



Office: 5072 Vista View Crescent  
Nanaimo B.C. V9V 1L6  
Tel: 250-751-8890; Fax: 250-751-8225  
Email: [dmalley@pdkprojects.com](mailto:dmalley@pdkprojects.com); [philwilliams@pdkgrain.com](mailto:philwilliams@pdkgrain.com)  
Laboratory: #2-12 McGillivray Place  
Winnipeg MB R3T 1N4 Canada  
[www.pdkprojects.com](http://www.pdkprojects.com)

March 2007

## Service and Support for Near-infrared Spectroscopy Applications: Biodiesel Industry

- Advice on instrument purchase
- Advice and assistance in establishing an operation, including calibration, reference analysis, and logistics
- Troubleshooting an existing operation
- Training in practical NIRS theory and operation for users

### *What is Near-infrared Spectroscopy (NIRS)?*

NIRS is a technology that uses the property of organic materials to absorb near-infrared light. This enables analysis for composition and functional properties. Near-infrared light is light with wavelengths of 700 to 2500 nm, next to and longer than visible light. Specific features of the absorption of the near-infrared light by the organic materials are used in the calibration process. Calibration involves developing a mathematical model between the spectral features of a set of samples and chemical or other conventional analytical data (reference data) on the same samples. Once NIR instruments are calibrated, they accurately predict the quantities of up to 30 constituents or functional properties of new samples simultaneously in seconds. Little or no sample preparation is required. Occasional conventional reference analyses are required for QA/QC in a routine NIRS operation. Analysis by NIRS is rapid, cost-effective, non-destructive, and environmentally-safe. It is analysis where it is required, when it is required, and in real-time.

### *How does NIRS benefit the biodiesel industry?*

Near-infrared spectroscopy has been shown to be useful in monitoring the transesterification reaction used to convert vegetable oils, animal fats, or waste oils into biodiesel. Standards for biodiesel set by the American Society for Testing and Materials (ASTM) address the presence of materials such as free and total glycerol, water, free fatty acid, and residual alcohol. These materials need to be limited in biodiesel so that it does not deteriorate during storage and it is safe for use in engines.

The NIR technology can be deployed in several ways in the biodiesel industry. These include the analysis of the fatty acid composition of oilseeds or of the vegetable oils derived from them to be used as feedstock. Secondly, using fibre optic probes, NIRS can be used to continuously monitor the transesterification process. In this way, NIRS indicates at various stages that the process is progressing as desired. Thirdly, although less sensitive than the standard gas chromatography (GC) usually used for quantifying minor components in biodiesel, NIRS can assess the quality of the completed biodiesel. It can be an alternative not only to GC but also to other methods for biodiesel standards, such as flash point used to determine residual alcohol. Finally, it is used to determine the composition of the blends of biodiesel with fossil diesel offered at the pump.

The reference analyses used for the calibration of the NIR instruments are performed using the analytical methods applied in determining biodiesel quality. These include GC, high-performance liquid chromatography prior to GC, and <sup>1</sup>H nuclear magnetic resonance spectroscopy (NMR). The use of NIRS for routine analysis at various points in the biodiesel industry reduce the lengthy time and considerable cost of conventional methods for determining whether biodiesel meets the standards. The technology also allows many more samples to be tested than would otherwise be the case, better ensuring a product that meets the standards and the expectations of customers.

## ***PDK Projects, Inc.***

PDK Projects, Inc. is a Canadian company with unique professional experience and credentials to support the application of near-infrared spectroscopy in agriculture and the environment. The company was incorporated in Manitoba in 1997 and registered in British Columbia in 1999.

NIRS experts, Dr. Phil Williams (analytical grain chemist) and Dr. Diane Malley (aquatic scientist), bring 50 years of combined experience in NIRS.

### **Dr. Phil Williams**

- 37-year career as Head, Analytical Methods Development and Services, Grain Research Laboratory, Canadian Grain Commission, Winnipeg, Canada
- purchased the second commercial NIRS instrument ever manufactured in 1972 and worked with the then nascent industry to assist the engineers to increase reliability for grain analysis
- established NIRS as the primary method of analysis of protein throughout Canada's export wheat terminals in 1975-76
- over decades has worked with a wide range of applications of NIRS in plants, elevators, and other industrial settings, including distilleries and feed mills.
- technical missions and consulting on grain quality and/or NIRS in over 40 countries
- recipient of 5 international awards for excellence in NIRS application
- co-author of two editions of reference book used world-wide, Near-infrared Technology in the Agricultural and Food Industries
- developed a two-day course for NIRS users including 140-page manual; delivered in 7 countries.

### **Dr. Diane Malley**

- 21-year career as Research Scientist and Section Manager with Department of Fisheries and Oceans, Winnipeg, Canada
- 16 years experience with innovative applications of NIRS for environmental monitoring and aquatic ecosystem protection with emphasis on field-portable instruments
- pioneered application of NIRS to hog manure nutrients and metals
- inventor on patent for NIRS flow-through cell for liquids and slurries

## ***What can PDK Projects, Inc. do for you?***

The choice of a NIR instrument to purchase can be daunting. There is a wide selection of instruments on the market varying in price, wavelength range, resolution, sample presentation, operating and calibration software, and ease of networking. PDK has wide experience with the industry, has worked with 20 instrument companies, and can advise on the one or a small number of instruments that can do the job. Perhaps your operation already has an instrument that has been delivered, set up to operate, and tested to be in perfect operating order. We play the important roles of:

- assisting in the development of reliable calibrations and on-going monitoring of the performance of calibrations, including instructing on the statistics to use in documenting calibration performance
- advising on reference testing methods and monitoring their performance
- instructing staff on instrument operation, including sample presentation, quality assurance/quality control (QA/QC), monitoring instrument accuracy and stability, and updating calibrations
- troubleshooting suboptimal performance of an operation.

## ***Is NIRS being used in the biodiesel industry?***

The NIRS industry supplies several instruments used for biodiesel analysis. One dedicated instrument determines the content of fatty acid methyl ester chains in biodiesel/fossil diesel blends. It also determines other ASTM standard components such as flash point, kinematic viscosity, cetane, acid number, cloud point, and total glycerin.

## ***For More Information***

- Call toll-free at 1-866-808-6735
- Visit [www.pdkprojects.com](http://www.pdkprojects.com) and use the contact form
- Email to [philwilliams@pdkgrain.com](mailto:philwilliams@pdkgrain.com) or [dmalley@pdkprojects.com](mailto:dmalley@pdkprojects.com)