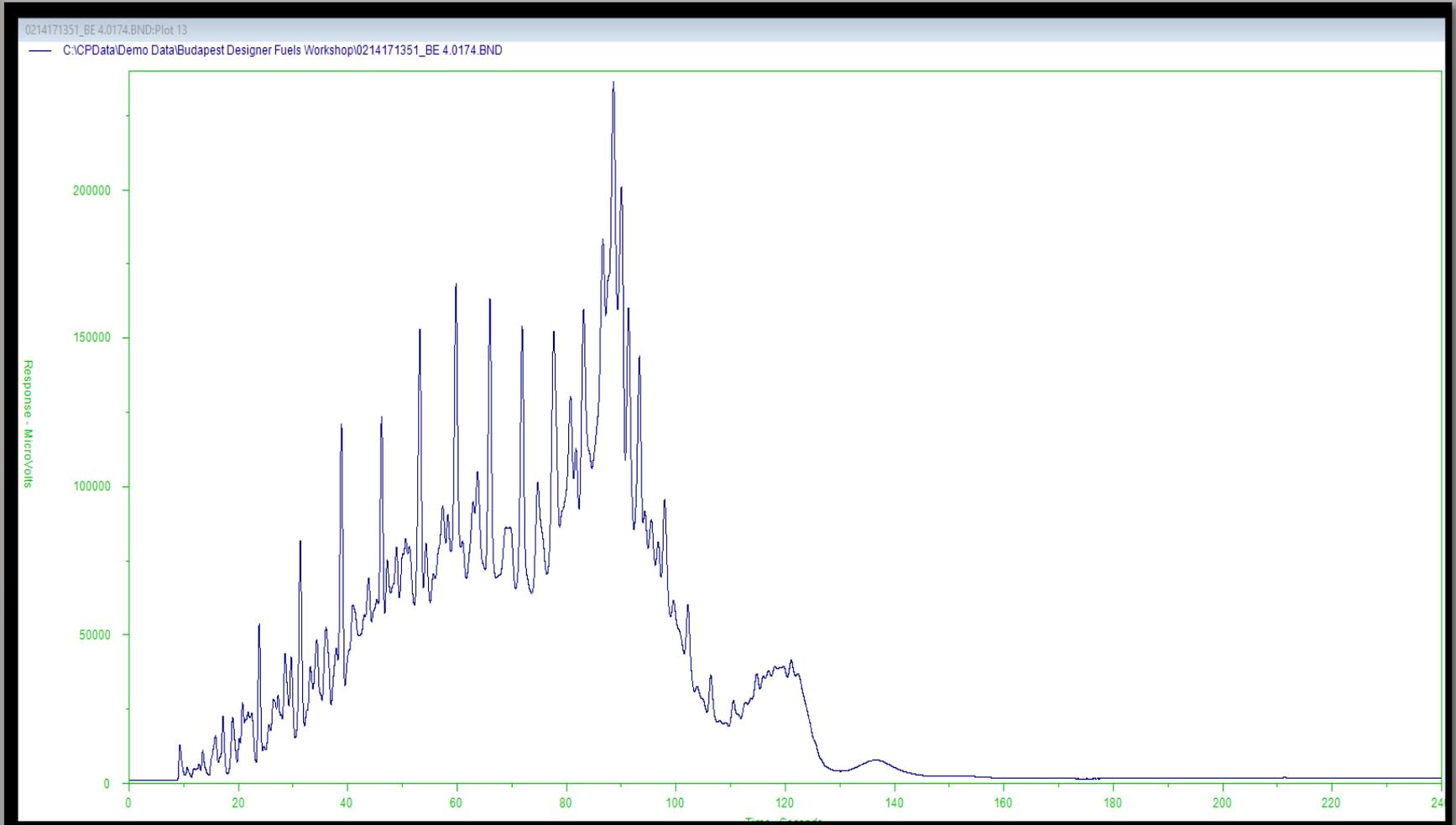
B I 0 Diesel from the Netherlands



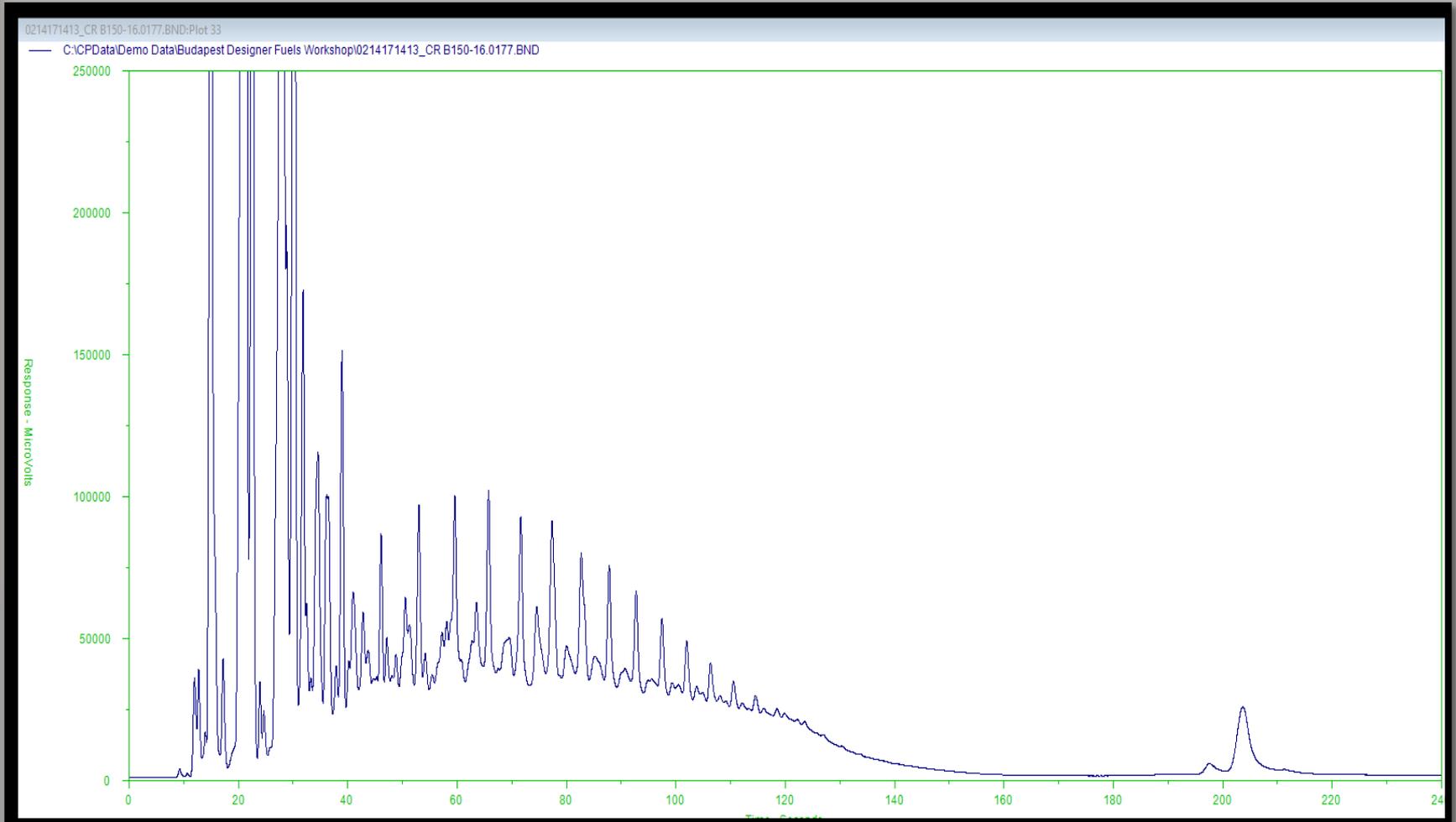
Belgian Captured Fuel #2



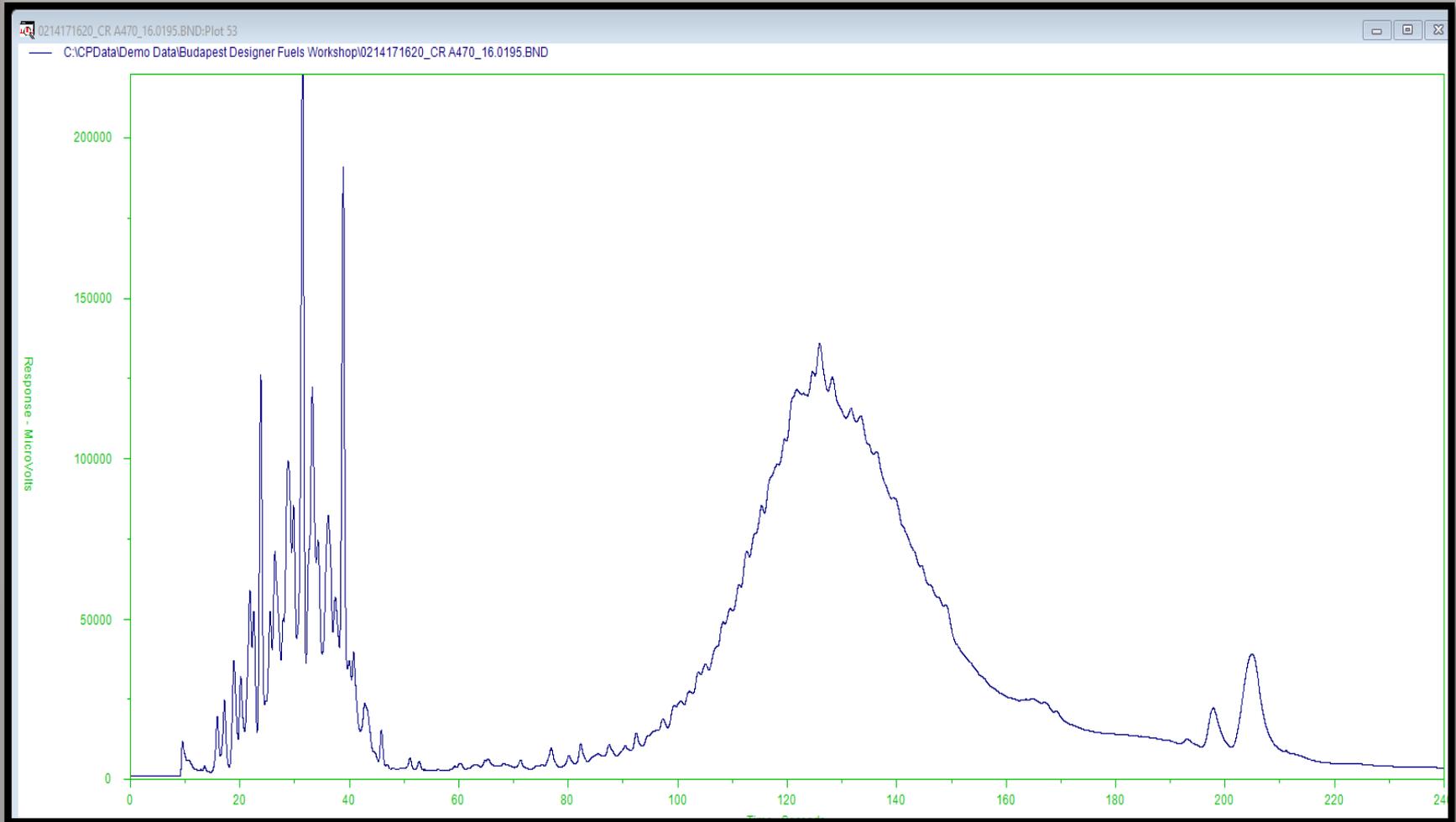
Belgian Captured Fuel #4



