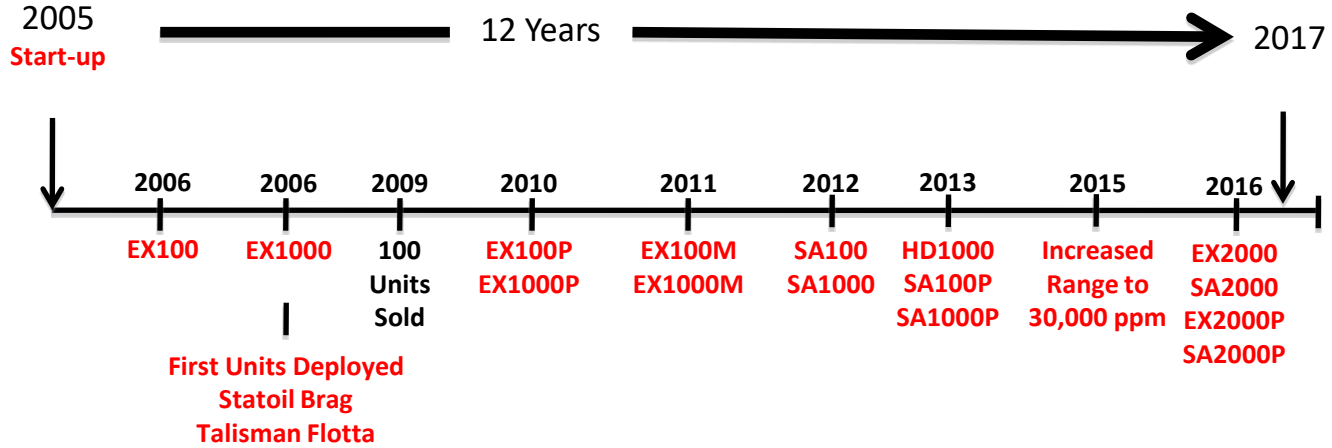


AN ONLINE MONITORING SYSTEM FOR THE CONTINUOUS MEASUREMENT OF NON-FLUORESCENT OIL IN WATER

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Customer Driven Innovation



Online Measurement Techniques

	Microscopy	Fluorescence	New Technique
Measure Range	0-1000ppm	0-20,000ppm	0-100ppm
Crude Oil	Works well with crude	Works well with crude	Works well with crude
Light Oil	Works well but not in the low range	Problematic at low concentration	Works well with light oil
Oil Droplet Size Fluctuation	Oil droplet size does NOT affect measurement	Oil droplet size will affect fluorescence and in turn measurement	Oil droplet size will affect fluorescence and in turn measurement
Effect of Solids	Can differentiate and measure solids size. High concentrations can be problematic	Generally has no effect on fluorescence/measurement	Some impact – unique optical configuration required
Effect of Gas	Problematic, can be counted as oil droplets	Gas does not fluoresce	Minimal impact
Effect of chemicals	Problematic, can be counted as oil droplets	Some chemicals can fluoresce and be measured as oil	Some impact
Pressure fluctuation	Generally has no affect on measurement	Generally has no affect on measurement	Little or no impact
Fouling	Although slightly more robust than other techniques, cleaning is critical to operation	Cleaning is critical to operation	Cleaning is critical to operation

Technology Gap

Low range - Light oil

There is a technology gap that is not currently being addressed. This involves low range measurement of light oils that contain minimal aromatics:

Specification

0-100ppm

Accuracy 2-5% of range

Light oils – No aromatic content

Must have long term/low maintenance capability

Applications

- **Condensate Measurement**

On-line discharge measurement for condensate fields or LNG fields has been a problematic measurement for fluorescent analysers.

- **Leak Detection**

Leak detection can cause problems as the possibility that the leaks may be from non-fluorescent HC's.

