

## Application Note

### Deuterium Oxide (D<sub>2</sub>O) in Water



#### Introduction:

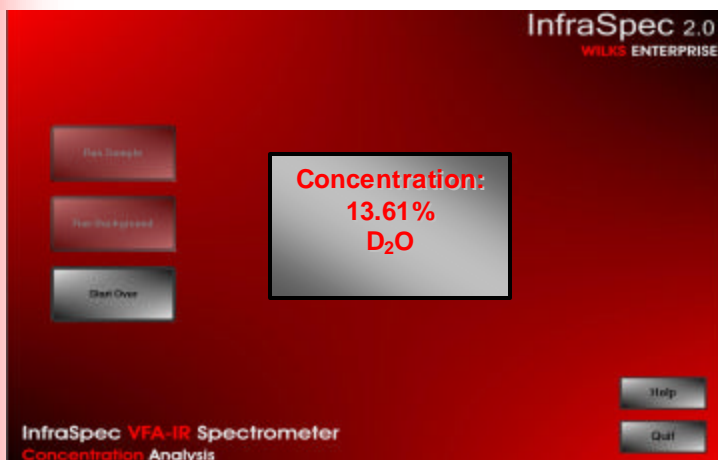
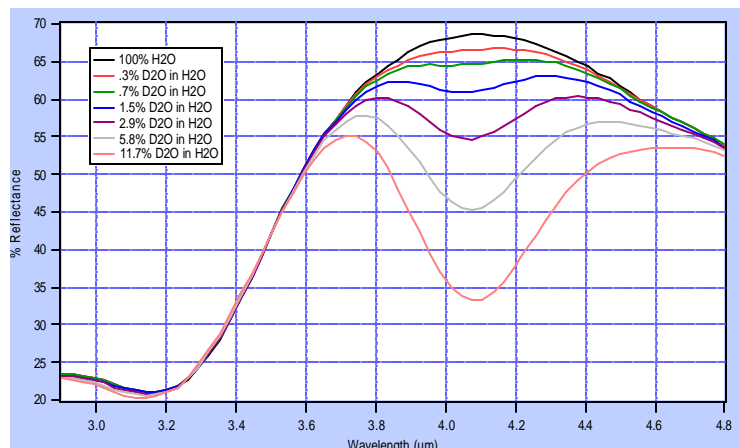
One use for D<sub>2</sub>O or heavy water is as a moderator in pressurized heavy water nuclear reactors. Water is used to transfer the heat energy from the D<sub>2</sub>O to the steam turbine. The measurement of D<sub>2</sub>O in water is important to determine whether there are any leaks between the water loop and the D<sub>2</sub>O loop. The InfraSpec VFA-IR Spectrometer can measure D<sub>2</sub>O concentrations in water from 0.01%.

#### Operating Principal:

The InfraSpec VFA-IR Spectrometer is a new concept in mid infrared instrumentation. It utilizes a patented design consisting of an electronically modulated source on one end and a linear variable filter (LVF) and 128 pixel detector array on the other. The result is a compact spectrometer with no moving parts, no optical path exposed to air. D<sub>2</sub>O has a specific absorption unique to water at 4.1 microns (2439cm<sup>-1</sup>). Quantitative measurements can be determined by the depth of the absorption band.

#### Analysis:

These spectra show the change in % reflectance due to different concentrations of D<sub>2</sub>O in water using an ATR sample plate. The InfraSpec VFA-IR software program can convert this data to a numeric value giving a readout in % D<sub>2</sub>O for a range of 0.2% to 100% with the ATR sample plate. With a transmission system and a sealed cell the effective path length is increased giving a % D<sub>2</sub>O range of 0.01% to 100%.



With an internal calibration table, the interface for the operator in the production is greatly simplified. If desired, a barcode scanner can identify the sample and the results can be accessed electronically from a remote laboratory. Spectra are also stored in the program for laboratory personnel to review if necessary.

### InfraSpec VFA-IR Spectrometer- ATR Sample Stage Specifications:

<b>D2O Measurement Range</b>	<b>0.2 minimum in H<sub>2</sub>O</b>
<b>H<sub>2</sub>O Measurement Range</b>	<b>0.2 minimum in D<sub>2</sub>O</b>
<b>Dimensions</b>	<b>6.5" x 4.25" x 1.6", 16.5 x 11 x 4 cm</b>
<b>Weight</b>	<b>3.5 lbs., 1.5 kg</b>
<b>P.C. Interface</b>	<b>RS 232 or USB</b>
<b>Power Requirements</b>	<b>12V DC, 2.0 amps</b>
<b>Power Supply</b>	<b>Universal AC/DC converter type (supplied as standard)</b>
<b>Suggested Temperature Operating Range</b>	<b>15°C - 60°C</b>
<b>Humidity</b>	<b>0 – 98% relative humidity (non-condensing)</b>
<b>Detector Array</b>	<b>128 Pixel linear pyroelectric array</b>
<b>Array Responsivity</b>	<b>5.4-10<sup>5</sup> V/W</b>
<b>Spectral Range</b>	<b>2.5-5.0 μm (4000-2000 cm<sup>-1</sup>)</b>
<b>For InfraSpec VFA-IR Spectrometer ATR Sample Plate</b>	
<b>ATR Crystal Material</b>	<b>Cubic Zirconia</b>
<b>ATR Surface Size</b>	<b>50 x 16 mm</b>
<b># of Reflections</b>	<b>10</b>
<b>Resolution</b>	<b>25 cm<sup>-1</sup></b>

### InfraSpec VFA-IR Spectrometer Transmission/Sealed Cell Sample Stage Specifications:

<b>D<sub>2</sub>O Measurement Range</b>	<b>0.01 minimum in H<sub>2</sub>O</b>
<b>H<sub>2</sub>O Measurement Range</b>	<b>0.01 minimum in D<sub>2</sub>O</b>
<b>Dimensions</b>	<b>6.5" x 4.25" x 1.6", 16.5 x 11 x 4 cm</b>
<b>Weight</b>	<b>3.5 lbs., 1.5 kg</b>
<b>P.C. Interface</b>	<b>RS 232 or USB</b>
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<b>Spectral Range</b>	<b>2.5-5.0 μm (4000-2000 cm<sup>-1</sup>)</b>
<b>Resolution</b>	<b>25 cm<sup>-1</sup></b>
<b>Sealed Cell path length range*</b>	<b>0.05 - 0.2mm</b>

\* Sealed cell provided by customer

**Wilks Enterprise, Inc.**

140 Water Street · South Norwalk, CT 06854 USA

Tel: 203-855-9136 · Fax: 203-838-9868

E-Mail: info@wilksir.com · www.wilksir.com

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