Czech Republic Capture B I 50



Czech Republic Capture A470



Analysis of Biodiesel-Diesel Blended Fuels by ASTM D7798

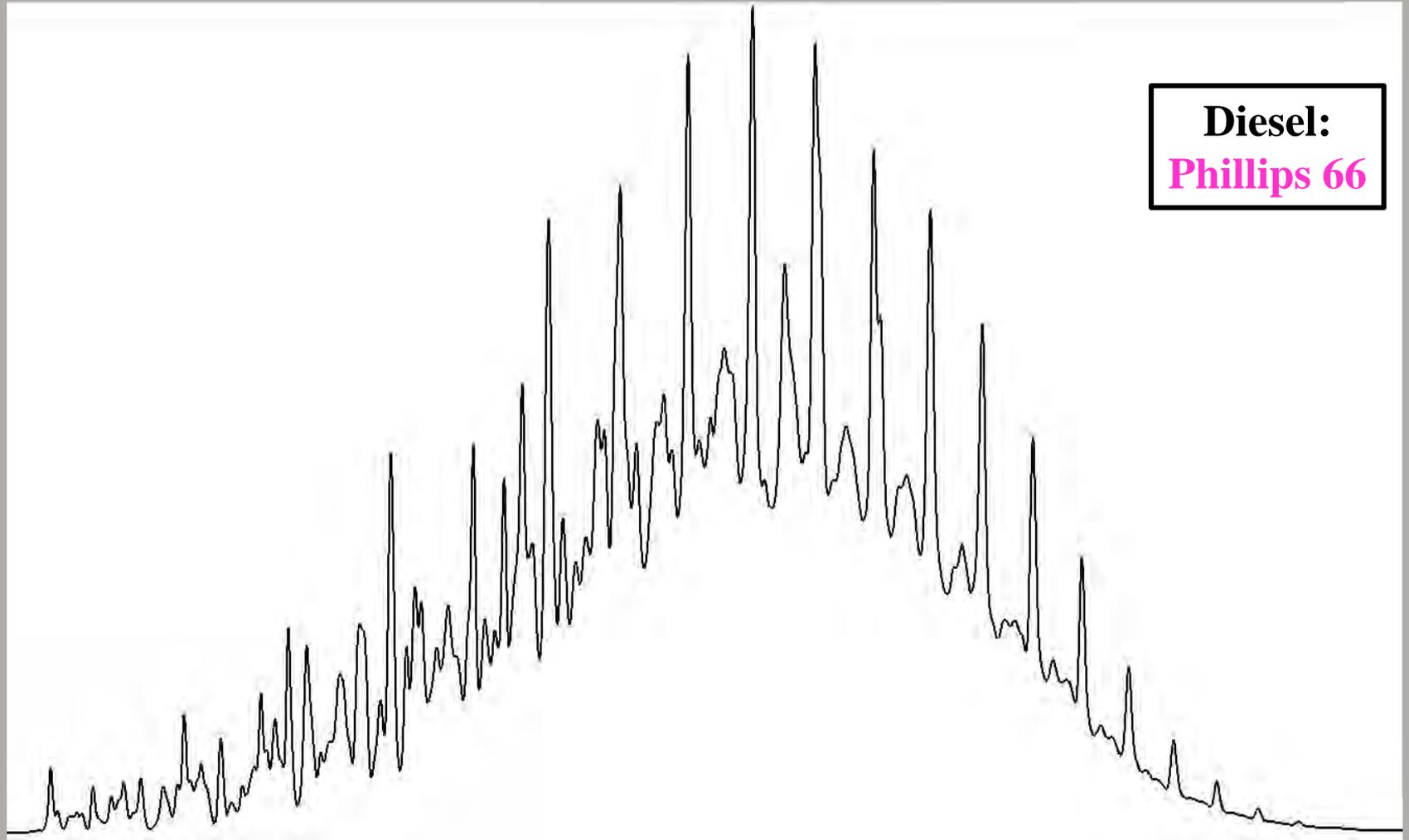
Identify and quantitate diesel fuel adulterants