- **Drilling Applications**

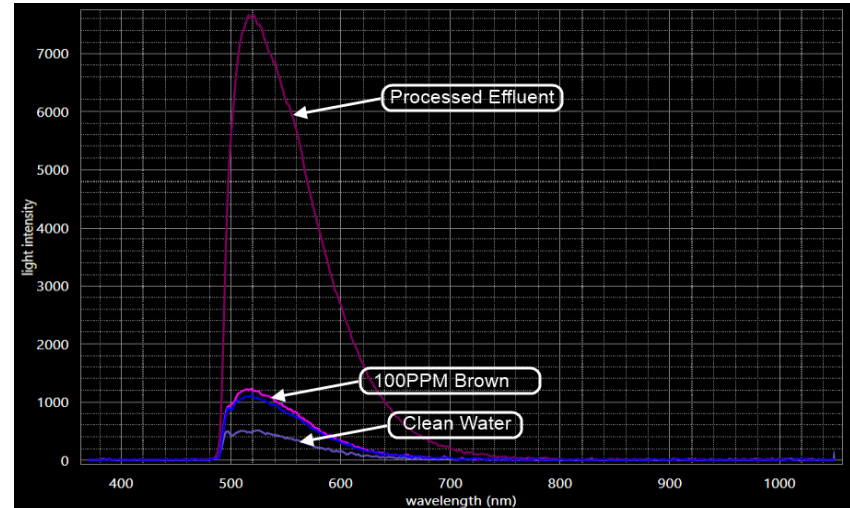
Base oil measurement is important for discharge purposes, but there can be a lot of interference from other sources affecting the accuracy.

Measurement of Lighter Oils

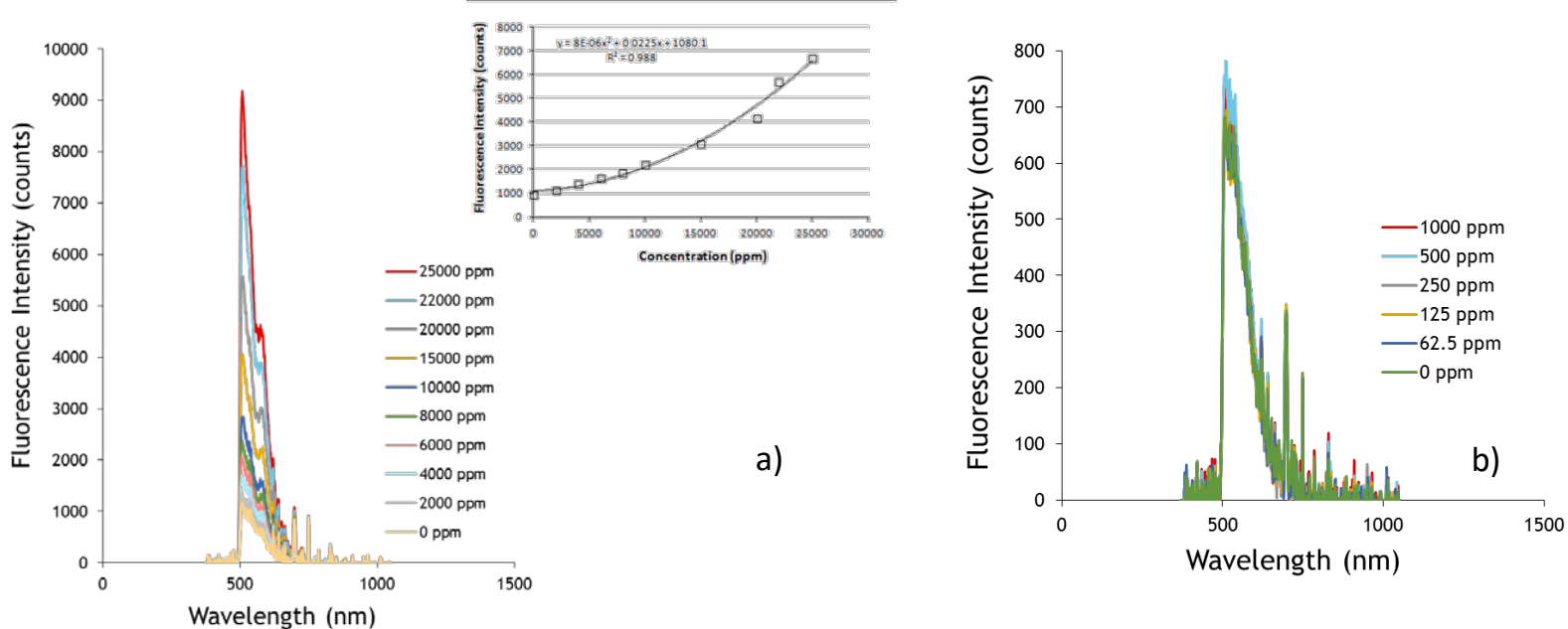
- Lighter oils, condensate, base oil, Mineral oil and diesel, contain a higher fraction of short linear alkane, which is **non-fluorescent**.
- Lighter oils contain a much lower percentage of cyclic aromatic hydrocarbons, responsible for the fluorescence.
- Measurement of such oils in water using fluorescence, when other substances may affect readings yields unacceptable results,



