COMPARING ON-LINE SENSORS: APPLICATION AND CRITICAL REVIEW OF THE ISO STANDARD 15839

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ABSTRACT

Continuously measuring water quality sensors are increasingly used in rivers, lakes and urban water systems. A key question is the selection of the right sensor for a specific application. A recently adopted ISO standard is providing a concise test protocol for on-line sensors. In this work six different nitrate sensors were tested and a critical review of the standard should answer the question whether this new standard is providing the required information to the end-user.

KEYWORDS
On-line sensors, ISO15839, sensor selection, accuracy

INTRODUCTION

On-line sensors are getting increasing attention (Figure 1) and can now be seen as state-of-the-art. They are used for monitoring and control allowing deeper insights in the variations of the water quality, to follow process dynamics and help to optimize the efficiency of our water systems. Whereas the accuracy of lab measurements is normally well-defined, the quality of the on-line measurements is mostly unknown. To overcome this problem, the International Organization for Standardization (ISO) has published a sensor test protocol (ISO15839, 2003) to characterise on-line sensors. This contribution will provide a critical review of the protocol and discuss its meaningfulness.

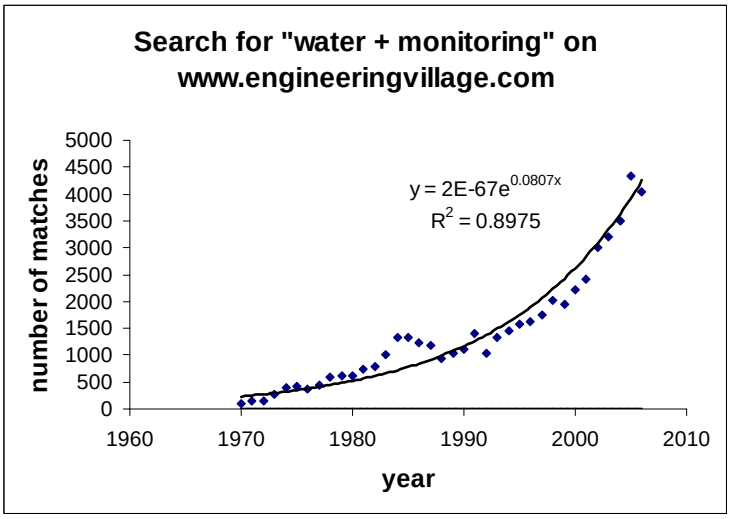

Figure 1: Increasing interest in water monitoring

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First results (Figures 2 and 3) show that the protocol provides basic information of a sensor under standard conditions but for field application the results are time and location specific, thus difficult to compare.

A critical point is the weighting of the protocol's calculated key numbers (Table 1). Some help should be provided to the end-user to define the important criteria for the sensor selection process. Other discussion points are the visualization of the results and the detection of time-dependent inaccuracies like drift effects.

The approach followed by the ISO 15839 is mainly looking at sensor accuracy from a sensor manufacturer perspective. An end-user will therefore not get all his questions answered. The ISO standard is compared with other available test protocols.

Table 1: Key numbers according to ISO 15839

	units	Sensor A Meas. Range 0-15 mg/l	Sensor B Meas. Range 0-20 mg/l	Sensor C (8mm) Meas. Range 0-10 mg/l	Sensor C (2mm) Meas. Range 0-50 mg/l	Sensor D Meas. Range 0-50 mg/l	Sensor E Meas. range 0-100 mg/l
coefficient of variation	%	6.6543	2.9478	3.4619	4.0508	1.8592	1.9538
limit of detection	mg NO_3-N/L	0.1250	0.0455	0.0351	0.0245	0.0155	0.0923
limit of quantification	mg NO_3-N/L	0.4167	0.1517	0.1169	0.0816	0.0516	0.3077
repeatability at 20 %	mg NO_3-N/L	0.0232	0.0232	0.0089	0.0450	0.0516	0.0516
repeatability at 80 %	mg NO_3-N/L	0.1959	0.0273	0.0494	0.0799	0.3082	0.0408
lowest detectable change at 20 %	mg NO_3-N/L	0.0695	0.0695	0.0268	0.1351	0.1549	0.1549
lowest detectable change at 80 %	mg NO_3-N/L	0.5878	0.0820	0.1482	0.2396	0.9247	0.1225
bias at 20 %	mg NO_3-N/L	0.7217	-0.0983	0.0200	0.3633	0.3333	0.4267
bias at 80 %	mg NO_3-N/L	0.0650	2.0567	0.3000	4.8617	4.6500	5.1767
short term drift	%/day	0.0248	-0.0171	0.0371	0.1103	0.2114	-0.1943
Day-to-day repeatability at 35 %	mg NO_3-N/L	0.5270	0.0407	0.0052	0.1036	0.3327	0.4502
Day-to-day repeatability at 65 %	mg NO_3-N/L	0.0886	0.1202	0.0475	0.1993	0.5282	0.8124