Fast, precise and low bias

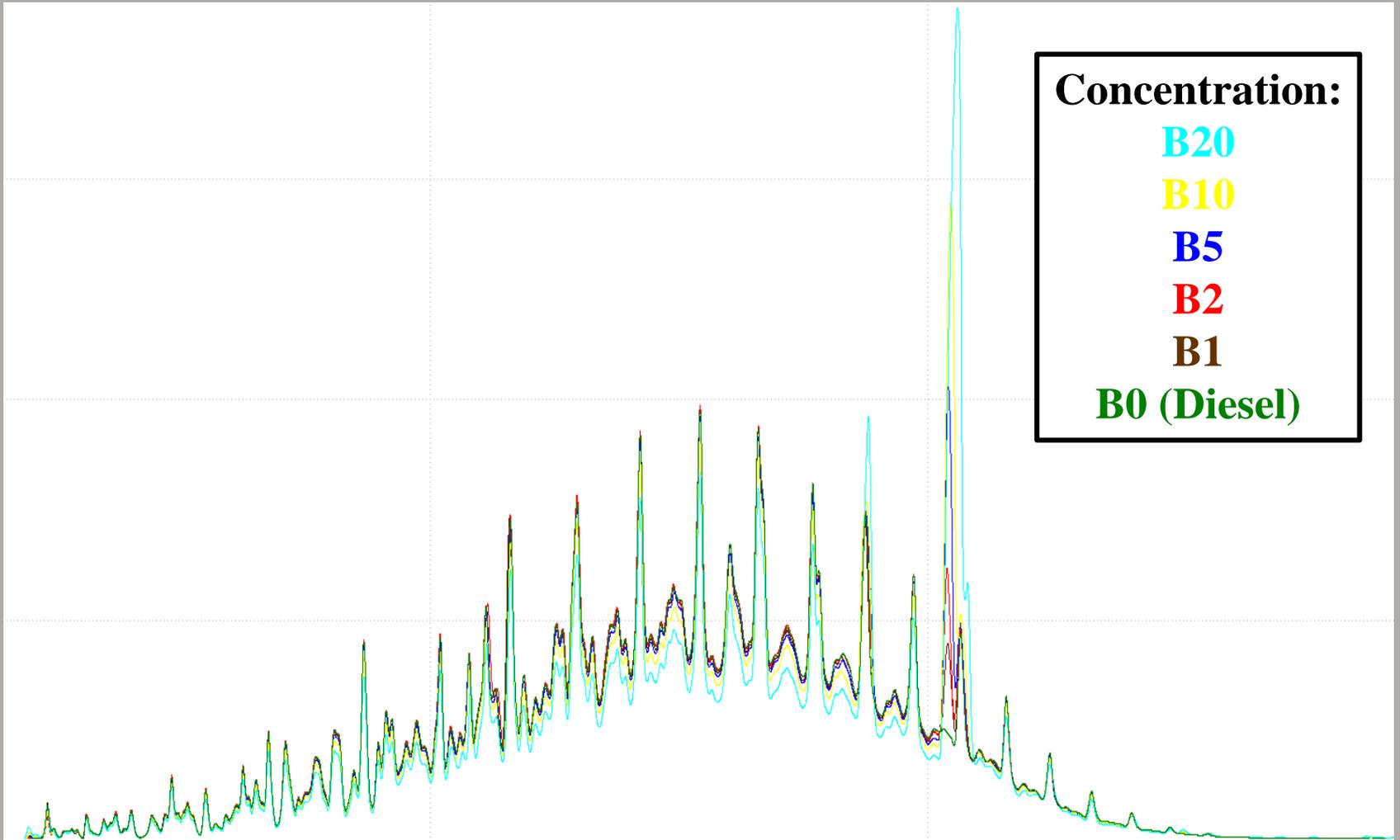
Sample Preparation

- Diesels acquired from four commercial sources:
 - Phillips 66, Sunoco, Shell, Flynn's
- Biodiesels acquired commercially or prepared in-house via transesterification. Feedstocks include:
 - canola, soybean, flaxseed, camelina, safflower, sunflower, waste grease, tallow (beef, pork/beef/poultry/soy blend)
- Samples include:
 - pure diesel, pure biodiesel (100%)
 - biodiesel diesel blends, concentrations (v/v): 1, 2, 5, 10, 20%
 - binary mixtures of biodiesel, real and prepared test unknowns
- In total, 180 samples were run using D7798 with Falcon UFGC.