Translucent Condensate
(low aromatic content)



UV/Vis Fluorescence Measurement Studies



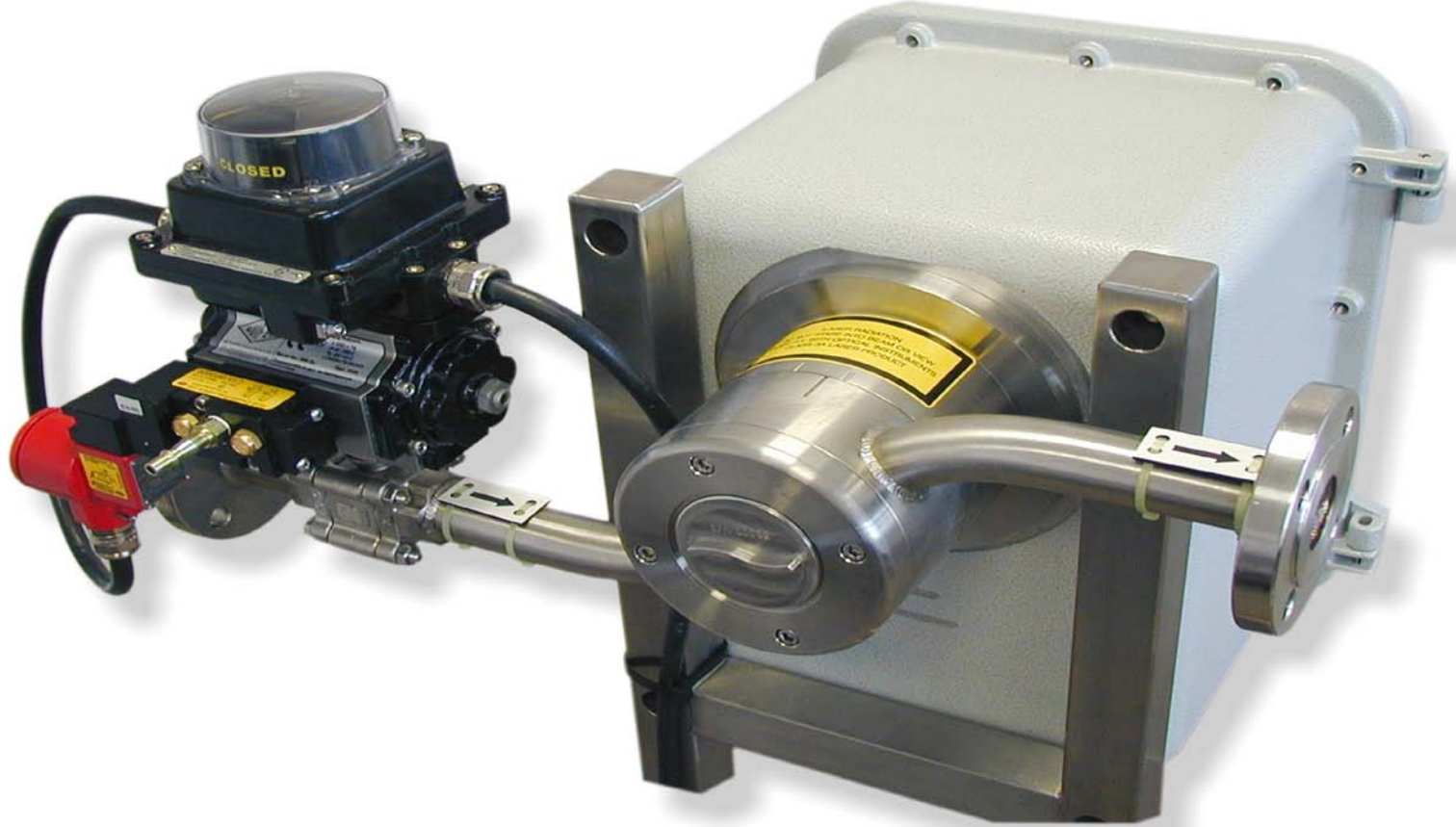
Fluorescence spectra of condensate in water for a range from 0 – 25,000 ppm (a) and 0 – 1000 ppm (b)

