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APPLICATION NOTE

TOTAL FERROUS MEASUREMENT

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Synopsis

The LaserNetFines® Q230 Particle Counter, Wear Classifier, and Ferrous Monitorincludes an innovative, patent pending magnetometer design to meet the need for abnormal wear measurement and trending by ferrous measurement. The dual magnetometer design provides both a total ferrous measurement (mg/ml) as well as a ferrous particle count and particle size distribution for Fe>25, 38, 50, and 100µ. This application note focuses solely on the total ferrous measurement capability of the Q230 as well as measurement accuracy and repeatability.

Introduction

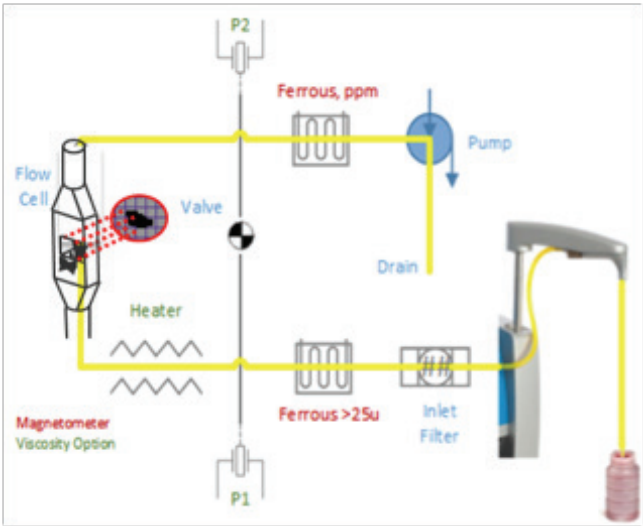
The measurement and trending of abnormal ferrous wear debris in machinery lubrication oils is arguably the most significant indicator of Machinery Health™ and a key predictor of catastrophic failure. Monitoring of abnormal ferrous content for industrial oil analysis is a well-established practice; common techniques include time resolved dielectric (5200 minilab) or magnetometer based designs such as the Kittiwake Analex PQ series and the Midas instrument. With some instruments there is no quantified result of ferrous content in ppm or mg/ml, instead, a dimensionless index called the "PQ" index is reported. The PQ instrument reports values on a scale from PQ=0 (no ferrous) up to a maximum value, typically PQ=750. A PQ reading < 25 is considered 'normal' wear.

The Spectro LaserNetFines Q230 Particle Counter, Wear Classifier, and Ferrous Monitor instrument includes an innovative, patent pending magnetometer design to meet the need for abnormal wear measurement and trending by ferrous measurement. The dual magnetometer design provides both a total ferrous measurement (mg/ml) as well as a ferrous particle count and particle size distribution for Fe>25, 38, 50, and 100µ.

This application note focuses solely on the total ferrous measurement capability of the Q230 and does not address the ferrous particle count and distribution or the wear classifier capability. However, it does address measurement accuracy and repeatability.

Spectro Ferrous Monitor

The Ferrous Monitor in the Q230 is a two-channel instrument that operates by sensing the change in inductance of a coil when a small amount of ferrous material is introduced into a sample cell inside the coil. There is one small coil that measures and sizes the individual particles, and a second larger coil that measures the total amount of magnetic material. Refer to the schematic for details.



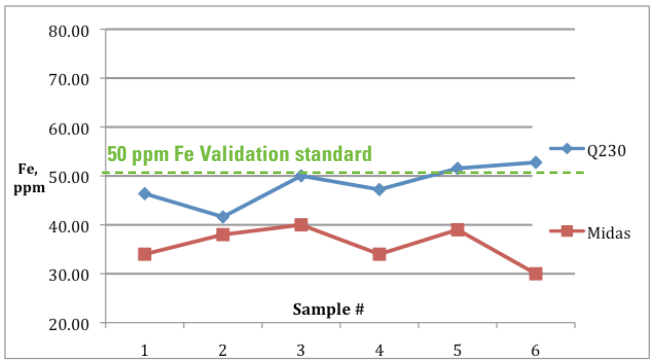
Experiment and Configuration

The performance of the Q230 Ferrous Monitor and a traditional magnetometer was evaluated against a gravimetric ferrous standard. The Spectro Scientific gravimetric ferrous validation standard, LNF-545, was used in a 50 ppm concentration. This standard is 76.2% ferrous in a 75 cSt matrix oil.

Six samples were drawn from the Fe validation standard and run on both the traditional magnetometer and the LNF Q230. The magnetometer was zeroed after each measurement by measuring a non ferrous sample prior to the next validation sample measurement. The LNF was operated normally, using Electron 22 to flush after each sample measurement.

Results and Discussion

The measured values for the six (6) samples along with the 50 ppm reference line are displayed in the following chart:



The measured values, accuracy and repeatability of the two instruments are summarized in the table.

	Q230	MIDAS
Sample 1	46.38	34
Sample 2	41.62	38
Sample 3	50.02	40
Sample 4	47.22	34
Sample 5	51.55	39
Sample 6	52.77	30
Std Dev	4.07	3.82
Avg	48.26	35.83
RSD%	**8.44**	**10.65**
Accuracy (average)	**3%**	**28%**

Conclusion

The ferrous measurement of the Q230 is more accurate and repeatable than the traditional magnetometer design tested and is well suited for abnormal wear measurement and trending for machine condition monitoring. Consider the following statistical results:

- The Ferrous Monitor in the Q230 demonstrated an accuracy of ± 3% compared to the ferrous validation standard. The traditional magnetometer demonstrated ±28% accuracy.
- The Q230 repeatability as given by the RSD % (Relative Standard Deviation) is 21% better (lower) than the traditional magnetometer design tested.

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