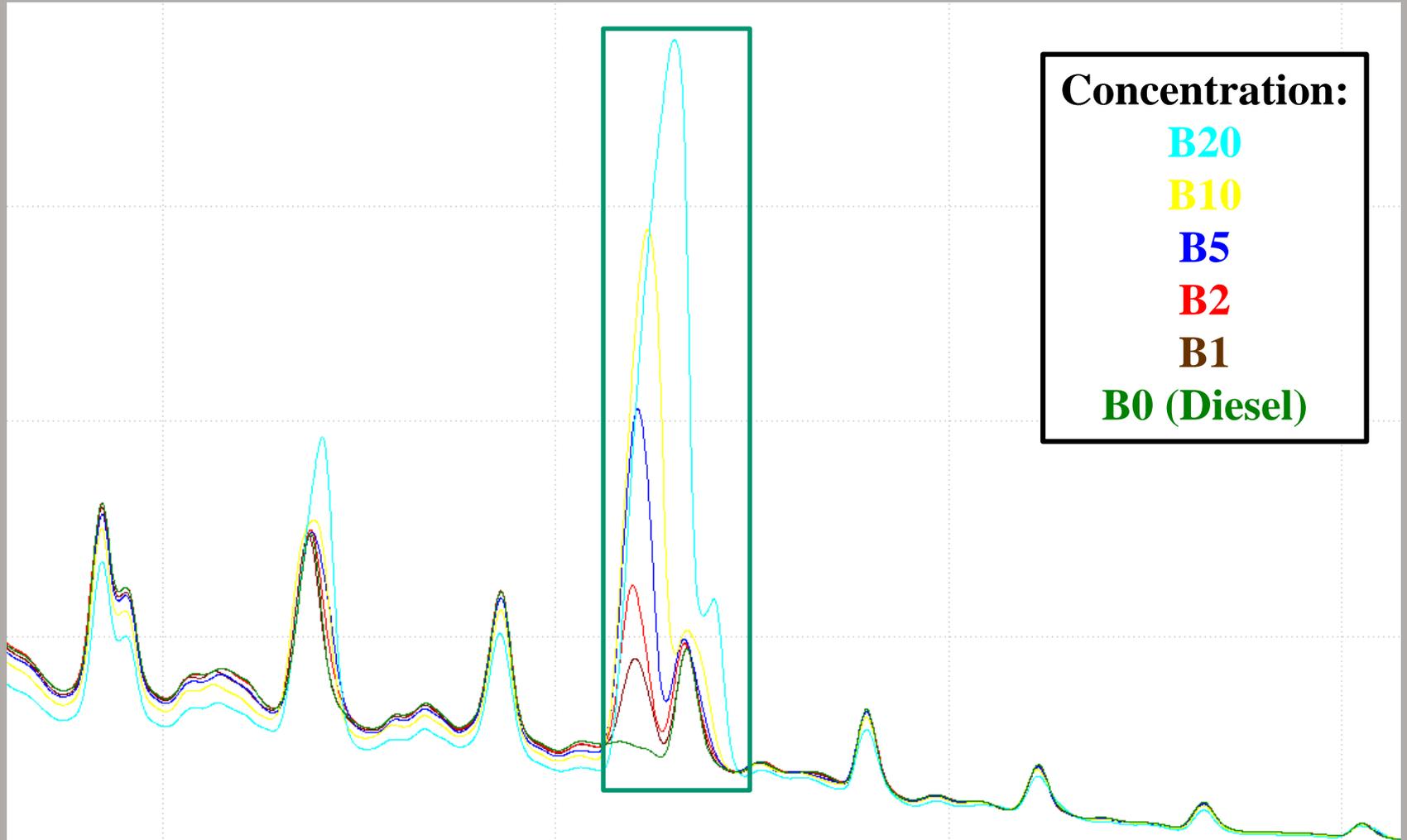
Pure Diesel Fuels on D7798



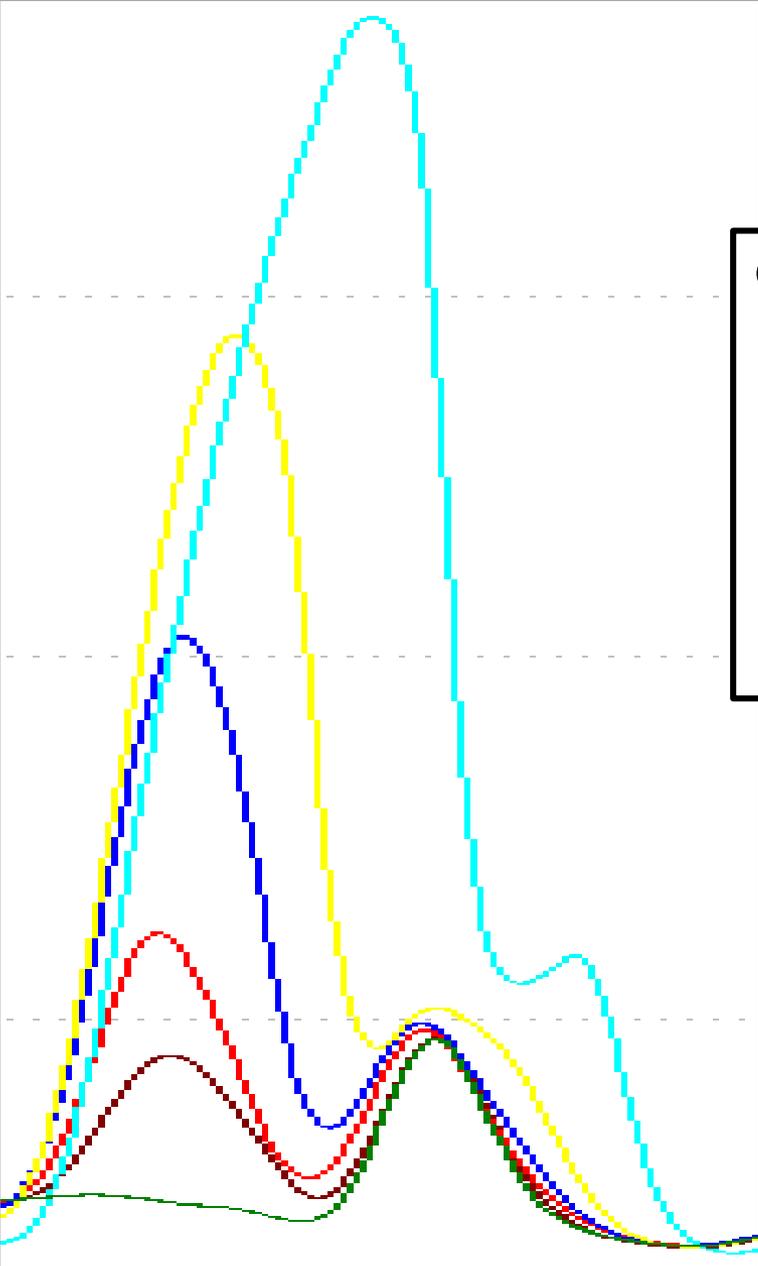
Soybean Biodiesel, Phillips Diesel



Soybean Biodiesel, Phillips Diesel



Soybean Influence



Concentration:

B20

B10

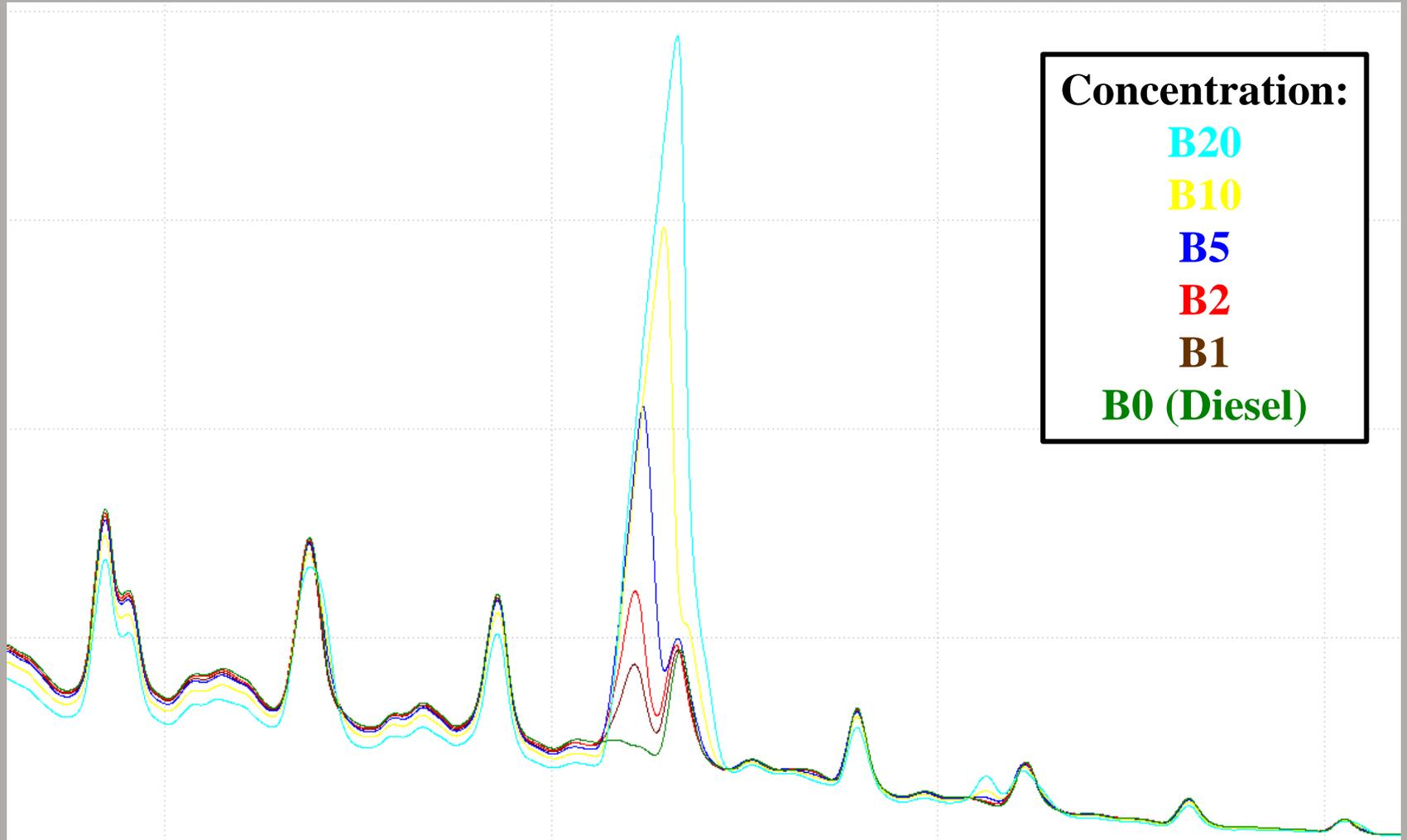
B5

B2

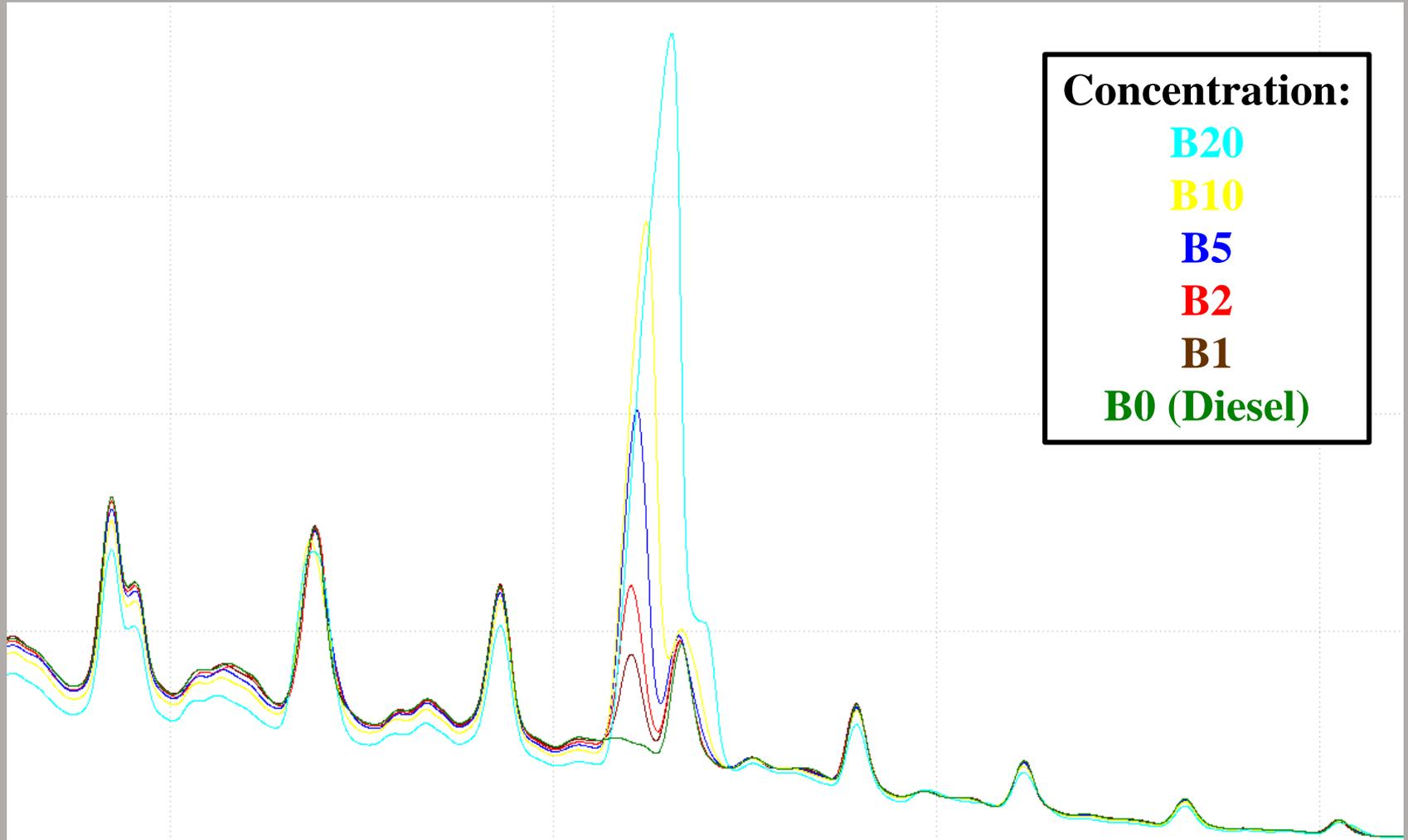
B1

B0 (Diesel)