No Observable fluorescence signal for concentrations in the range from 0 – 1000 ppm

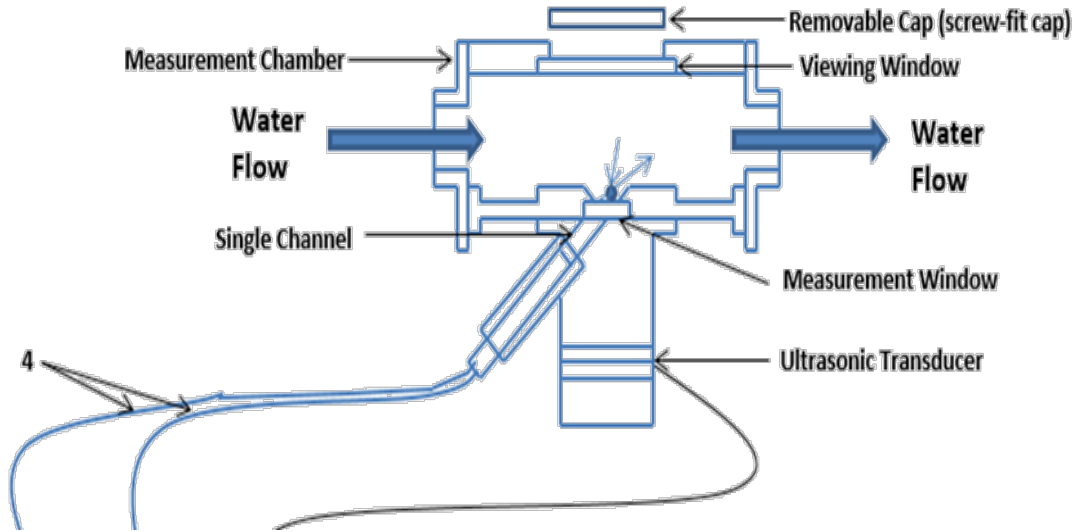
UV/Vis Fluorescence Measurement Studies

- Fluorescence analyzers are more suitable for oils with high aromatic content.
- There is a need for more flexible on-line OiW monitors for direct and instantaneous detection of lighter oils in water.
- An important contribution of this work is the identification of a **new optical arrangement for the detection of lower concentrations of lighter oils**, which uses a **solvent free extraction method** for sampling.