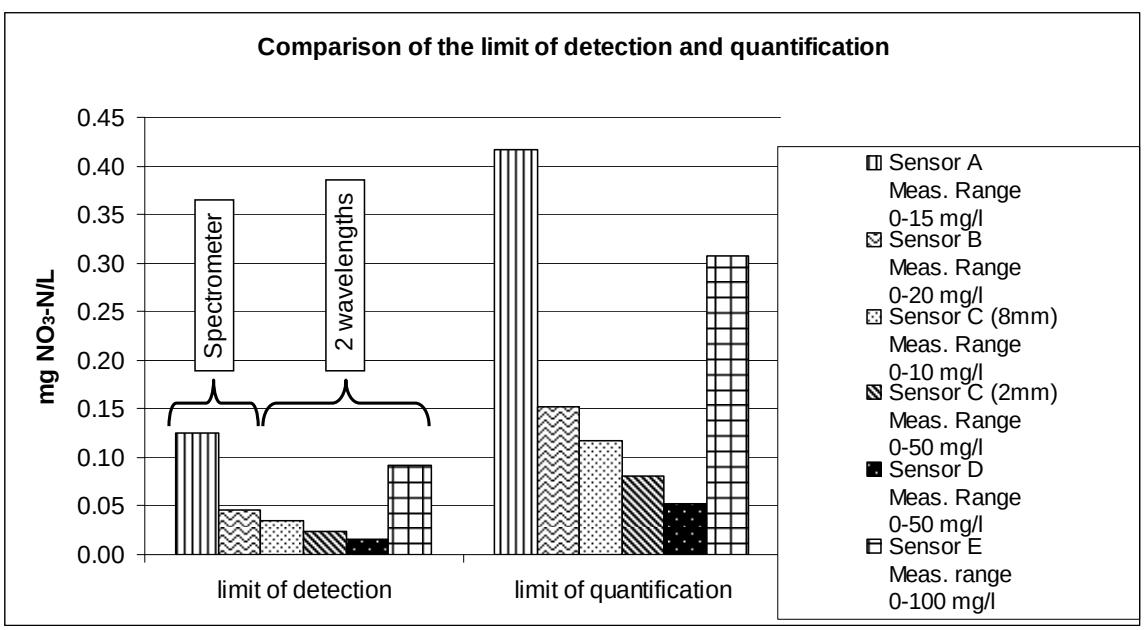

Figure 2: Comparison of "Limit of detection" and "Limit of quantification" for 6 nitrate sensors

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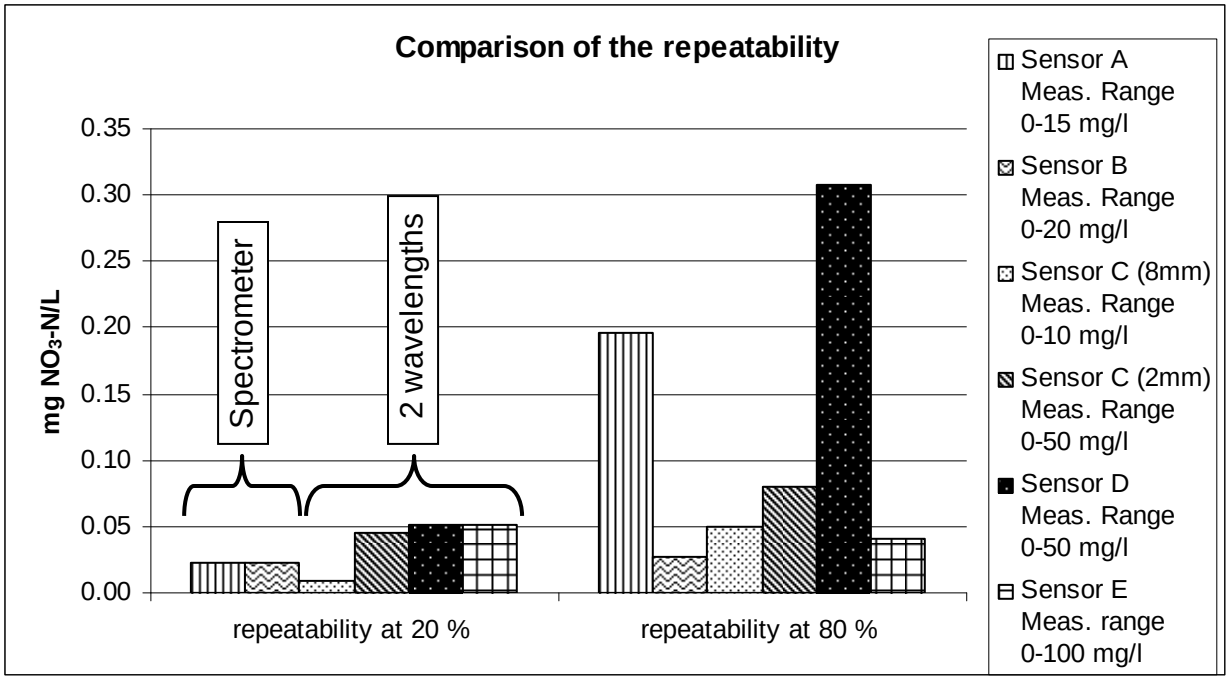

Figure 3: Comparison of "Repeatability" at 20% and 80% of the measuring range

Literature

ISO 15839, 2003. Water quality — on-line sensors/analysing equipment for water — specifications and performance tests. Geneva, Switzerland.

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