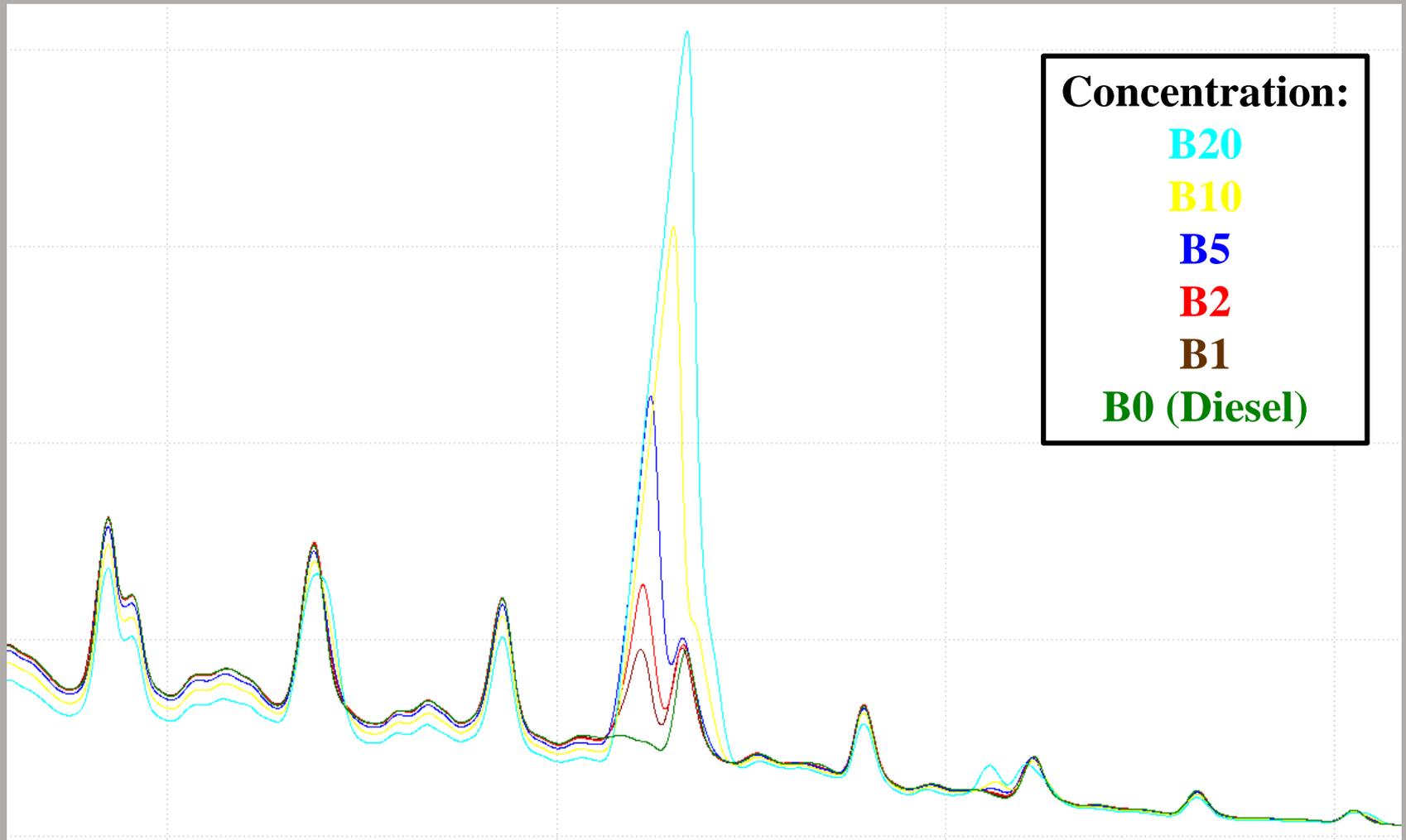
Soyabean Biodiesel, Phillips Diesel



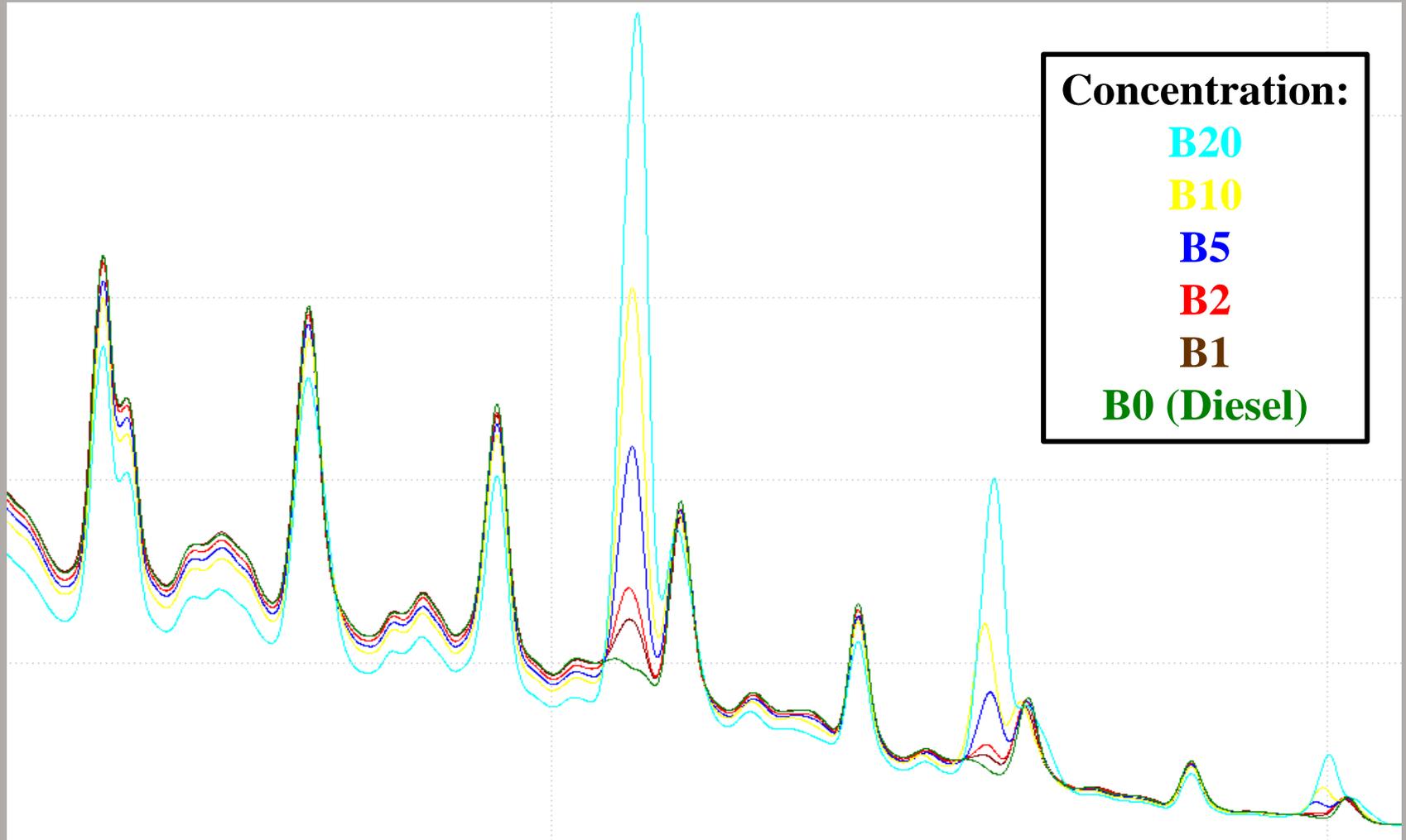
Flaxseed Biodiesel, Phillips Diesel



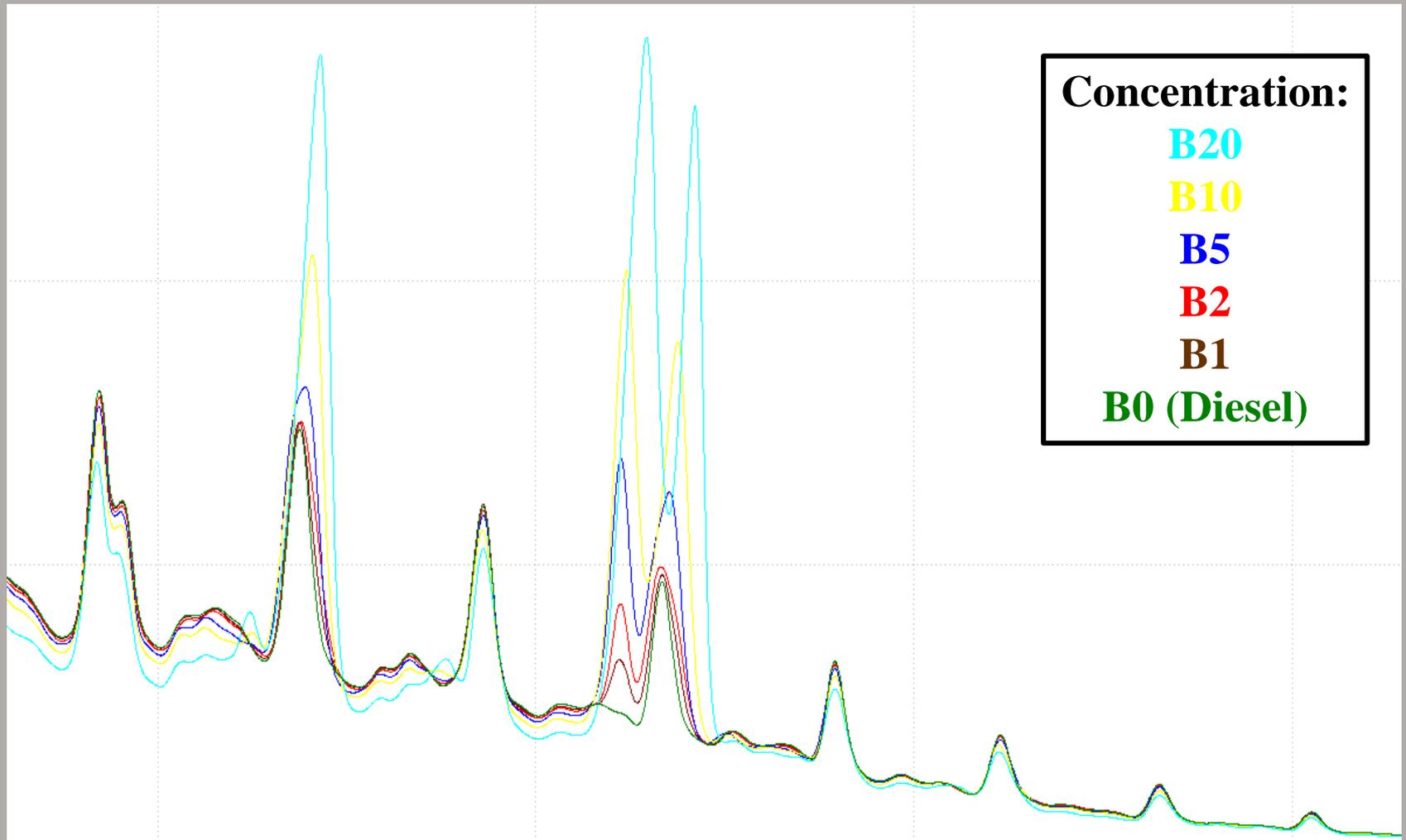
Canola Biodiesel, Phillips Diesel



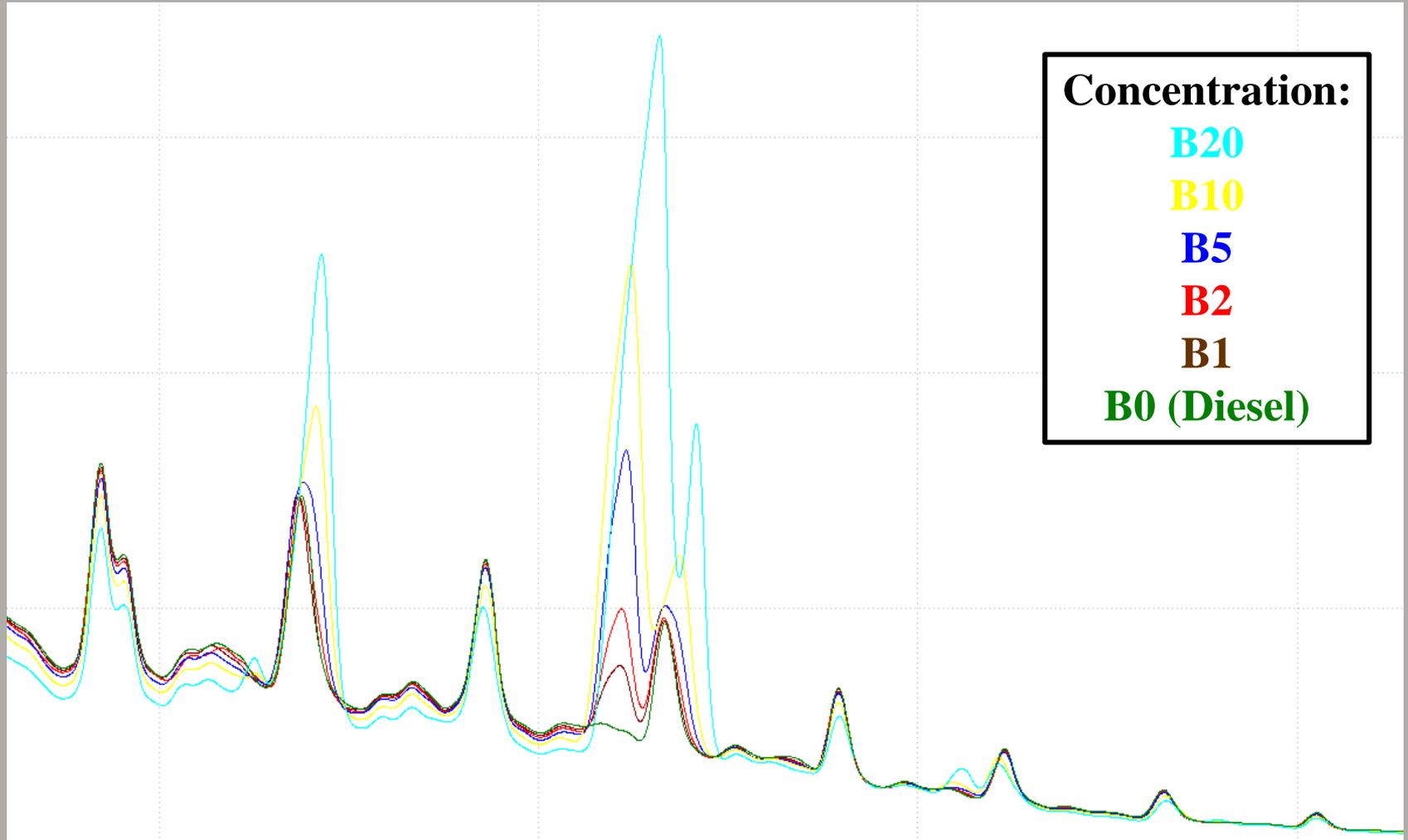
Camelina Biodiesel, Phillips Diesel



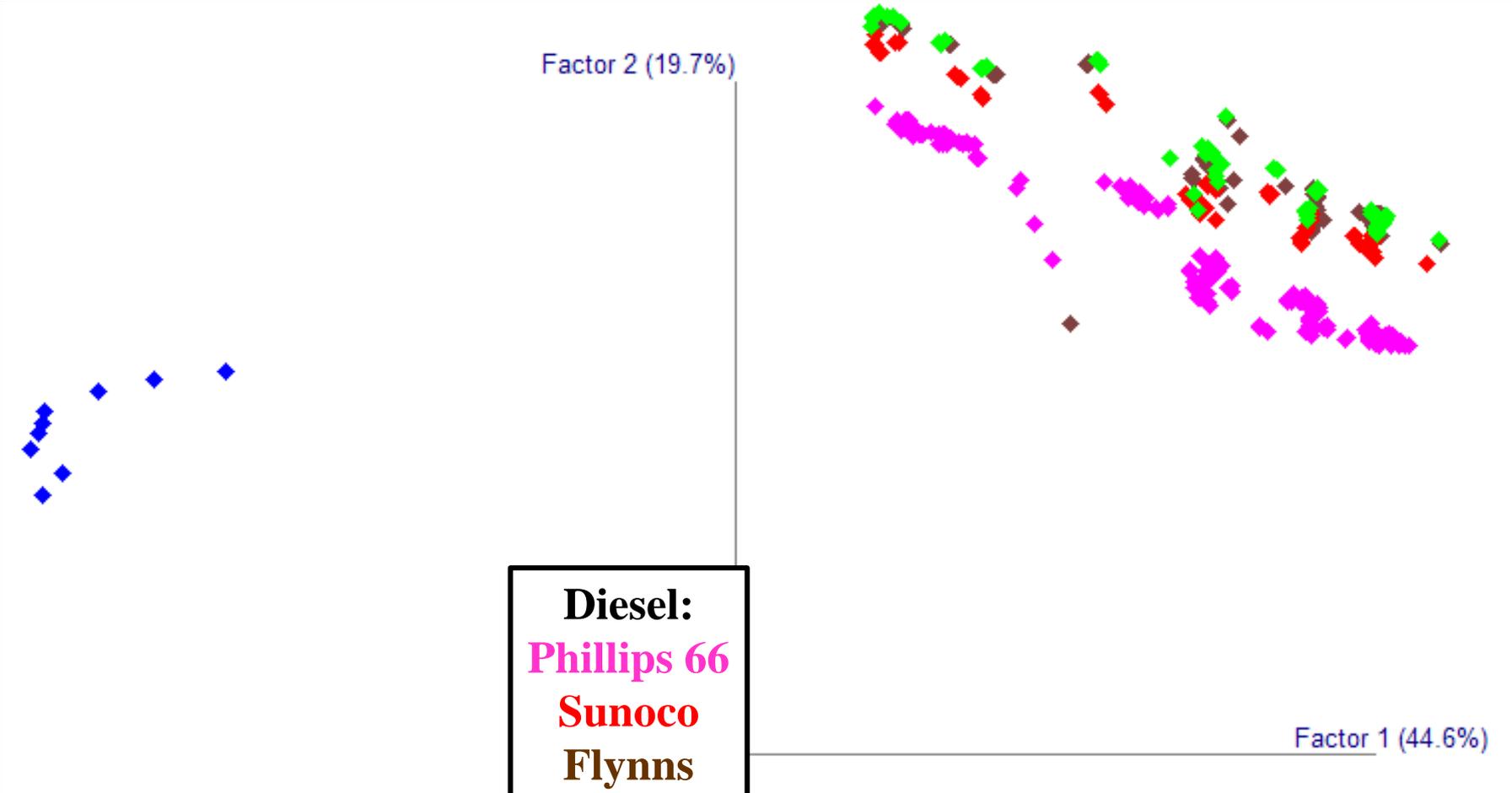
Tallow Biodiesel, Phillips Diesel



Tallow Biodiesel, Phillips Diesel