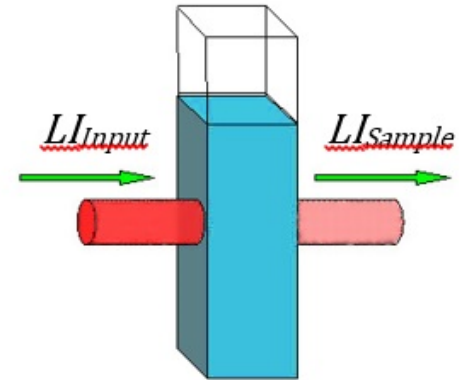
Absorbance Optical Set-up



Measurement Principle

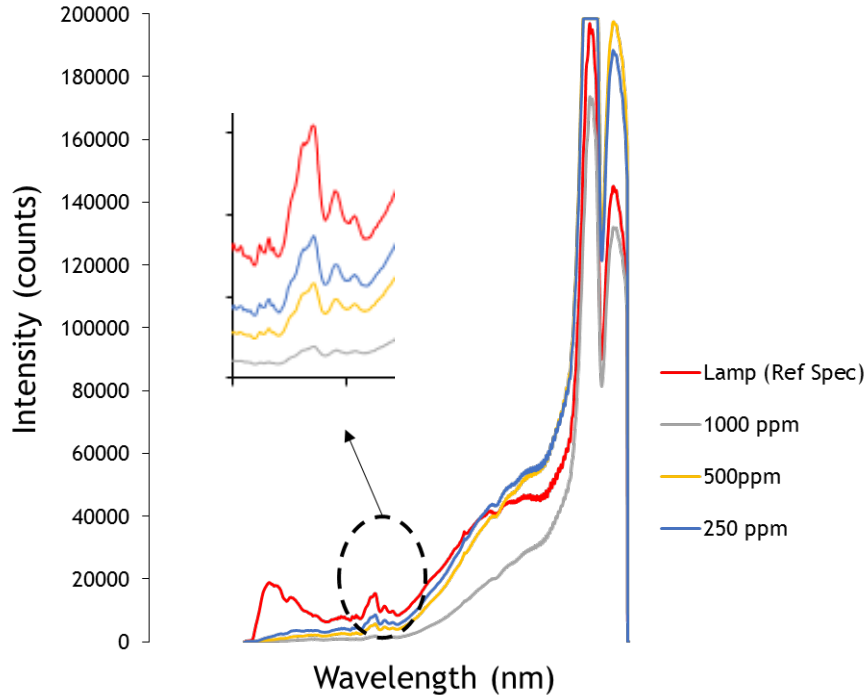


Sample Measurement



$$\text{Absorbance} = \text{Log}_{10}\left(\frac{LI_{Input}}{LI_{Sample}}\right)$$

Absorbance

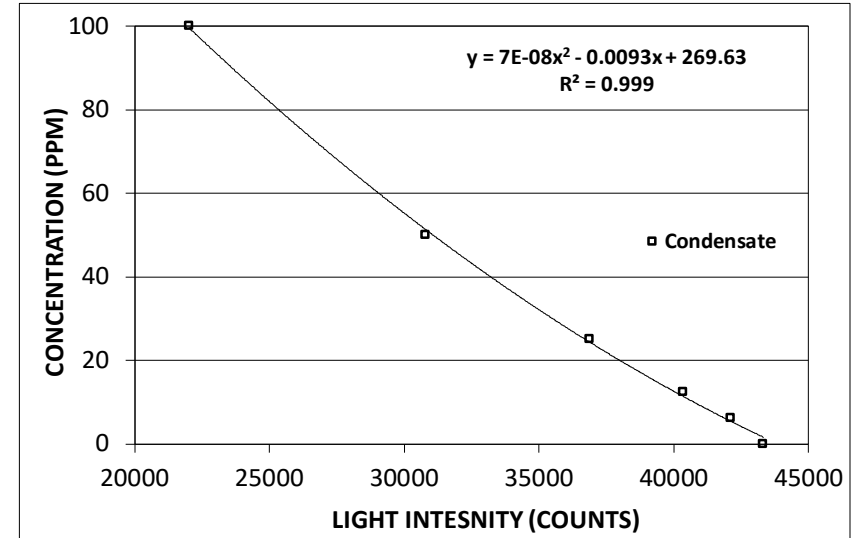
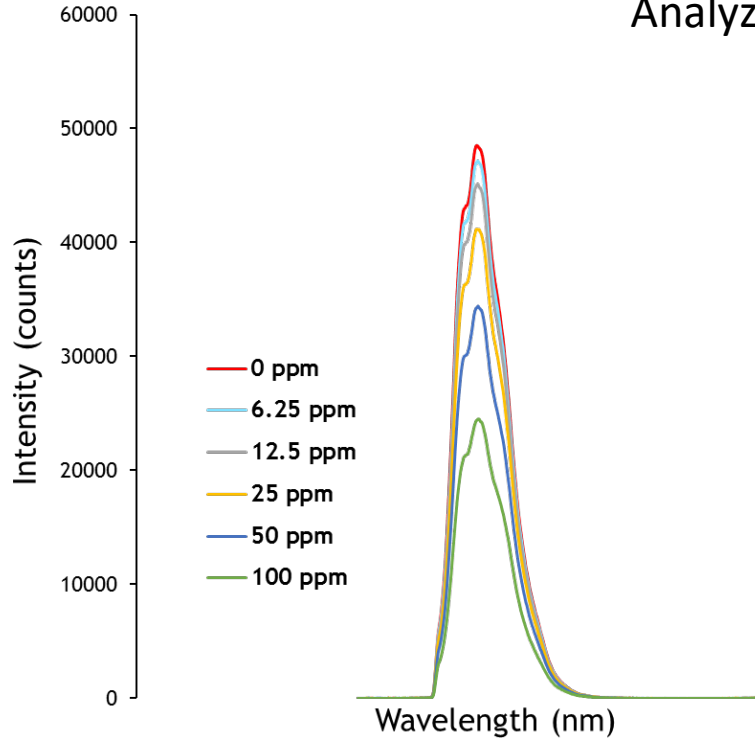