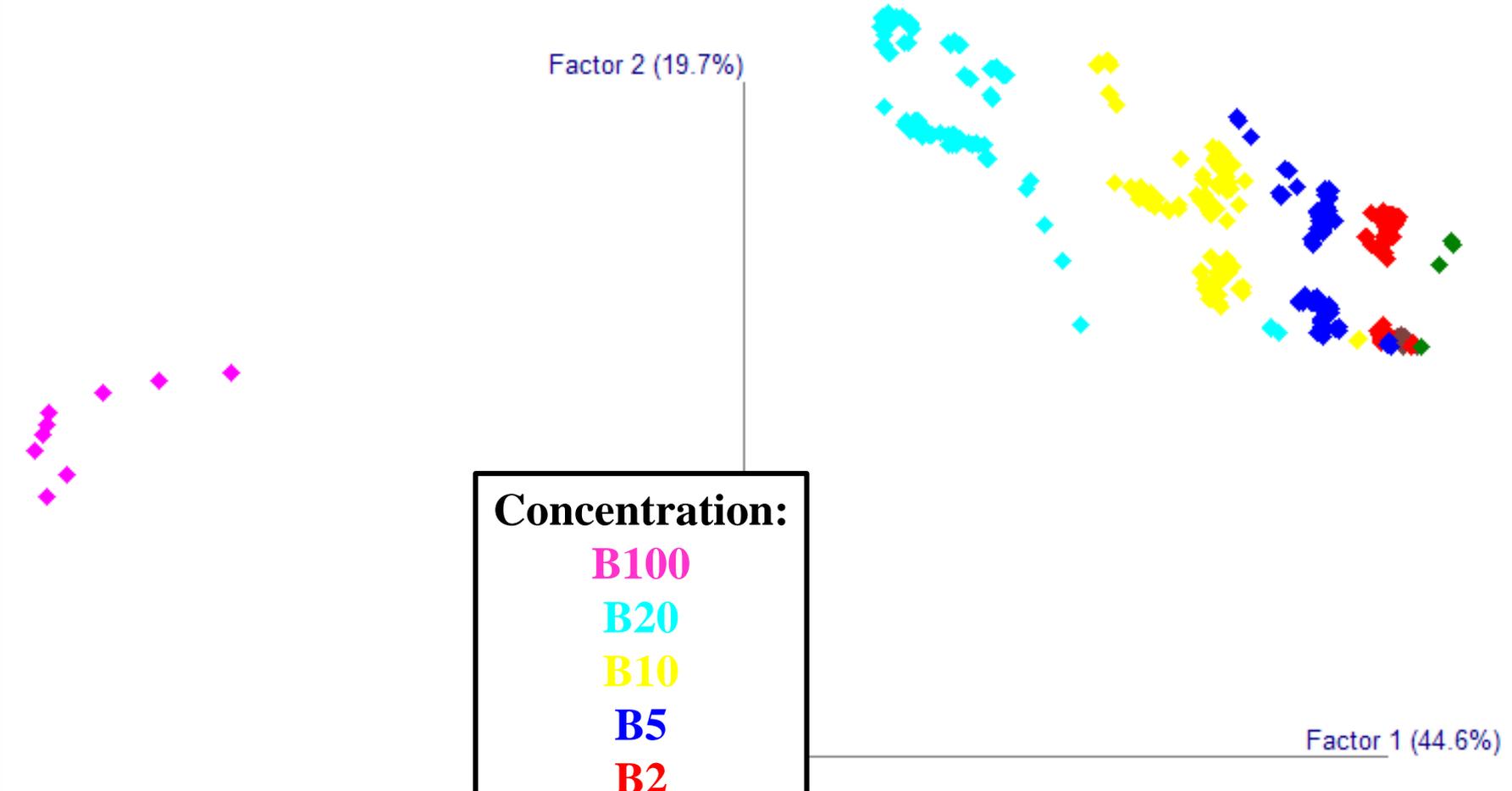


PCA Results



Diesel:
Phillips 66
Sunoco
Flynn's
Shell
Biodiesel

PCA Results



Conclusions

- There are challenges in taking a GC method on the road to flush out fraud
 - Transportable means that power consumption must be minimized without sacrificing analytical prowess
 - The system must be fast to set up, fast to run samples (cycle time), and easy for a non-chromatographer to use
 - Automation must include an objective interpretation
 - The GC system must be reliable and repeatable, from instrument to instrument
- D7798 has proven to be a fast and useful method for identification and quantitation of biodiesels blended with diesel fuels

Acknowledgements

- Dr. Amber Hupp, Professor Holy Cross College
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(meeting in Budapest 2017)