- Intense absorbance was observed in the UV and visible region of the spectrum
- A wavelength band was identified as a good candidate to search for light oils in water in the visible region

Absorbance spectra of condensate for different concentrations

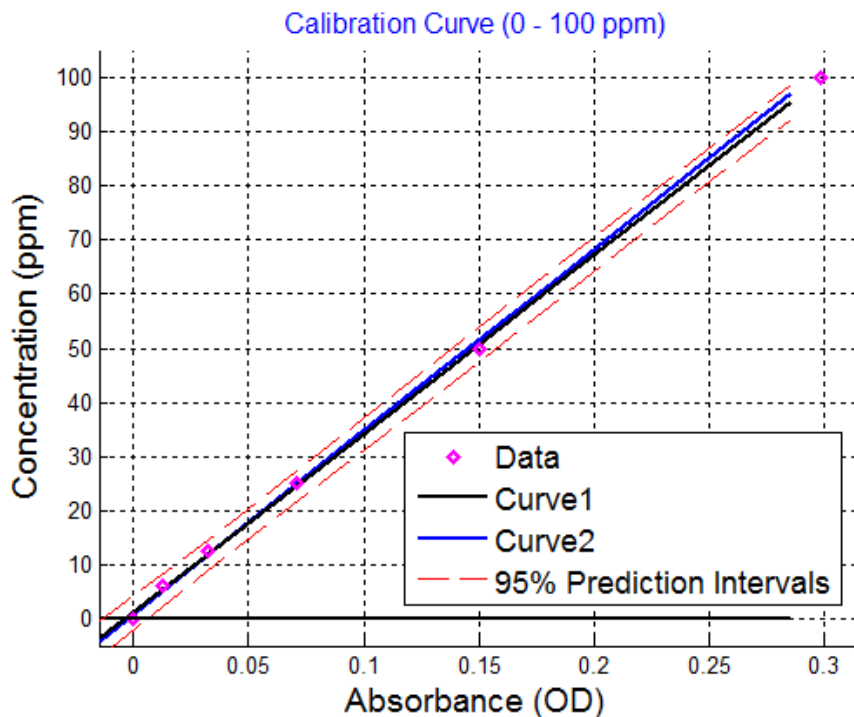
Vis Absorbance Measurement Studies

Analyzer Calibration 0-100 ppm



Spectral intensity of translucent condensate for a range from 0 – 100 ppm.
Tests carried out using Dutch North Sea Condensate

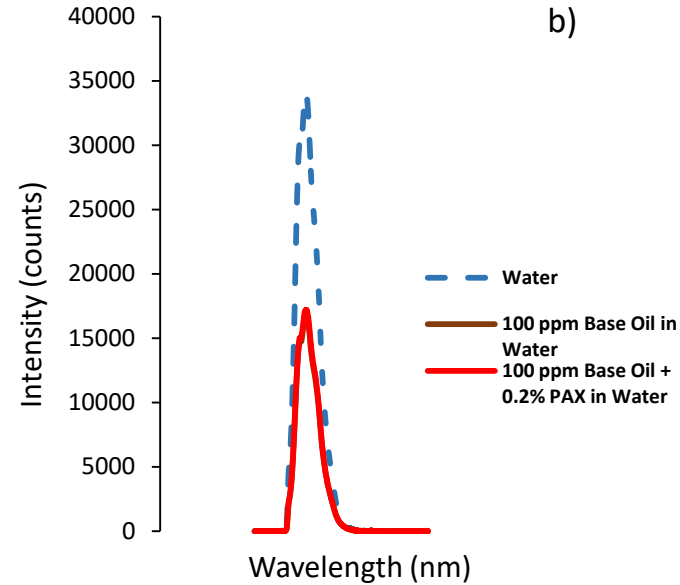
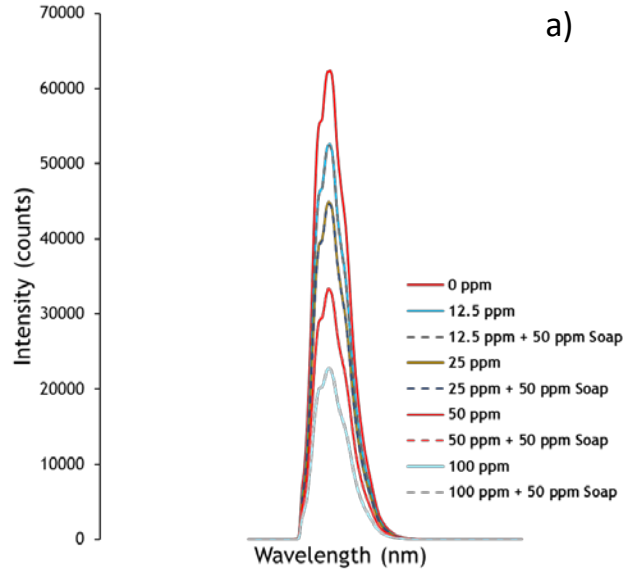
Vis Absorbance Measurement Studies



- Repeatability and accuracy are within $\pm 2\%$ of full scale range.

Uncertainty in this range is given at 95% confidence interval.

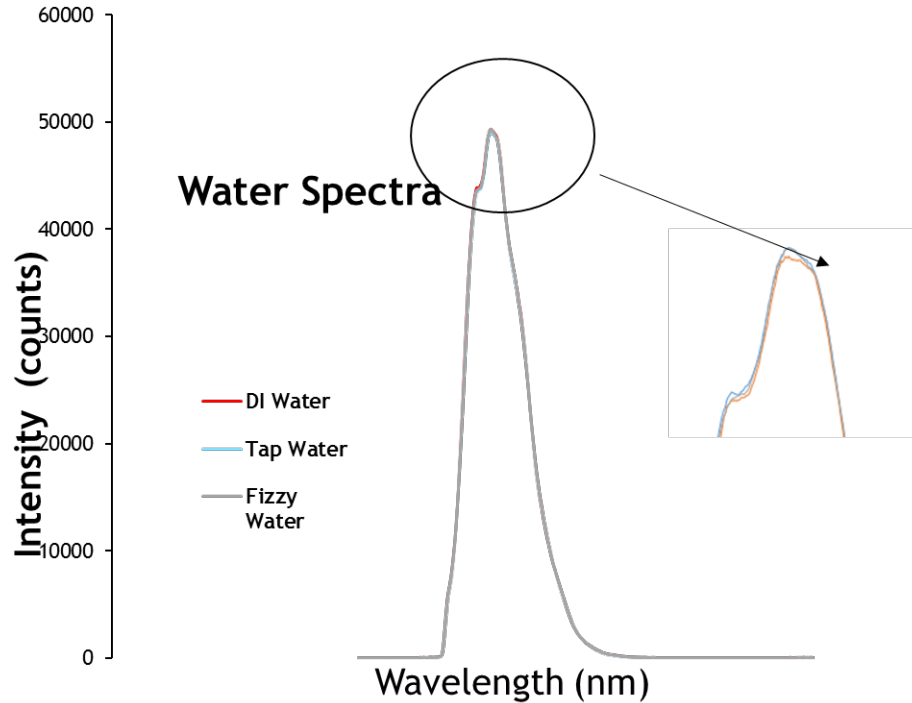
Effect of Contaminants



Spectral intensity of base oil for a range from 0 – 100 ppm in soap (50 ppm)-water solution (a) and 0.2% PAX –water solution (b)

Vis Absorbance Measurement Studies

Effect of Bubbles/Dissolved Gases



- No impact on the measurement accuracy due to the tiny bubbles of dissolved gases in the sample

Conclusions

- Packaged with Advanced Sensors existing patented Ultrasonic Automatic Cleaning, a new optical arrangement of the excitation source and the detector allows accurate, repeatable and reliable results.
- The optical arrangement incorporated in the Vis-Absorbance analyser (ASL EX2000) provides extended capabilities to measure low/non-fluorescent oils at lower ppm levels.
- Studies to date have been successfully conducted for non and low fluorescent oils in the concentration range from 0 – 100 ppm, with 95% repeatability and 2% accuracy. Studies continue to develop higher (>200ppm) and lower range (sub 1ppm) capability.
- Field validation sites identified
 - 2 - North Sea Locations
 - 1 - North America Location

Thank You

Any Questions?